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Student perceptions about learning anatomy

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STUDENT PERCEPTIONS ABOUT LEARNING ANATOMY

by

Andrew John Notebaert

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Science Education
in the Graduate College of
The University of Iowa

July 2009

Thesis Supervisor: Professor Brian Hand

ABSTRACT

This research study was conducted to examine student perceptions about learning anatomy and to explore how these perceptions shape the learning experience. This study utilized a mixed-methods design in order to better understand how students approach learning anatomy. Two sets of data were collected at two time periods; one at the beginning and one at the end of the academic semester. Data consisted of results from a survey instrument that contained open-ended questions and a questionnaire and individual student interviews. The questionnaire scored students on a surface approach to learning (relying on rote memorization and knowing factual information) scale and a deep approach to learning (understanding concepts and deeper meaning behind the material) scale. Students were asked to volunteer from four different anatomy classes; two entry-level undergraduate courses from two different departments, an upper-level undergraduate course, and a graduate level course. Results indicate that students perceive that they will learn anatomy through memorization regardless of the level of class being taken. This is generally supported by the learning environment and thus students leave the classroom believing that anatomy is about memorizing structures and remembering anatomical terminology. When comparing this class experience to other academic classes, many students believed that anatomy was more reliant on memorization techniques for learning although many indicated that memorization is their primary learning method for most courses. Results from the questionnaire indicate that most students had decreases in both their deep approach and surface approach scores with the exception of students that had no previous anatomy experience. These students had an average increase in surface approach and so relied more on memorization and repetition for learning. The implication of these results is that the learning environment may actually amplify students' perceptions of the anatomy course at all levels and experiences of enrolled students. Instructors wanting to foster deeper approaches to learning may

need to apply instructional techniques that both support deeper approaches to learning and strive to change students' perceptions away from believing that anatomy is strictly memorization and thus utilizing surface approaches to learning.

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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the Ph.D. thesis of

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ABSTRACT

This research study was conducted to examine student perceptions about learning anatomy and to explore how these perceptions shape the learning experience. This study utilized a mixed-methods design in order to better understand how students approach learning anatomy. Two sets of data were collected at two time periods; one at the beginning and one at the end of the academic semester. Data consisted of results from a survey instrument that contained open-ended questions and a questionnaire and individual student interviews. The questionnaire scored students on a surface approach to learning (relying on rote memorization and knowing factual information) scale and a deep approach to learning (understanding concepts and deeper meaning behind the material) scale. Students were asked to volunteer from four different anatomy classes; two entry-level undergraduate courses from two different departments, an upper-level undergraduate course, and a graduate level course. Results indicate that students perceive that they will learn anatomy through memorization regardless of the level of class being taken. This is generally supported by the learning environment and thus students leave the classroom believing that anatomy is about memorizing structures and remembering anatomical terminology. When comparing this class experience to other academic classes, many students believed that anatomy was more reliant on memorization techniques for learning although many indicated that memorization is their primary learning method for most courses. Results from the questionnaire indicate that most students had decreases in both their deep approach and surface approach scores with the exception of students that had no previous anatomy experience. These students had an average increase in surface approach and so relied more on memorization and repetition for learning. The implication of these results is that the learning environment may actually amplify students' perceptions of the anatomy course at all levels and experiences of enrolled students. Instructors wanting to foster deeper approaches to learning may

need to apply instructional techniques that both support deeper approaches to learning and strive to change students' perceptions away from believing that anatomy is strictly memorization and thus utilizing surface approaches to learning.

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CHAPTER 1: GENERAL OVERVIEW

This chapter serves as an overview of the research study that was conducted. It starts by identifying the problem of interest and describing the purpose of this study. This is followed by a brief literature review followed by the proposed research questions. Finally, an outline of the proceeding chapters is presented.

Statement of the Problem

In many educational areas, a debate continues about the best way to instruct students in order to maximize learning. Anatomy classes face a unique challenge in that they are seen as a foundational course for careers in almost all health science fields. Anatomy classes are often perceived as being filled with endless amounts of terminology and identification, and the conventional mode of instruction has relied on students learning through memorization. With changes in learning theories, some have looked towards modern student-centered methods of instruction that are grounded in modern learning theories such as constructivism in an attempt to go beyond memorization. Many studies on anatomy education that have looked at different types of instruction and student performance have yielded mixed results. No consensus has been reached regarding teaching methods, but there is a silent agreement on the need for students to be able to learn anatomy beyond just accumulating facts.

In order to move anatomy education beyond the goal of only acquiring factual information, instructional changes should be considered that move toward student-centered instructional environments. The purpose of this is to ensure that the learning environment is more conducive to going beyond the simple facts that may be studied in textbooks and entering a situation where learners focus on understanding and uncovering the reasoning behind the factual information that is normally presented. This may require the instructors of anatomy to be aware of the ideas that students have regarding learning anatomy prior to beginning instruction. Only a few studies have attempted to describe

these ideas, and often student ideas are collected and described after the course has finished.

This study will address the need for describing the ideas that students have about learning anatomy prior to the beginning of instruction. The purpose of this study is to examine the different ideas that students have regarding learning anatomy and describe how these ideas change throughout the course of a semester. The study will also examine the students' perceptions about the anatomy class and compare how their ideas regarding learning in anatomy relate to their perceptions. This study will look at different types of anatomy courses that contain students enrolled in the course for a variety of reasons.

Overview of Literature

Anatomy education is often seen as a basic knowledge course that all in the health field are required to take and thus it is at the center of the curricular debate in medical education (Drake, 1998; Elizondo-Omana, Guzman-Lopez, & Garcia-Rodriguez Mde, 2005; McKeown et al., 2003; Monkhouse & Farrell, 1999; Older, 2004). The debate goes on between educators who want it to remain a traditionally taught course and those who feel it should revolve around some of the more recent learning theories. Traditionalists fear that student-centered curricula will shrink the importance and time spent on anatomical education (Elizondo-Omana et al., 2005; Monkhouse & Farrell, 1999; Older, 2004). Opposing this view are those who think that student-centered approaches must be adopted and that these student-centered approaches must play an integral part in anatomy education as it helps set the foundation for the rest of a student's medical education (Drake, 1998; Miller, Perrotti, Silverthorn, Dalley, & Rarey, 2002; Morrone & Tarr, 2005; Percac & Armstrong, 1998; Terrell, 2006).

While there is much literature in medical education examining new teaching reforms in anatomy, only a few even mention student-centered learning (Morrone & Tarr, 2005; Terrell, 2006). Research involving student-centered teaching approaches has

shown some benefits to student learning (Bavis, Seveyka, & Shigeoka, 2000; Brock, 2000; Marx, Honeycutt, Clayton, & Moreno, 2006) but few of these, if any, have developed any theoretically sound reasoning behind these successes. This leaves instructors who seek change to attempt implementing these methods only because they worked for someone else without a real understanding of why they work or even if they worked only out of chance.

Student-centered instruction, grounded in modern learning theories such as constructivism, acknowledges that everyone brings some prior knowledge to a subject (Windschitl, 2002). Instructors need to understand and assess students' prior knowledge, especially the student's ideas about how to learn a particular subject. In mathematics instruction, Simon (1995) points out that a teacher's "knowledge of students' learning of particular content, as well as the teacher's conceptions of learning and teaching … contribute to the development of learning activities and a hypothetical learning process" (p. 138). In order to progress anatomy education beyond the focus on memorization, instructors should have a thorough knowledge of how the students view the learning of anatomy.

Student ideas about learning have been researched and classified by Saljo (1979) and later added to by Marton, Dall'Alba, and Beaty (1993). The authors identified six major conceptions that students have about learning. These levels were placed in hierarchical order from simple ideas focused on factual information to complex ideas focused on deeper understanding and include:

1. Increasing knowledge
2. Memorizing and reproducing
3. Applying
4. Understanding
5. Seeing something in a different way
6. Changing as a person

Entwistle (1997) also provides categories into which student ideas towards learning were grouped. Three categories emerged: a deep approach, a surface approach, and a strategic approach. The deep approach was geared toward understanding, while the surface approach focused on coping with course requirements. The strategic approach, initially seen as being somewhere between the other approaches, was an approach used to receive high course grades.

Biggs, Kember, and Leung's (2001) also grouped students' ideas regarding approaches to learning into deep and surface approaches. Both approaches were the combination of two ideas, motives and strategies. Surface approaches were described as students attempting to put forth minimal effort and were driven by fear of failure. These students relied on rote memorization for learning. Deep approaches were geared toward engagement of the material through intrinsic interest and these students worked to maximize learning through the use of cognitive learning strategies.

Few authors in medical education have made attempts to describe the student learners in this academic setting with the exception of one particularly notable qualitative study that used participant observation to study first year medical students and their ideas and perceptions of their medical training (Becker, Geer, & Hughes, 1977). Many of the other medical education reports focus on study habits and the competitiveness of students (Conrad, 1986; Dhalla et al., 2002; Moxham & Moxham, 2007). Additionally, studies on learning in anatomy are often conducted after the cessation of class meetings, in which students must retroactively describe their ideas of learning (McLean, 2001; Pandey & Zimitat, 2007). In contrast, one study has reported student ideas on learning and its influence on performance in medical school. McLean (2001) reported that students who performed higher had much deeper ideas about learning as described by Marton, Dall'Alba, and Beaty (1993). One could argue that these deeper ideas of learning, ones in which the learners believed that learning involved the changing of ideas and changing

as a person to get a different view of the world, are part of the foundations for learning theories focused on cognition.

Several anatomy education authors have stated the importance of going beyond a classroom where rote memorization is the primary method of learning (Drake, 1998; Miller et al., 2002). In order to move anatomy classrooms to a more student-centered environment, it may be beneficial to get students to utilize deeper approaches to learning while in the classroom. As it stands now, most students think that one "learns" anatomy through rote memorization and will thus utilize traditional means of memory and drill and practice in order to get a grasp of the material, regardless of how it is presented (Miller et al., 2002; Pandey & Zimitat, 2007).

In order to promote anatomy education and to have it progress as a field of study, educators must look at new ways to teach that go beyond rote memorization. But to do this, there must be a clear understanding of what it means for students to learn anatomy. This can be done by having the instructors reflect on this as well as the students. Together, students and instructors can move away from the shallowness of memorization and more towards a deeper understanding of anatomy.

Research Questions

In order for anatomy classes to move towards student-centered instructional approaches, teachers must have a good sense of student ideas about learning anatomy and how students perceive anatomy as an academic subject. Previous research has failed to adequately indicate what ideas the students have when entering an anatomy course, both about the course itself and about how they are going to learn. The focus has almost exclusively been about ideas on learning after the course has been completed, with little regard to how these ideas and perceptions change as a result of taking the anatomy course. In order to help educators make informed decisions regarding the teaching of anatomy, the following research questions are proposed:

1. What are the different types of ideas that students have about learning anatomy and how do these compare to their ideas about learning in general?
    a. How do these ideas about learning anatomy change from the beginning to the end of an anatomy course?
2. How does the student's perception of the anatomy class relate to his or her ideas about learning anatomy?

Dissertation Overview

Chapter two begins to establish the framework for this research study by outlining previous research from several key areas. The first area covered is educational research studies focused on theories of learning, followed by studies of approaches to learning and perceptions of the learning environment. Finally, the chapter discusses the state of the anatomy education research with a focus on traditional and modern aspects of anatomy education.

Chapter three outlines the methods of this research study beginning with the rationale for using a mixed methods approach. The chapter sets the context of the study by describing the setting where this research was conducted and the participants that took part in this research. This section also describes the different anatomy classes that were asked to be a part of this study. Then this section will describe the data collection procedures, both qualitative and quantitative, and the instruments used. Finally, there is a discussion of the analyses, focusing on the different data collection methods and how these provide the basis for the discussion.

Chapter four presents the results of this study in several different components. The first component is comprised of the qualitative data coming from the surveys and interviews that were conducted. The second part outlines the quantitative data which includes various demographics and the results from the Study Process Questionnaire. The

final part of the results outlines three particular case studies in an effort to illustrate some of the general differences seen among the students who participated in this study.

Chapter five serves as the final chapter and contains several sections. The first is the discussion section which outlines some answers to the proposed research questions and then identifies and discusses the themes that were apparent in the data. Following that, the chapter discusses the implications of the findings and identifies potential limitations to the results and discussion. This chapter concludes with some proposed future directions as well as a summary of the entire research study.

CHAPTER 2: LITERATURE REVIEW

The following section contains a review of the literature that is pertinent to this research study. The review begins with a general discussion about current learning theories. It continues by reviewing student approaches to learning and student perceptions of the learning environment. The review concludes with a discussion about the current state of anatomy education literature by focusing on the arguments between traditional anatomy education and modern methods for teaching anatomy.

Theories of Learning

While there are multiple theories about what it means to learn, the ensuing discussion will focus on how some of the major theories pertain to the role students take in learning, as the central focus of the dissertation is student ideas on learning.

Students as the Recipients of Knowledge

Many traditional theories of learning view students as the recipients of knowledge, such that learning can almost exclusively be described as the acquisition of knowledge. In these cases knowledge is related to something tangible in which one entity possesses knowledge and it is up to the other to acquire it through learning. While there are many variations on these theories, this discussion will center on two of the more seminal theories, behaviorism and information processing.

Behaviorism

Behaviorism involves the idea that organisms respond to stimuli and that learning is the shifting of responses to a more desired outcome in response to selected stimuli. Proponents of behaviorist theories often point to classic stimulus-response experiments conducted by psychologists such as Pavlov and Skinner. Pavlov was known for his ideas on "classical conditioning" in which a response could be learned through the use of conditioned stimuli (a stimulus used to create a desired response) (Pavlov & Anrep, 1927). Skinner's ideas revolved around "operant conditioning" or the use of both

positive and negative reinforcement in order to generate the appropriate responses (Skinner & Frederic, 1965).

In this view of learning, the students generally receive knowledge that is held by a more informed expert or instructor. The process of learning occurs through transmission of information from the instructor to the learner and responses are reinforced by positive feedback (such as praise from teacher or high grades) or negative feedback (such as negative criticism or failing grades). Students learn by relying on rote memorization and often spend large amounts of time in drill and practice activities. In this situation the goal of learning is to increase the production of correct responses and reduce or eliminate incorrect responses.

The main feature of this view of learning is that responses are an observable phenomenon. Both external events and internal events such as thinking and emotion are tied to physiological responses taking place within the organism. Here, mental activity is the internalization of stimuli and response, and language serves as an overt externalization of the internal responses. Outcomes of behaviors are directly observable and can be measured scientifically, as the mind is really constructed of a series of responses to various stimuli which all can be observed in some form (Skinner, 1945). In a sense, the brain serves as a processor (although behaviorism largely ignores the "processing"), the stimuli act as the input, and one's responses (e.g., answers on an exam) are the output.

Information Processing Theory

While behaviorism describes students as passive learners, information processing describes learning as a cognitive process in which students are active participants. A similarity exists in that students still receive knowledge from external sources. However with information processing theory, students actively process the information within memory through cognition, and learning takes place with changes to memory.

Information processing theory expresses learning as changes in memory. A person uses his or her senses to observe the world, and some of these senses are passed to working memory where information is processed through cognition or rehearsal. This information can either be converted to output or encoded to long term memory where it is stored and retrieved when needed. Long term memory storage is hierarchical and related information is stored together (Terrell, 2006). The major limitation to learning exists through limits on working memory which has finite capacity. The instructional implications of this limitation focus on cognitive load, or the demands that the learning task places on the working memory (Sweller, 1988). Because of cognitive load, only so much information can be recalled and manipulated at one time. This is the major reason for instructors basing teaching methods on information processing as they attempt to disseminate information in manageable chunks (Regehr & Norman, 1996).

Students as Knowledge Constructors

Constructivism has come to be a major theory of learning in modern education. Although not necessarily a new idea about learning, it has recently gained in popularity among educators, at least in one form or another (Phillips, 2006).

While there are multiple variations of constructivism, there are two main views of how learning takes place within constructivism while most definitions come somewhere between the extremes. While these two sides do have similarities in how they explain how someone comes to know something (learning), the mechanisms that are utilized are somewhat different. These two camps are usually centered around ideas from two philosophers. Cognitive constructivism, based on Jean Piaget's ideas of how learners adapt knowledge individually, and social constructivism, based on Lev Vygotsky's ideas that knowledge is a cultural product and is shaped by societal and cultural influences (Windschitl, 2002).

Cognitive constructivism stems from the idea that learners adapt knowledge based on their experiences. The idea is that learning takes place in order for a person to adapt to and explain his or her environment. The learner is presented with a problem that his or her knowledge structure cannot explain, and thus must either incorporate this by assimilating new ideas into the current knowledge structure or by accommodating and radically restructuring his or her current idea into a new knowledge structure (Posner, Strike, Hewson, & Gertzog, 1982). Von Glasersfeld (1989) acknowledges that while social interaction is important for providing the learner validation of what has been learned and thus adds a further level of security that the knowledge is viable, it is not essential for an individual to construct knowledge.

Social constructivism also describes how a learner adapts to and explains events happening in the environment. However, in social constructivism, social aspects are seen as a requirement for knowledge construction. Vygotsky (1978) introduced the "zone of proximal development" in which a learner is capable of reaching a learning goal that is close to his or her existing structure but only through the help of a more experienced guide or tutor. Social aspects are especially important since humans use language, a social construct, to portray ideas both to themselves and others (Wertsch, 1985; Wertsch & Tulviste, 1996). Additionally, an individual filters experiences, which in turn are influenced by tools created through culture (Duffy & Cunningham, 1996).

While there has been no clear consensus as to which side more appropriately explains how we come to *know*, several authors have tried to bridge the gap. Vrasidas (2000) states that, "Unless the socially constructed knowledge is being processed in the individual's mind and related to her experiences, it will not be meaningful." Cobb (1994) also explains that use of a particular definition is contextual, in that social constructivism determines the conditions for learning while cognitive constructivism defines the learning process. He also explains that the two theories are complementary and that there should not be a "forced choice" made by individuals.

Regardless of which side of the spectrum an individual is on, there is agreement among constructivists that learning is an active process and should involve authentic learning activities meaning an activity should mimic the real world as much as is appropriate. Constructivism goes against the standards of traditional behaviorist instruction in which students sit back and receive information from the instructor. The students are active in that they are responsible for forming questions, seeking answers, and testing their solutions (Bednar, Cunningham, Duffy, & Perry, 1992; Cobb, 1994; Dewey, 1916; Thayer-Bacon, 2000). Authors dealing with teaching methods often state that authentic situations and activities are important in that it involves the students in either real-life or as close to real-life situations as possible as this is necessary to relate the newly constructed knowledge to the real world or else the knowledge becomes useless (Grabinger, 1996; Herrington & Oliver, 2000; Honebein, Duffy, & Fishman, 1993; Palincsar & Brown, 1986).

Student Approaches to Learning in Higher Education

Educational research in higher education began studying student ideas regarding learning in the late 1970's. Several different research groups began using a variety of research methods to investigate the process of student learning.

Some researchers started using qualitative methods to try to understand how students view learning (Marton & Säljö, 1976; Säljö, 1979). Using a research method known as phenomenography, these researchers used in-depth interviews with students aimed at describing how a student viewed a particular phenomenon, in this case, learning in general (Marton, 1981; Marton & Säljö, 1976, 1997). These early research studies laid the groundwork for future endeavors that examined how students approached their studies and the relationships that these ideas had with different learning outcomes.

Five distinct conceptions of learning were originally proposed by Säljö (1979) based on interviews with individual students which discussed the students' understanding

of learning in an educational environment. These categories were developed to be used as descriptions of students' conceptions about learning and include the following categories:

1. Increase knowledge
2. Memorizing
3. Acquisition of facts which can be retained or utilized in practice
4. Abstraction of meaning
5. Interpretation aimed at the understanding of reality

The first three categories are quite similar in that learning is seen as a quantitative increase in personal knowledge and that knowledge is a given entity that is stored by the individual. The initial category refers only to the accumulation of knowledge, and not to an understanding of the use of knowledge. Memorizing goes just beyond the previous category and adds the application of returning what was memorized, but only by being returned in the same manner as it was originally presented. The third category, while still involving a quantitative increase in knowledge, adds in the application of the knowledge but not as an exact reproduction of what has been memorized. These initial categories, unlike the following, do little to introduce meaning into what is being learned (Marton et al., 1993; Säljö, 1979).

The remaining categories describe conceptions that are centered on deriving meaning from what is being learned. Differences in these categories are partly due to emphasis on the type of meaning that is being abstracted. In the fourth category, the meaning is being abstracted about a particular situation, while the fifth category is focused on how learning locates meaning of a particular conception in reality. This description also involves the changing of a particular view rather than the case of developing meaning about a particular area (Säljö, 1979). In a confirmatory study by Marton, Dall'Alba, and Beaty (1993), a sixth category, "Learning as changing as a person," was discovered and added to the original descriptive categories. This description, found to be rare among the students interviewed, builds upon the previous

categories but focuses more on the person changing as a result of learning. A change takes place in the learner where he or she recognizes that the individual is in control of what is happening rather than something happening to the learner.

Biggs (1979) and Entwistle and Ramsden (1982) both used quantitative means to describe student approaches to learning. Biggs, using an information processing framework, developed the Study Process Questionnaire (SPQ), a survey instrument that allowed teachers to evaluate student ideas about learning approaches in a variety of contexts (Biggs, 1987a, 1987b). Using factor analysis, Biggs identified three distinct approaches to learning. A surface approach, in which students are motivated by fear of failure, is when students approach a specific task wanting to expend as little effort as possible. They will often shrink their focus and rely on the use of rote memorization. A deep approach sees students trying to engage with the subject matter. They have an intrinsic motivation and attempt to maximize meaning and understanding in their studies. A third approach is known as achieving. Here, the students are attempting to maximize grades and are motivated by achievement, and they often employ study strategies that lead toward effective use of time and management of resources. A revision of the SPQ eliminated the achievement approach in order to simplify the survey instrument as the authors state that the two-factor form is the most relevant for instructors using the SPQ (Biggs et al., 2001). This revision would appear to be justified as a student utilizing an achieving approach is most likely to rely more on memorization than understanding in order to maximize performance evaluations.

Ramsden and Entwistle (Entwistle & Ramsden, 1982; Ramsden & Entwistle, 1981) developed the Approaches to Study Inventory (ASI). This survey inventory categorized students into three categories as well. The surface approach focuses on students memorizing the material. A deep approach is when a student attempts to understand the material and derive meaning from his or her studying. A third category called relating ideas was also described. This category indicates that students try to see

the connections between old and new knowledge and they attempt to find connections to real life. This category is often combined into the deep approach category, as they are both seen to measure a deep approach (Trigwell & Prosser, 1991b). This would appear to be prudent given the more recent push towards a focus on cognition in educational research.

Both of these methods and inventories which describe student approaches to learning have similarities. They all contain measures designed to describe a student's approach to learning as either surface or deep. In the surface approach, students focus on rote memorizing and recall without any focus of internalizing knowledge or deep understanding. Students utilizing deep approaches focus on understanding of the material and trying to bring out personal meaning. While some of the inventories support additional levels of distinction, such as the SPQ's achieving category and the ASI's relating category, they are often lumped together with similar categories. Researchers have commented that the surface and deep approaches appear to adequately describe how students approach learning for a given task and thus more researchers remove the extra category in order to simplify the instrument (Biggs et al., 2001; Trigwell & Prosser, 1991b).

However, within these varied measures there are some distinctions that should be made, particularly in terms of the level of analysis. For example, Marton and Säljö's (1976) method is most appropriate for evaluating approaches at the task level, since the approach used varies with relation to the task. Students will often choose different approaches for the variety of tasks and situations that they encounter in the learning environment. Biggs' approach is often described as appropriate for the course level (Trigwell & Prosser, 1991b), however this is criticized as possibly identifying a stable trait rather than one that varies with the task (Bowden & Marton, 1998). Biggs, Kember, and Leung (2001) counter this argument by stating that "SPQ responses are a function of both individual characteristics and the teaching context" (p.137). They continue by

offering three situations where using the SPQ would be appropriate. The preferred approach is to examine individual student differences in a given context. Other approaches would be to either examine individual patterns across different tasks or to examine a group's approach in a particular situation and use the results for comparison to other groups.

Student Perceptions of the Environment

A student's approach to learning varies from task to task, and much of that approach may be dictated by the learning environment. While the actual environment is important, the biggest influence on learning may be the student's perception of the learning environment (Trigwell & Prosser, 1991a). Students have perceptions of a variety of components of the learning environment including teacher effectiveness, workload, and assessments. In educational research, these are often discussed as perceptions that the student has prior to entering the learning environment (Biggs, 1989; Lizzio, Wilson, & Simons, 2002), and as such it may be best to assess these perceptions prior to the observed timeframe. However, many studies examine these perceptions on a retroactive basis meaning that student perceptions are assessed after a course or unit has been completed. Researchers will often use either the institution's standard course assessment questionnaire or a general evaluation instrument such as a version of the Course Experience Questionnaire (CEQ) developed by Ramsden (1991). This questionnaire is based on the idea that students are in the best position to comment on the effectiveness of the learning environment. While these perceptions inform the instructor about the students' thoughts at the end of the course, it does little to inform him or her about the students' mindset at the beginning of the course or how their thoughts have changed throughout the course.

Positive experiences in a given course are attributable to many different factors. Most notable is the student's perception of the quality of instruction (Jackling, 2005;

Lizzio et al., 2002; Ramsden, 1991; Trigwell & Prosser, 1991a). A perception of high quality teaching can be affected by other perceptions such as appropriate workload (Kember & Leung, 1998), styles of assessment (Crawford, Gordon, Nicholas, & Prosser, 1998; Lizzio et al., 2002), and a perception of independence (Richardson, 1994a; Wilson, Lizzio, & Ramsden, 1997). A notable part of many of these studies is the use of survey instruments to describe student perceptions of the learning environment. While these are quick methods to gather data from multiple subjects, they do not get yield as deep an understanding of the student perceptions as some qualitative methods may uncover, and some research indicates quantitative course evaluations are prone to measurement error (Feeley, 2002). Observation and interviews are powerful tools that help discover the reasoning behind student perceptions of the learning environment and have been utilized by some researchers (Jackling, 2005; Tomanek & Montplaisir, 2004).

Learning Outcomes

Educational researchers are often interested in exploring factors that serve to increase student learning as measured by a variety of learning outcomes. These may be organized by different forms of measurement -- quantitative measures such as course or assignment grades or qualitative assessments that involve student verbal explanations or writings.

Quality learning outcomes are sometimes described as the goal of higher education (Trigwell & Prosser, 1991a, 1991b), where such outcomes go beyond simple course objectives and a fact-based orientation to learning. These learning outcomes attempt to describe the course in terms of relationships and abstractions of meaning (Biggs & Collis, 1982). These outcomes are often indicated as being a better measure of student learning than *quantitative measures* (Ramsden, 1992; Trigwell & Prosser, 1991a).

It is worth noting that quality learning outcomes have been examined by researchers using both qualitative and quantitative means. Researchers such as Marton

and Säljö (1976) and Prosser and Millar (1989) have examined these outcomes using a phenomenographic approach, utilizing content-based descriptions at either the task or course level. These two groups of researchers focused on student descriptions of what they learned, reporting both how the student structures his or her thinking about what was learned and what the student refers to in his or her descriptions. Others have used a quantitative construct to measure quality learning outcomes. One such tool was developed by Biggs and Collis (1982) and is called the Structure of the Observed Learning Outcome (SOLO) taxonomy. The SOLO taxonomy method involves categorizing student responses to questions into five hierarchical categories of quality learning outcomes that range from simple to complex ideas about the intended concept (Biggs & Collis, 1982; Van Rossum & Schenk, 1984). This taxonomy is comprised of five categories although some researchers have found that two categories are more commonly found in interview responses and adequately divide student ideas into simple and complex categories (Trigwell & Prosser, 1991a). The multi-structural category is a simple description of learning outcomes that refers to the student being able to list or describe the individual parts of the concept but is not able to describe any relationship among the ideas. A more complex outcome occurs when a student gives a response that falls within the relational category, which is when the student is able to list the individual parts and link them together in meaningful ways.

Relationships among Learning Approach, Perceptions of Environment, and Outcomes

There are numerous studies that have looked at many of the relationships found among these areas. Each of these studies attempts to add a piece to the puzzle with the ultimate goal of understanding how the learning approach was adopted and how the environment interacts with the student. Here the ultimate goal is an attempt to maximize student performance outcomes.

Learning Approach and Perception of Learning Environment

There are several relationships between student approaches to learning and different perceptions of the learning environment. One of the more studied aspects is the notion of appropriate workload and approach to learning. Often, students who perceive a high workload will adopt surface approaches such as rote memorization (Dahlgren, 1984; Diseth, Pallesen, Hovland, & Larsen, 2006; Eley, 1992; Entwistle & Ramsden, 1982; Jackling, 2005; Kember & Leung, 1998; Kreber, 2003; Ramsden & Entwistle, 1981; Trigwell & Prosser, 1991a). However, few studies have shown a correlation between decreased workload and the adoption of deeper learning approaches (Diseth et al., 2006). This may indicate that the surface approach is more susceptible to perceptions of workloads (Trigwell & Prosser, 1991a) or that there is a lack of attention paid to deep approaches and appropriate workloads.

Learning approaches are often linked with the students' perceptions of the quality of instruction. While a perception of non-effective teaching may influence surface motives for learning (Jackling, 2005), good teaching, including providing clear objectives and allowing student independence, are often found to promote deeper approaches to learning (Jackling, 2005; Lizzio et al., 2002; Richardson, Dawson, Sadlo, Jenkins, & McInnes, 2007; Trigwell & Prosser, 1991a). It is interesting to note that researchers have found that students respond favorably to clear objectives. Often, objectives provided in class and in syllabi are behaviorist in nature and direct students toward memorizing or achieving strategies. A thorough analysis of the objectives given to students and how particular types of objectives influence approaches to learning may be warranted before recommendations for practice could be made.

When making recommendations for moving student approaches towards a deeper level, researchers point to increasing teacher effectiveness through multiple means. This includes explicitly promoting deeper approaches to learning (Trigwell & Prosser, 1991a),

providing motivation through instruction and appropriate feedback (Diseth et al., 2006), and providing more in-class activities that are relevant both to the student and to the course itself (Tomanek & Montplaisir, 2004). Focusing efforts on teaching improvement must incorporate multiple aspects in order to have positive effects as student approaches to learning are influenced by multiple sources (Kember, 1997; Tomanek & Montplaisir, 2004; Trigwell & Prosser, 1991a).

Finally, an aspect that has received less attention is the students' perception of being able to transfer knowledge to a generic area. Transfer of knowledge is often indicated by the students demonstrating an increase in problem solving ability and analytic skills that can be used outside of the given instructional area. Kreber (2003) utilized factor analysis of a version of the CEQ and found that student confidence in problem solving and increases in organizational skills and written communication were indicative of a generic skills development. This study also found that students not receiving encouragement to develop these generic skills may be more likely to adopt surface approaches. Conversely, students using deep approaches to learning reported having an increase in generic skill enhancement (Richardson et al., 2007), even across different academic environments such as the humanities and sciences (Lizzio et al., 2002).

While there are some clear relationships between approaches to learning and perception of the learning environment, inherent characteristics of the student may play an important part in determining learning approach. A strong predictor of deep approaches to learning is increased age or educational experience (Brundage & MacKeracher, 1980; Kreber, 2003; Merriam & Caffarella, 1999; Richardson et al., 2007). This seems plausible, as increases in age would lead to more exposure to different learning environments. Additionally, advanced educational experiences such as adult learning or post-undergraduate work usually favor those who are studying for a particular

career as they may be more motivated by learning and gaining experience for their career than achieving high grades (Ehrman & Oxford, 1988; Merriam & Caffarella, 1999).

Gender as a predictor of learning approaches has been researched with mixed results. Some studies find that females are more apt to utilize surface approaches (Byrne, Flood, & Willis, 2002; Hassell & Joyce, 1997), while others find no evidence for gender differences (Booth, Luckett, & Mladenovic, 1999; Kreber, 2003). Differences or lack thereof, due to gender may also be an effect of the academic field being studied (Ehrman & Oxford, 1988; Polachek, 1978).

Finally, the academic field of study may have some influence. For example, accounting students have a propensity to adopt surface approaches (Beattie, Collins, & Mcinnes, 1997), as are students of medicine (Newble & Entwistle, 1986; Newble, Entwistle, Hejka, Jolly, & Whelan, 1988; Newble & Gordon, 1985) although this approach is discouraged in medical education (General Medical Council, 1993). These fields may be prone to adoption of surface approaches, as they are often regarded as being heavily fact based. Although adoption of student-centered methods of teaching in medical education, such as problem-based learning, have been shown to promote deeper approaches (Brockbank & McGill, 1998; Newble & Clarke, 1986), there is still some argument as to the legitimacy of these approaches and their appropriateness for future medical clinicians. However, a recent study reported that 1st and 2nd year students at a medical school designed to promote deep approaches with problem-based learning had already entered medical school with a predominantly deep approach to learning (Reid, Duvall, & Evans, 2005). This may be an interesting aspect of post-undergraduate education as students entering professional schools are often thought of as having high academic ability as selection criteria is often stringent.

Learning Approach and Learning Outcomes

Relationships among approaches to learning and learning outcomes have also been studied with mixed results. One of the major issues is that assessment type can influence the relationship between learning approach and outcome (Jackling, 2005; Marton & Säljö, 1997; Tait, Entwistle, & McCune, 1998; Trigwell & Prosser, 1991a; Van Rossum & Schenk, 1984). In a study of learning approaches in accounting, a student was found to have utilized deep approaches for learning a particular unit and was able to adequately answer a series of conceptual understanding questions given during an interview. However, the author reported that the student failed the normal assessments for the unit, while others utilizing surface approaches did well on unit assessments and could not adequately answer most conceptual questions (Jackling, 2005). Students are often successful with memorizing strategies (Svensson, 1984; Trigwell & Prosser, 1991b), and deep approaches are associated with quality learning outcomes (Lizzio et al., 2002; Tomanek & Montplaisir, 2004; Trigwell & Prosser, 1991b) but not with quantitative outcomes (Diseth, 2003; Entwistle & Ramsden, 1982; Entwistle, Tait, & McCune, 2000).

Perceptions of the Learning Environment and Learning Outcomes

The relationship between student perceptions of the learning environment and learning outcomes is a topic that has not been thoroughly explored. Students who perceived that the learning environment contained quality teaching, clear goals, and student independence have been measured as having higher levels of academic outcomes, in terms of both quantity and quality (Lizzio et al., 2002). There is evidence that increasing a student's positive perception of a course can be related to higher levels of understanding (Gibbs, 1992; Ramsden, 1992; Trigwell & Prosser, 1991a).

Relationships among all Three

Several studies have attempted to find relationships among all three areas. Trigwell and Prosser (1991a) used a factor analysis approach with data collected from nursing students. One of the factors indicated that student perceptions of the learning environment (including good teaching, clear goals, and independence), deep approaches to learning, and quality learning outcomes were all interrelated. Ramsden (1992) reported that some parts of the learning environment were related to both quality learning approaches and learning outcomes. Lizzio, Wilson, and Simons (2002) indicated that learning environments influenced outcomes both directly and indirectly through learning approaches, and all of these mentioned studies indicate that there are some deep interrelationships among these areas.

Issues with Relationships

Even though there are many studies indicating a variety of relationships among learning approaches, perception of environment, and learning outcomes, there are several strong caveats that must be taken into account. This includes breakdown of relationships, cautions in interpretations, and the educational meaningfulness of the relationships.

A major issue with relationships between learning approach and perceptions of environment is that for some students there is little relationship. Academically challenged students have been found to have a disintegrated approach to learning (Meyer, Parsons, & Dunne, 1990; Prosser, Trigwell, Hazel, & Waterhouse, 2000). Students with low levels of prior knowledge often try to incorporate multiple approaches, believing that the task allows them to utilize both surface and deep approaches. However, this causes a "disintegration" among their perceptions and the approaches to learning they want to use, and this has not been shown to aid students in class assessments (Prosser et al., 2000).

The interrelationships found in research must be cautiously interpreted. While many of the indicated studies label approaches to studying as deep or surface, readers and instructors must take caution, as these labels are meant to describe behaviors and not the

individual (Biggs et al., 2001; Coffield, Moseley, Hall, & Ecclestone, 2004; Riding & Rayner, 1998). When researchers are using certain categories for descriptive purposes, these will often be the categories that are revealed from the data and not necessarily indicative of the issue of interest (Kember, 1997). There is a strong probability that students may often fall into more than one category of description as they may display attributes from multiple areas of interest (Kember, 1997; Prosser et al., 2000). Also, as mentioned above, use of assessment types vary and can affect outcomes. Many assessment types may not be appropriate for exploring quality learning outcomes (Clarke, 1986; Trigwell & Prosser, 1991b). Outcomes have been found to be related more to affective than to cognitive, student traits and many standard assessments do not adequately explore cognition (Clarke, 1986; Lizzio et al., 2002; Trigwell & Prosser, 1991b).

Finally, conflicting evidence may cause questions about the meaningfulness of the results. As previously stated, gender has been shown to have both a significant effect (Byrne et al., 2002; Hassell & Joyce, 1997) and no effect on approaches to learning (Booth et al., 1999; Kreber, 2003). While some studies indicate that deep approaches are more likely to been seen with perceptions of good teaching (Jackling, 2005; Lizzio et al., 2002; Richardson et al., 2007), others have indicated that both surface and deep approaches are highly correlated with perception of good teaching (Trigwell & Prosser, 1991a, 1991b).

Teacher Approaches to Teaching

While student approaches to learning are major determinates as to what is learned, how the teacher approaches the instructional environment is also an important aspect of the equation. In order to fully investigate the environment surrounding the learning situation, describing teachers' perceptions and approaches to teaching can give greater context to the learning situation. Students' perceptions of teachers is an important factor

in learning outcomes, but there may be an influence on student perceptions based on how teachers approach the act of teaching in their individual classrooms.

Teacher approaches to teaching were not looked at intensely until after many of the research studies on student approaches to learning were published. Much of the teacher research focused on teaching strategies and methods rather than the ideas that teachers held about how best to teach (Brown & Bakhtar, 1988; Trigwell, Prosser, & Taylor, 1994). The research group of Prosser and Trigwell along with several other researchers set out to describe approaches to teaching and how these approaches related to students approach to learning. Much of the work was based on some similar ideas that were being described in the approaches to learning literature.

Using a similar methodology that was used in research on student conceptions of learning, the team of Prosser and Trigwell produced several research papers aimed at describing teachers' conceptions and approaches to learning as well as how these conceptions and approaches related to how students approached learning in these classes (Prosser & Trigwell, 1997; Prosser, Trigwell, & Taylor, 1994; Trigwell et al., 1994; Trigwell, Prosser, & Waterhouse, 1999). Using qualitative methods, the researchers interviewed teachers involved in first year university courses in physics and chemistry. Teachers viewed learning in two ways: 1) a focus on acquiring some knowledge with the teacher or some other entity as the holder of knowledge, and 2) a focus on conceptual change with the students having some previous knowledge of the ideas as they worked toward developing their ideas. Their conceptions of teaching also followed a similar pattern in that teaching was placed somewhere among transmission of knowledge to teacher helping students acquire knowledge to teachers helping students change conceptions (Prosser et al., 1994). When describing approaches to teaching, the interviewees indicated that teaching was one of three definitions: 1) teacher-focused with transmission and acquisition as the major components, 2) an interaction between student

and teacher, or 3) student-focused with conceptual change as the major component (Trigwell et al., 1994).

Additional studies have examined how teacher conceptions and approaches are related to student learning. Gow and Kember (1993) interviewed and surveyed teachers and students and established two categories of teaching conceptions: teaching as knowledge transmission and teaching as learning facilitation. Teachers who viewed teaching as knowledge transmission were less likely to have students who adopted deep approaches to learning, while teachers who saw teaching as learning facilitation were less likely to have students who adopted surface approaches. Another study found similar approaches to teaching; one that was teacher-focused and utilized knowledge transmission and one that was student-focused and tried to use conceptual changes as the basis for learning. In this study, teacher-focused/information transmission teachers were associated with having students who used surface approaches to learning, and to a lesser degree, student-focused/conceptual change teachers were associated with deep approach students (Trigwell et al., 1999). Both of these studies have indicated that student approaches to learning are related to how the teacher approaches the teaching experience. It should be noted that many of these studies utilized a relational perspective, meaning that teachers' ideas and approaches are best related to a specific teaching situation (Ramsden, 1987). One author notes that teachers may even adapt their approaches based on responses to student desires so that a relationship between teacher approaches and conceptions does not mean that the teachers influence student approaches (Trigwell et al., 1999).

Anatomy Education Research

Anatomy education is often described as a basic science, a body of fundamental knowledge needed for application to clinical practice (Cottam, 1999; Dahle, Brynhildsen, Fallsberg, Rundquist, & Hammar, 2002; Drake, 2002; Drake, Lowrie Jr, & Prewitt, 2002;

McLachlan, Bligh, Bradley, & Searle, 2004). Because of the perceived importance of knowing the thousands of structures in the human body, anatomy students are often asked to memorize and return this information for examinations with the expectation that this will aide them in future clinical practice (Miller et al., 2002). With changes in learning theories moving medical education away from traditional methods of instruction and the expectation of rote memorization (King, 1993; Miller et al., 2002; Terrell, 2006), anatomy education has been part of a debate on the changing face of health science education due to the fact that it is perceived as a basic science about which all health professionals should have deep knowledge (General Medical Council, 1993).

Traditional Anatomy Education

Traditional educators and researchers of anatomy often see curricular change as the end of anatomy instruction as it is currently known (Monkhouse & Farrell, 1999; Older, 2004). The major concern stems from curricular changes shifting towards 'vertical integration' (Dahle et al., 2002; Rosse, 1973) -- the teaching of anatomical knowledge throughout medical education by linking it with clinically oriented courses, thus reducing the number of formal hours spent in anatomy education. The general feeling is that this will leave future clinicians with a smaller knowledge base about anatomy in which to build clinical knowledge (Monkhouse & Farrell, 1999; Older, 2004).

Reduction of hours in formal anatomy education appears to be the largest concern of traditional anatomy educators. Use of alternative methods for learning and integrating anatomy is thought to draw much-needed attention away from basic science which is seen as fundamental for clinical application (Crisp, 1989; Dahle et al., 2002; Monkhouse & Farrell, 1999; Older, 2004). Much of the reduced time is thought to be directed at anatomical dissection, a tool that many feel is a necessity for medical training (Aziz et al., 2002; Dyer & Thorndike, 2000; Elizondo-Omana et al., 2005; Mc Garvey, Farrell, Conroy, Kandiah, & Monkhouse, 2001; Monkhouse & Farrell, 1999; Older, 2004;

Winkelmann, 2007). There is already a wide variation in the amount of time students spend in dissection laboratories (Drake et al., 2002), and many schools face curricular changes that some researchers report will end up decreasing the number of hours dedicated to anatomical education (Rosse, 1973). Several editorials from students and clinicians echo the stance that time spent in the anatomy laboratory was invaluable and is seen as a cornerstone of medical education (Ellis, 2001; Hanna & Freeston, 2002).

Evidence for maintaining a traditional anatomical education is often linked with studies examining student knowledge of anatomy as perceived by clinicians (Cottam, 1999; Staskiewicz et al., 2007; Waterston & Stewart, 2005) . These studies often evoke a negative feeling with the reader in that clinicians view students as leaving medical education with inferior anatomical knowledge. It is interesting to note that upon closer inspection of these studies, respondents providing negative responses to survey questions are skewed towards clinicians in surgical fields which are often thought to require high levels of anatomical knowledge. When asked for suggestions for educational improvements, many responding clinicians indicate that it would be beneficial to incorporate more clinically relevant anatomy education (Staskiewicz et al., 2007) and that it would be valuable to vertically integrate anatomy education (Waterston & Stewart, 2005). Both of these educational improvements, as previously stated, are seen as contrary to traditional anatomy education by some educators. In another study, both practicing clinicians and anatomists had lower expectations of satisfactory anatomical knowledge of Year 4 medical students than did a representative panel of the same Year 4 students (Prince, Scherpbier, van Mameren, Drukker, & van der Vleuten, 2005). At the same time, there appears to be a lack of studies examining clinicians' knowledge of anatomy. Since none of the studies reported experience or knowledge of the surveyed clinicians, it would be hard to judge exactly at what level recent graduates should be, much less be able to compare them to where they should be in practice.

While there are curricular changes that have and are being implemented in anatomy and medical education, traditional educators often view modern teaching methods as nothing but flights of fancy that should be dismissed for the time-tested traditional teaching styles (Ellis, 2001; Monkhouse & Farrell, 1999; Older, 2004). Problem-based learning (PBL), a modern teaching method for medical education, often bears the brunt of criticism as an ineffectual alternative to traditional teaching techniques. Colliver (2000) states that the theory behind PBL method is weak. However, Norman and Schmidt (2000) defend PBL by stating that much of the research on PBL is done at an individual curriculum level; therefore deficiencies may be due to inadequate implementation, as at least one study has reported (Prince, van de Wiel, Scherpbier, van der Vleuten, & Boshuizen, 2000). In fact, some authors have incorrectly made reference to failings in PBL when compared to traditional programs in examination performance (Staskiewicz et al., 2007) when in fact the original authors state that there is no systematic evidence for differences between the two types of programs (Verhoeven, Verwijnen, Scherpbier, Holdrinet, & Oes, 1998). Albanese (2000) suggests that it would be difficult to show differences between curricular programs and that "even if knowledge acquisition and clinical skills are not improved by PBL, the enhanced work environment for students and faculty that has been consistently found with PBL is a worthwhile goal" (p. 729).

Modern Anatomy Education

Generally, educational methods have moved away from the traditional aspects of teaching towards a student-centered orientation. With the introduction of problem-based learning in medical education, the health science fields have also taken some steps towards instructing in a student-centered manner (Barrows & Tamblyn, 1980). As previously discussed, new methods of teaching in the medical field have had several detractors and have faced numerous challenges to widespread implementation.

Several authors have written about curricular change in the anatomical sciences, many of which stress the need to move away from the traditional styles of anatomy education (Drake, 1998; Eizenberg, 1988; Miller et al., 2002; Morrone & Tarr, 2005; Reidenberg & Laitman, 2002; Terrell, 2006). Morrone and Tarr (2005) describe the importance of a "theoretical eclecticism," or utilizing methods from various theories in order to maximize student learning. Terrell (2006) echoes this statement by describing how different learning theories can be beneficial to anatomy education. He stresses that a single theory would have difficulty trying to reach the broad range of goals needed for mastery of anatomy. Drake (1998) points out that the goal is to maximize student learning, thus preparing clinicians in the best way possible. None of these authors describe a reduction in anatomy education but more of a re-thinking about how anatomy education should be implemented in classrooms; however, the move to more student-centered teaching like using PBL has been slow in reaching educational programs.

A big problem with moving to more modern teaching methods in anatomy education has been the scarcity of research on anatomy programs using alternative teaching methods. Research on non-PBL methods used in anatomy education that fit into a student-centered teaching theory, such as student inquiry, are few and mostly rely on anecdotal evidence and teacher practice guidelines (Brock, 2000; Marx et al., 2006). These reports provide little empirical evidence as to the benefits of the proposed use of alternative methods and mainly serve as descriptions of programs that have seen some success. While providing some useful tools that may initially seem interesting, educators must realize that without a sound knowledge of the theory behind these alternative methods, success in using them may be a matter of luck. Teachers who truly wish to change their methods must have a firm grasp of why a new method may enhance student learning so that when problems arise, the appropriate adjustments may be made. Without this understanding, failure to increase learning will be seen as a problem with the instructional method and not with how it is being used.

CHAPTER 3: METHOD

This study takes an exploratory approach to understand student ideas about learning anatomy and how these ideas shape the student experience in an anatomy course. This study also examines how student ideas about learning anatomy change after having taken an anatomy course. In an attempt to fully explicate these ideas, a mixed method approach was adopted to allow for both a deep examination of students' ideas behind their approaches to learning anatomy (i.e., qualitative approach) as well as identification of general trends in how the students' approaches to learning change from the beginning to the end of an anatomy course as reported by a standard survey instrument (i.e., quantitative approach). The following section describes the rationale for the mixed method approach, introduces the instruments used, provides details about study participants and finishes by describing data analysis methods.

Mixed Methods Approach

Mixed methods research designs are an attempt to combine traits of quantitative and qualitative research in order to create a more complete picture of what is occurring. A mixed method research design tries to integrate both qualitative and quantitative data so that researchers can draw inferences from each in an effort to explore a particular phenomenon from multiple views. This research study follows a concurrent mixed methods design in which qualitative and quantitative data are acquired and analyzed simultaneously so that inferences that are made are supported by evidence from both sets of data.

A mixed method approach was used because it offers a more complete analysis of the variables of interest. Qualitative data analyses provide a deeper understanding of the thought processes behind an idea, but generalization is not permissible due to the specificity of the situation that the researcher explores with a limited sample of participants. By contrast, quantitative data analyses provide the ability to generalize

results to a larger population. However, understanding the deeper meaning behind the results is difficult as the data collected generally only produces a snapshot of the situation in which the participant is involved.

Mixed methods research approaches are seen as a necessity for studying education environments as these particular contexts are complex and constantly evolving (Greene, Benjamin, & Goodyear, 2001). Mixed approaches offer the researcher the ability to view multiple aspects of the context which provides a more meaningful view of the phenomenon of interest and thus allows the researcher to more fully understand what is being observed (Greene, 2001). The social sciences are quite complex and uncertain and through the use of multiple methods one can be confident that a more complete picture is being observed and described (Cook, 1985; Salomon, 1991).

While using multiple research approaches, a researcher may overcome the limitations of using a single approach, but he or she must understand that there are potentials for other limitations that arise with mixed methods. These limitations may include the need for increased time due to large data collection and difficulty in finding agreement in the data from multiple sources. Researchers must work towards balancing these limitations otherwise these potential problems may compound and call into question the results. Additionally, different methods may carry different weight when attempting to answer particular research questions and so researchers must be attentive to what they view as the more important aspects of the research or even what data is most relevant to a given research question (Greene et al., 2001).

Mixed methods approaches are fairly common in educational research as researchers strive to understand the ideas behind how students and teachers approach the phenomenon of learning in the classroom. Prosser and Trigwell (1997) utilized an iterative mixed method approach (Greene, 2001) as part of a two phased project when studying the classroom environment and teachers' approaches to instruction. The study developed and tested a quantitative instrument from qualitative data. The first phase of

the study involved the researchers gathering qualitative data through interviews to examine the teachers' perceptions of the teaching environment and using those results to develop the Perceptions of Teaching Environment Inventory (Prosser & Trigwell, 1997). The second phase involved examining the relationship between the results of the newly developed inventory and a second set of results obtained from the Approaches to Teaching Inventory (Prosser & Trigwell, 1993). Jackling (2005) utilized a coordinated mixed method approach (Greene, 2001) in which she used the Study Process Questionnaire (Biggs, 1987b) to examine students' approaches to learning while inviting a subset of the students for interviews to discuss their understandings of the concepts of the class. Gow and Kember (1990) used a similar methodology as the previous study, employing the Study Process Questionnaire (Biggs, 1987b) followed by interviews that led to a deeper exploration of student responses to the questionnaire. All of these studies utilized mixed method approaches for a variety of reasons, and were able to explore the factors and contexts of interest at a deeper level than if just one fixed methodology was used.

Context

The context for this study is framed around the idea that in order to develop classrooms that enhance learning, one must determine how the students perceive the class and their idea of learning in that unique learning environment. In order to explore student perceptions about anatomy and anatomy learning, the researcher chose to examine anatomy classes and the students that enroll in these classes. This was done partly because of the researcher's involvement in and desire to pursue a career teaching anatomy but also because of the general thought that anatomy is a basic science and that it can best be learned through traditional teaching methods.

All of the classes and students participating in this study represent a convenience sample drawn from a large Midwestern university enrolling over 30,000 undergraduate

and graduate students. The majority of students were enrolled in the College of Liberal Arts and Sciences, while some were working toward professional degrees in their study area. Classes involved were from two different departments of the university, the Department of Integrative Physiology and the Department of Anatomy and Cell Biology.

The Department of Integrative Physiology houses a unique program aimed at providing both undergraduate and graduate degrees in Integrative Physiology. The programs are designed around human biology and the response to stresses in the environment. Student graduate from the program with an expectation of entering a health science field or pursuing a degree in a health profession such as medicine, physical therapy, or athletic training. The department provides classes for general education requirements as well as specific courses aimed at its majors.

The Department of Anatomy and Cell Biology is a department under the Graduate College of the university and only offers a PhD in Anatomy and Cell Biology, designed to prepare graduates for a career in research and education in the anatomical and cell biology sciences. Classes are offered through the College of Medicine as the department serves the medical school and other professional schools such as the dental school. Classes also serve graduate students in the Physical Therapy program, the Nursing program, and the Physicians Assistant program although the department also regularly offers courses for undergraduate students.

Study Participants

Academic Classes

The researcher chose to focus on a group of four different anatomy classes that represent a variety of levels and environments for students to learn anatomy. The courses chosen for participation in the research were two different entry-level undergraduate level anatomy courses, one upper-level undergraduate anatomy course, and one graduate level anatomy course. The two entry-level undergraduate anatomy classes were used because

they were taught in different departments and thus may represent different views about how to teach an entry level anatomy course. The upper-level undergraduate course was selected because of its target audience, a group of students who were in the same major and had similar career ambitions as each other. The graduate class was chosen because it represented the final level at which students would be taking a formal academic anatomy course before pursing a professional career in the health sciences. The classes are briefly described in Table 1; in addition, a deeper description is presented further in the text.

Table 1

Anatomy Classes Participating in this Research Study

Course	Level	Audience	Lab	Methods	Objectives from Syllabus
Integrative Physiology (E-IP)	Entry level Undergrad	General Pre-health	None	Lecture	Define and identify structures
Anatomy and Cell Biology (E-AC)	Entry level Undergrad	General Pre-health	Optional	Lecture	Normal anatomy, clinical applications
Integrative Physiology (U-IP)	Upper Level Undergrad	IP Majors	Separate class	Lecture	Describe, define, and identify
Doctor of Physical Therapy (PT)	Graduate	DPT majors	Required	Lecture and dissection	Normal anatomy and variations, focus on movement

Each of the four classes was observed by the researcher twice in order to get an understanding of how the class was led by the instructor. The researcher visited each class during the first formal meeting as well as a second class meeting later in the semester. The researcher sat in the back of the room and took field notes describing the instructor's style and methods as well as the students' role in the classroom discourse.

Integrative Physiology Entry-level Course

The Department of Integrative Physiology offers several sections taught by two instructors of an entry-level human anatomy course (E-IP) every semester as well as during summer and winter academic sessions. This course is designed as a general survey of human anatomy aimed at students needing an anatomy course for entry into an undergraduate major as well as students looking to pursue advanced degrees in the health sciences. Many of the students enrolling in this class are entering the Integrative Physiology major or other pre-professional major. A large proportion of students are also expecting to attend medical, dental, nursing, or some other health professions school. Students in the Department of Dance also regularly take this course as a requirement for their major. This course is also available as fulfillment of one of the university's general education requirements, and students interested in human anatomy often enroll. This course is a three semester hour course with no attached laboratory or discussion section, and there are no pre-requisites to enroll in the class.

The E-IP courses used in this study either met twice a week for one and one quarter hours during the day or met once a week for two and a half hours in the evening. Two different instructors led these sections, one involved with the day section and one night section and the other with a night section and an online guided study course, although no students were asked to participate from the online course. Both of the instructors taught sections of this anatomy course utilized the same set of objectives. The objectives were given to the students as part of the syllabus during the first class meeting and described in-depth the requirements of the class. These contained everything that was available for the students to be tested on and were primarily define, identify, and describe type objectives. Some examples are:

1. Define regional and directional terms used in association with the body.
2. Summarize developmental events during the first week of the embryo, from fertilization to blastocyst.

In addition to the objectives, students were provided with a set of thinking questions for each unit, designed to get them to think more deeply about the content. Although the students were not tested on the thinking questions, the instructors directed the students to these as a way to see the material from a different perspective, and the answers to the questions were often discussed in class. Some examples of these questions are:

1. Why do lymph nodes become swollen and tender when there is an infection in the body?
2. Discuss why the projections (tuberosities and condyles) and shaft of the tibia is [sic] so much larger than those of the ulna.

There were four assessments for this course, a 40-point quiz during the third week and three 70-point, non-cumulative examinations that were given approximately every five to six weeks. The quiz and examinations were made up of multiple choice, true/false, and matching questions as well as several extended response questions which required students to respond with several brief sentences or a drawing of some anatomical structure. Course grades were curved at the end of the semester under the guidelines provided by the College of Liberal Arts and Sciences. Curving the course grades involved setting percentages on a normal distribution and then assigning letter grades based on the student's placement along the curve. Therefore, a student in the top 5% of the class regardless of raw score would be given an "A" grade for the course. This curve is calculated independently each semester, and students are guaranteed that their grade will not decrease as a result of the curve, meaning that if everyone did better than 90% in the course, all would receive an "A" grade.

This course was taught using a traditional lecture style and employed a teacher-centered methodology. The instructors used Microsoft PowerPoint presentation software to disseminate course information utilizing text, photographs, and diagrams from the required textbook or other anatomical reference sources. Before each class, students

were provided access to a modified electronic copy of the presentation with bits of information missing in an attempt to maintain student concentration on the material during the lecture. There was minimal student-teacher interaction during the lecture period. The instructor often asked general questions to the students, but answers were given sometimes as a group or from individual volunteers without being called upon by the instructor. Often the instructor would only wait briefly for a response before giving the answer and moving on. Student-student interaction was almost non-existent as the instructors did not utilize any type of small group activity. More interaction, although it was still relatively minimal, was seen in the evening sections of the class, as these were generally smaller settings with a maximum of 40 students. Both instructors utilized anecdotes and described clinical situations not presented in the course notes in an attempt to foster student understanding of the material.

Anatomy and Cell Biology Entry-level Course

Similar to E-IP, the Department of Anatomy and Cell Biology offers an entry-level course (E-AC) designed for students in medical science majors such as pre-nursing and pre-pharmacy, and only students from these majors may enroll in the course with no other pre-requisite requirements. This course is offered once every semester, but no online course or night sections are available. The E-AC course is available for three semester hours of credit and offers an optional laboratory section that has been recently added. This laboratory section is a one semester hour course that meets once a week, and about 15% of the students enrolled in the lecture course at the time of this study were enrolled in the laboratory class. Students in the laboratory class are given the opportunity to explore computer images, plastic models, skeletal bones, and plastinated specimens (dissected structures that undergo a chemical process to "plastinate" the material) as part of the laboratory experience.

The lecture course included in the study met three days a week for 50 minutes each meeting. The course was taught by a single instructor who had divided the course into four sections: "*Building the Body," "Movement of the Body," "Control of the Body,"* and "*Maintenance of the Body."* Each unit was approximately four weeks in duration with a non-cumulative examination following each unit of instruction. Examinations were 45 questions and were primarily multiple-choice with some true/false questions. In addition to the examinations, students took daily five-question quizzes via a classroom response system (CRS). These quizzes were presented at the beginning of each class and responses were recorded by the CRS system so that students received their two best scores from the daily quizzes as part of the overall assessment of the course. Grades were not curved for this course.

Objectives provided for this course were more general than for the entry-level Integrative Physiology course. Students were expected to be able to do the following by the end of the course:

1. Apply appropriate anatomical terminology when referring to the human body.
2. Understand the normal structure of human cells, tissues, organs and systems of the human body.
3. Integrate information from current clinical literature with basic anatomical concepts, i.e. understand basic clinical processes (e.g., diagnostics, treatments) and how they relate to the normal and/or abnormal anatomy.

The instructor of this course also utilized teacher-centered methodology and relied on a traditional lecture format to present the material. However, she did not utilize PowerPoint software as frequently as in some of the other anatomy courses that were observed. Lecture presentations were generally based around several pictures and/or diagrams with minimal text. Students were provided a packet of pre-printed material that had the presented material along with ample white space for note taking. The instructor also utilized an overhead projector and transparencies to draw and label structures during

the course of the lecture, and students were encouraged to add the drawings to their notes. Student-student interaction was also minimal but there appeared to be a little more teacher to student interaction in this entry-level class than in the E-IP course based on the two researcher observations. This instructor asked questions more frequently but often continued on when no answer was given in a short amount of time.

Integrative Physiology Upper-level Course

The upper-level human anatomy course (U-IP) is offered by the Department of Integrative Physiology and is a requirement for students already enrolled in the Integrative Physiology program; other students may take the U-IP course with permission from the instructors. The course that was included in this study was taught by two instructors, one of whom instructed two sections of the entry-level undergraduate course in Integrative Physiology (E-IP). The course was an in-depth version of the entry-level course with an additional focus on structural and functional relationships within the human body. The course met three days a week for 50 minutes per meeting and was available for three semester hours of credit. Note: This course is no longer offered by the department and the entry-level course is now required for students in the Integrative Physiology department. A separate laboratory course was also required for Integrative Physiology majors in which students dissected cats and studied other specimens, although the students were not required to take the course concurrently with the lecture course.

Objectives, very similar to the ones provided to the entry-level class, were distributed along with the syllabus. These objectives typically consisted of defining, describing, and identifying terms; however some objectives were linked to understanding the relationships between structure and function. All of the objectives were the sole source of quiz and examination questions, and no thinking questions were provided. Some examples of the provided objectives are:

1. Define the four principal types of bone.

2. Discuss the function of the vertebral column.
3. Describe the structural components which influence range and ease of motion at a joint.

Course assessment consisted of four non-cumulative quizzes and four non-cumulative examinations. Quizzes were primarily multiple choice questions that tested factual information, while the examinations tested structural and functional relationships using multiple choice and multiple answer type questions (multiple answers may be chosen as being correct). The quizzes accounted for one fifth of the course grade, while the examinations made up the remainder, and no adjustments to the grades were made at the end of the course.

Instruction in this class was much like the entry-level anatomy course taught in the same department. The class was driven by traditional lecture that was focused on teacher-centered methods of instruction. Minimal teacher-student interaction took place and student-student interaction was negligible within the classroom. Students were provided with complete sets of lecture notes instead of the versions that were used in the entry-level class with information missing. The presentations were made up primarily of text, photographs, and diagrams from the textbook or other references; however, the presentations were lengthier and contained more information than those found in the entry-level class but were given in a shorter period of time.

Graduate-level Course

The graduate-level course (PT) is offered to students in the first year of the Doctor of Physical Therapy program and is taught through the Anatomy and Cell Biology Department. Students entering the Physical Therapy program have at least a bachelor's degree in any academic field and have been accepted into the Physical Therapy program. Students often have, but are not required to have, previous experience in an anatomy class. The course included in this research study was made up of both a lecture and

laboratory component, each of which was taught by a separate instructor. Lectures took place three times a week for 50 minutes each and the laboratory met twice a week for three hours each meeting. The course offered five semester hours of credit.

Objectives for this course were laid out in a general manner in the syllabus, and these objectives were geared toward physical therapy students. The physical therapy students were expected to have knowledge of the details of the regional aspects of the body, the structures and surrounding structures of both normal and common variations of human anatomy, and those pertaining to a focus on movement and structures of the musculoskeletal and nervous systems deemed important for prospective physical therapists. Examinations were divided between written exams based on lecture material and practical exams based on laboratory material, with the lecture portion accounting for 60% of the overall grade. The students took four written examinations and eight quizzes (two quizzes for each unit). Lecture exams consisted of multiple choice questions and some identification of structures from pictures, while laboratory exams were identifications of dissected specimens and other models.

Instruction in this course was the least teacher-centered out of the four classes described here, based on two researcher observations, although overall it could not be classified as student-centered due to the reliance on lecture format. Instruction in the physical therapy classroom was primarily lecture-based with some PowerPoint presentations which were almost exclusively diagrams and pictures. The instructor utilized the blackboard and an overhead projector for drawing structures and labeling. Students were provided with the presentation pictures online before the class as well as some of the hand-drawn material used in the class. During the classes that were observed, there was some brief teacher to student interaction in the form of question and answer moments, and students offered answers and asked questions a little more freely than in other anatomy classes. Every couple of weeks, a class was devoted to skeletal

structures in which the students paired off to identify and work with skeletal bones and structures while being led by the instructor.

Data Collection Procedures

The researcher employed two sets of data collection instruments with the first involving a set of surveys that were distributed and completed by participants, one at the beginning and one at the completion of the semester. The second involved a series of interviews with a second set of participants, one at the beginning of the semester and one at the end. Additional data sources came from classroom observations conducted by the primary researcher. All portions of the data collection process were reviewed and approved by the university's Institutional Review Board (IRB). Prior to recruiting volunteer students for this study, the researcher contacted all of the instructors for the involved courses to ask for permission to contact enrolled students. When permission was granted, the researcher asked for and acquired access to group email lists of the students enrolled in the respective classes. Separate email invitations were sent to the students for the survey and the interview portions of the study, and these invitations informed students that they could choose to volunteer for one or both portions of the study. Data collection started during the first few weeks of the Fall 2008 semester and continued until the end of that semester.

Interview Data

An email was sent to all students enrolled in the included anatomy courses approximately one week prior to the beginning of the fall semester. The email invited students to participate in a short interview about their upcoming anatomy class. Students were asked to submit some times that they were free to participate, and follow-up emails were used to set a single time and meeting place for the interview. Students interested in participating in the interview were scheduled as soon as possible within the first three weeks of the semester to avoid having student ideas influenced by the first examination.

Only one student was able to complete the first interview prior to the first class meeting as the other participants were either not available before the class started or did not volunteer until after the first class meeting.

Approximately three weeks prior to final examinations, students who had participated in the initial interview were contacted by email to schedule a time for a final interview. These interviews took place as soon as convenient times were agreed upon and all took place before the final examination for each of the classes.

Survey Data

In order to solicit participants for the survey, the researcher initially went to each class that was to be involved with the research project and introduced himself and the project to the students. He notified the students that he had previously contacted them about the interview portion of the study but that the survey was being conducted independently and participation was not required in both should they choose to take part in the survey. He explained that they would be receiving an email with details about the survey portion of the study and that the email would contain a link to a survey website. The email would include some brief information about the project, the link to the survey website, and contact information for the researcher, his advisor, and the IRB in case the potential participant had any questions prior to taking the survey. Choosing to participate in the study was voluntary and the instructors did not know which students had chosen to participate. The researcher then asked for and addressed any questions that the students had about participating in the project.

The students were asked to complete the survey within the first three weeks after the first class meeting, prior to any examinations taking place. The reason for this timeframe was to ensure that student ideas about the class could not be shaped by the experience of taking the assessment or by how they performed on the initial assessment. The online survey took approximately 15 to 20 minutes to complete and students were

free to terminate their involvement at anytime as the survey website would not record responses until the participant had completed the survey. Two follow-up emails were sent to all of the students approximately one and two weeks after the initial email in order to increase the response rate for the survey.

Two weeks prior to the final examinations in each class, a second email was sent to only the students that had participated in the initial survey asking them to take a final survey. The survey was made available to the students for approximately two weeks after the final examination, with two follow-up emails to encourage participation in the final survey and minimize attrition.

Instruments

Survey Instruments

Two surveys, one initial and one final version of the survey, were used as data collection instruments and they were constructed together in order to assess student ideas about learning anatomy before taking the course and at the completion of the course. The initial survey contained the informed consent document. Potential participants were to read the document and ask questions of the researcher, his advisor, or the IRB. Participants were instructed that consent would be implied if they completed the survey and submitted their responses online.

The initial survey (Appendix A) asked for some demographic information including name, anatomy class, age, gender, race, and approximate grade point average (GPA). The survey also asked for information regarding the student's academic major/minor, career goals, previous anatomy experience, and reasons for taking the course. The next section included some open ended questions pertaining to the student's preferred learning styles and methods, perception of the upcoming anatomy class, perceptions of how he or she would learn in the anatomy class, and how he or she compared learning anatomy to other academic courses. A final question asked students

to rate how difficult they thought the class would be using a rating scale from one to ten, with one being very easy and ten being the most difficult.

The final portion of the survey included a revised version of Biggs, Kember, and Leung's (2001) Study Process Questionnaire (SPQ). This questionnaire contains 20 items intended to elicit student responses as to how they will approach their study in a particular class. Responses are given using a 5-point Likert-type scale ranging from "A - this item will never or rarely be true" to "E - this item will always or almost always be true." Question items were revised to more align with taking an anatomy class and students were instructed to answer as to how they thought they would approach their anatomy course.

Each of the items of the SPQ was categorized into four subscales with five items belonging to each category. Two categories were geared towards the student's motive for studying while the other two were assigned to the strategy used while studying. Both the motive and the strategy categories had a surface and a deep component, identifying the student's engagement with the studying process. Table 2 summarizes the four categories and the general descriptors of each category.

Table 2

Subcategories of the Study Process Questionnaire

	Surface	Deep
Motive	Fear of failure	Intrinsic Interest
Strategy	Narrow target, rote learn	Maximize meaning

Note. Adapted from "The Revised Two-factor Study Process Questionnaire: R-SPQ-2F," by J. Biggs, D. Kember, and D. Leung, 2001, *British Journal of Educational Psychology, 71*(1), p. 135.

Each response on the SPQ was given a score from one to five with one being awarded for an "A" answer and five being awarded for an "E" answer. Each category had a minimum value of five and a maximum of 25. The surface subcategories and the deep subcategories were respectively combined to give scores for the overall surface approach and the deep approach to studying. These scores were used to quantify the student's perception of using surface and deep learning approaches for the particular class. The items have been previously tested for goodness of fit to their respective subcategories as well as tested for internal consistency (Biggs et al., 2001). Because of the response rate, a confirmatory factor analysis could not be completed. However, the researcher did calculate a measure of reliability for the SPQ. Cronbach's alpha was calculated for all of the questionnaire items comprising the Surface Approach (SA) score and all of the items comprising the Deep Approach (DA) score for the initial survey responses. Cronbach's alpha for the SA scores was .674 and was .777 for the DA scores. While scores are generally termed acceptable when greater than .70, the researcher determined that the SA scores could be considered acceptable because Cronbach's alphas for the subscales of SA were lower (surface meaning = .579 and surface strategy = .479), meaning that the single factor of SA was a more appropriate fit.

A final survey (Appendix B) was provided to the students who had participated in the initial survey. This survey was structured similarly to the initial survey in that it had some open ended questions and then another revision of the SPQ. The open ended questions inquired about the student's likes and dislikes about the anatomy course as well as aspects of the course that helped or hindered the student's learning. The questions also asked about the student's satisfaction with the content learned and if the course changed his or her enthusiasm for anatomy as a subject. The survey then asked the student for the methods and resources that the student used for learning in the class and if the student felt that he or she learned in a similar manner compared to other classes that the student had previously experienced. A final question asked for the student to rate the difficulty of the

course using the same scale as the initial survey. The students were also asked to complete a second SPQ focusing on how the student actually approached studying for the anatomy class, as this version of the SPQ was modified to present items that reflected how the course was approached.

Both survey instruments were prepared and presented to the students via a website called WebSurveyor (WebSurveyor Corporation, 1997-2006). This is an online survey website with access provided to researchers at the University for conducting surveys and collecting survey data. The website is a secure site with no personal information collected, and participant responses were only made available to the researcher. Website access was only available to the researcher and was password protected.

Interviews

Interviews conducted for this research project involved an initial and final interview with participating students. With the assistance of two faculty members, a general interview schedule was created for the initial student interview (Appendix C). The interview involved an introduction from the researcher about himself and the research project. He described the purpose of the study, how privacy would be maintained, how the student's name was acquired; it included a description of the informed consent process as directed by the IRB. If the participant agreed, verbal consent was given and the interview continued. The researcher also asked if the conversation could be audio recorded for future transcription and analysis.

The interview had a semi-structured format in which some directed and focused questions were asked, but probing questions were also included to get further detail about responses. Questioning began with some basic demographic information such as name, age, year in school, and GPA. The researcher inquired about the course the student was taking, why they were enrolled in that particular course, and if they had any previous experience in an anatomy course which included undergraduate, high school, or any other

course where anatomy played a major component of the content. The students were then asked to describe what they thought the class would be like, including ideas about what they thought they would learn, how they would learn it, and how they would know that they had learned something. The researcher also asked for the student's definition of learning, his or her ideal learning situation, and what he or she needed for learning the material, such as resources or situations. The researcher ended the interview by asking the student if the researcher could contact him or her for clarification or to ask any additional questions once the initial interview was reviewed.

The final interview was structured similarly to the initial interview in that a general interview schedule was created with the exception of specific focused questions for each individual participant based on responses that were given during the initial interview (Appendix D). Students were asked about the things that they liked and did not like about the class, what they learned, and how they went about their learning process. The researcher asked for opinions on how to improve the class and the difficulty of the class. Individual questions asked the student to reflect on his or her definition of learning from the initial interview and how it applied to his or her learning of anatomy. The researcher also ended this interview by asking for permission for follow-up contact in case there was need to ask for clarification or to pose additional questions.

Data Analysis

Because the data being collected consist of both quantitative and qualitative measures, a variety of analysis methods were be used. Quantitative measures include independent variables from the demographic information provided by the participants such as gender, age, and GPA. Dependent variables were comprised of the ratings of difficulty and the SPQ subscale scores. In addition to descriptive statistics (e.g., means, frequency counts), planned analyses consisted of statistical tests of significance including student *t*-tests and one way Analysis of Variance (ANOVA) with follow-up testing as

indicated. The statistical tests were conducted to determine several relationships: the differences within and between each of the participant class groups with respect to gender, age, and GPA. All tests of significance were conducted using an a priori significance level of .05 unless corrections needed to be made due to the number of groups being analyzed or the number of statistical tests being conducted.

Qualitative data from both of the interviews and the surveys were analyzed using the constant comparative method (Strauss & Corbin, 1990). Initially, the audio data acquired from the interviews was transcribed and imported into ATLAS.Ti (version 5.0), a software package for qualitative data analysis. The researcher initially utilized an open coding strategy consisting of review of each transcript and coding of statements that pertained to the questions that were asked. After the first participant's initial transcript was coded, the researcher continued with a second student's initial transcript and applied the codes that emerged from the first transcript as needed or added codes when the situation called. The researcher then returned to the first transcript and reviewed the codes that were added to determine if any of those codes applied to the original and made adjustments. The second step of coding involved developing categories of codes that addressed each of the questions. This step, called axial coding, initially looked at each question involved in the interview and then looked at categorizing codes for the entire situation in order to come up with a general framework. The goal of this process was to determine a core idea as expressed by the given data. The researcher then linked other groups of categories to this core idea in order to express the relationships between these secondary categories and the core idea (Strauss & Corbin, 1990). Codebooks for both the initial surveys and interviews and the final surveys and interviews are found in Appendix E and Appendix F.

The researcher attempted to triangulate the data sources in order to assure that the inferences made are accurate. The researcher compared the results from the interviews and the surveys for those participants who completed both parts of the study. The

researcher looked for similarities and differences in responses to open-ended questions, interview responses, and the SPQ results. When it was appropriate, the researcher made inferences based on multiple sources of data and made note when there was a discrepancy between sources. The researcher also consulted with another researcher about ideas and themes to ensure consistency in ideas and to provide a second source for analyses, thus attempting to reduce researcher bias in interpretations. The codebooks and several representative transcripts were given to this second researcher for review. The two researchers then discussed any differences and made changes to the codebooks where it was appropriate.

The researcher utilized a coding scheme for direct quotes that allowed easy access to where quotes originated from. The coding followed this sequence: (Participant, Source, Line Number). The participant indicates who the particular speaker is either in the interview or the survey. For instance, S1 indicates that the quote is from the first student participant. The source indicates where the quote is from. SII stands for "Student; Initial Interview" and SFI stands for "Student; Final Interview." SIS is the "Student; Initial Survey" and SFS is "Student; Final Survey." An example of this coding would be (S2, SFI, 3). This quote would be from line three of the second student's final interview.

CHAPTER 4: RESULTS

The following chapter presents the results from both the qualitative and quantitative data from this research study. The qualitative data are a combination of the initial and final interviews as well as the open ended questions from the initial and final survey. Quotes that exemplify the ideas that arose from the data are presented to give context for the reader. The quantitative data are presented from the results of the Study Process Questionnaire (SPQ) that was administered as part of the initial and final survey. Demographic data from the four classes used in the study are also presented in this section as well as statistical analyses conducted on the quantitative data.

Twenty-three students participated in both the initial and final interview portion of the study. Fifty-five students completed the initial survey and 28 of those completed the final survey. Eleven students participated in all aspects of the study.

Qualitative Results

Table 3 presents the number of students participating in the initial and final interviews based on overall enrollment in each of the anatomy course. All of the interview volunteers were female except for two males in the U-IP course and one male in the PT course.

Table 3

Number and Demographics of Interview Participants in Each Course

	Course Enrollment[a]	Study Participants	Age[b]	GPA[c]
Entry Level IP (E-IP)	214	6	20.33±.82	3.09±.28 n=4
Entry Level AC (E-AC)	114	4	21.33±2.08	3.48±.33 n=3
Upper Level IP (U-IP)	46	5	21.80±1.30	3.79±.11 n=4
PT	35	8	24.75±7.44	3.76±.19 n=7

[a]Course enrollment numbers were collected at the end of the course and do not reflect the initial enrollment.

[b]Age presented in mean years and standard deviation.

[c]Grade Point Average (GPA) based on a 4.0 scale and presented in mean and standard deviation. The number of participants reporting GPA is also presented.

Ideas on Learning Anatomy

Initial

Students were asked in both the initial interviews and surveys about how they thought they would learn anatomy. Answers varied in relation to the student's ideas about the process of learning anatomy and the strategies that they believe they will employ to learn anatomy.

When students talked about the process of learning anatomy, many indicated that they would focus on memorizing the content. Twelve of the 23 students (52.1%) completing the initial interview stated that they expected to memorize the content in the

anatomy course with statements such as "I'm going to try to memorize all the major parts," (S38, SII, 76) and "A lot of memorization, but I don't know, there's a lot of memorization" (S20, SII, 87). Fourteen of the 55 students (25.5%) completing the initial survey explicitly indicated memorization as the primary learning process that was expected to be used in the anatomy course.

While not always mentioning memorization, many of the interviewed students anticipated the use of repetition in order to master the material (14 out of 23, 60.9%) including eight of the students who mentioned memorization as the primary learning process. A female student from an entry level anatomy class stated

> I know we can't go over it and over it again but to be able to just keep going over it continuously to make sure I can understand it as well as I can
>
> (S48, SII, 36)

An additional 16 students (29.1%) from the initial survey also indicated that they believe repetition would be the primary strategy for learning the course content.

Very few students indicated that they would use processes of learning other than memorization and repetition for the anatomy class. Only one student, an upper level undergraduate, indicated the importance of putting together the relationships that occur within the human body as an important part of the learning process.

> But also taking time to see how everything works, how different body parts interact with others on a bigger scale.
>
> (S20, SII, 87)

Some of the students did indicate that trying to relate the material to their own body was an important learning strategy. Seven of the initial interviewed students (30.4%) but only four of the initial surveyed students (7.3%) indicated that they would try to relate the material from the class to themselves.

> It teaches you about yourself, not like math that has nothing to do with me, but anatomy it's how you function; I can think 'oh this is why this happens.'
>
> (S5, SII, 17)

Other strategies were very important in learning anatomy and were mentioned by a number of students in both the interviews and the surveys. Taking and studying notes as well as using visual references were the most common quotes from the interviewed students (26 quotes for both). Twenty one references were made regarding the expectation of reading as a strategy for learning anatomy and only four of the interviewed students (17.4%) indicated that they would focus on the key ideas. Student responses from the survey indicated that they believed that reading would be the most used strategy for learning (28/55, 50.9%) followed by attending lecture (21/55, 38.2%) and studying notes (16/55, 29.1%). Nine students (16.4%) indicated that they believed visuals would be an important learning strategy and only four (7.3%) mentioned the importance of relating the material to their own bodies.

Final

Students were asked in both the final interview and the final survey to describe how they learned anatomy and what strategies they used to help them learn. Fifteen of the 28 survey respondents (53.6%) and 13 of 23 interview respondents (56.5%) specifically indicated that they memorized content as the primary mode of learning. Memorization was also the most often cited reason for similarities to other classes (memorize in other classes too)

> The way I learned was basically memorize the parts and functions. So basically yah, I just try and memorize everything in all my classes for the tests.
>
> (S19, SFS, 313)

and differences from other classes (more memorization in anatomy).

> It's not just understanding the material, it is remembering it. Some subjects you just need to understand the idea and it sticks in your memory, but with anatomy it is a matter of more repetition and reinforcement.
>
> (S5, SFS, 316)

> …but it's the nature of anatomy, a lot of memorization, doing the note cards and that sort of stuff.
>
> (S43, SFI, 36)

> With other [classes], if you understand, you can conceptualize on a test and get answer. If you don't memorize for this one and it's on the test, you won't know the answer.
>
> (S54, SFI, 37)

Few students indicated that they would focus on relationships and tying information together. Comments regarding relationships as being important were exclusively mentioned in the final portion of the study by students doing interviews and were only made by six students (26.1%).

> Really stressed origin, insertion, critical thinking, if this goes from here to there, what will it do, rather than just memorizing, which is which.
>
> (S39, SFI, 8)

> I would look at the slide, think more abstractly, the bigger picture, funnel it down, they would mention one word that had been mentioned earlier, would go back to myself, this is what they're talking about.
>
> (S4, SFI, 19)

When students were asked what resources they used to learn anatomy, 17 of the survey respondents (60.7%) and 18 of the interviewees (78.3%) indicated that they used their notes as a primary study tool. Seventy-five percent (21 out of 28) of those surveyed and fifty-two percent (12 out of 23) of those interviewed mentioned that the textbooks played a major role in their studies. Interviewees also indicated that visuals (16/23, 69.6%), social learning (9/23, 39.1%), and lecture attendance (6/23, 26.1%) were all important for learning anatomy.

Summary

More than half of the students involved in the research study believed that learning anatomy would be an exercise in memorization or repetition and over half indicated that memorization was their primary approach to learning. Few students indicated their intentions to focus on the relationships or to try to relate the material to themselves. After the course, only interviewed students mentioned the importance of relationships in their learning of anatomy. Many of the students indicated the importance

of notes, visuals, and textbooks as tools they thought they would use to learn anatomy and tools that they actually used. Much fewer indicated the use of social aspects of learning such as using study groups.

Ideas About Learning

Initial

Students were asked to identify preferred learning styles and methods in the interviews and surveys as well as being specifically asked to define learning in the interviews. Sixty percent of those surveyed (33/55) described a practice model as their preferred mode of learning, including hands-on and practice activities. Only one surveyed student identified memorization as a preferred way of learning. Twenty students (20/55, 36.4%) identified wanting a knowledgeable person to be involved in the learning process, specifically a teacher, mentor, or an experienced partner.

For those who were interviewed, 16 of 23 (69.7%) described a preference for asking and answering questions, usually with the instructor. Fourteen of the 23 (60.9%) identified repetition as being a preferred mode of learning, either through reviewing material repeatedly, re-writing or reading notes, or repeating through active trial and error. Active learning or hands-on activities and group learning such as classmate study sessions were both identified by 11 interviewees (11/23, 47.8%). Passive learning, such as listening, reading, and attending lectures was mentioned as preferred by 43.5% (10/23), and four students (4/23, 17.4%) expressed the importance of reflecting on the presented ideas.

The interviewed students were also asked to provide their definition of learning. Many of these students (18/23, 78.3%) reported that learning was defined as an acquisition of either information or knowledge. One upper level undergraduate simply stated that "learning is storing something in my brain" (S38, SII, 108). Three of the interviewed students (3/18, 16.7%) also identified learning as changing ideas.

> Take a new idea and incorporate ideas into your own set of ideas that you have-so it's no longer new it's become old
>
> (S53, SII, 73)

> What will better my understanding is what I will do and if things aren't the way then I'll change my way and learn by experience. I'll learn from my mistakes and change things to make it better.
>
> (S48, SII, 98)

> Changing old knowledge, relearning or updating knowledge base
>
> (S28, SII, 45)

Only one student (1/23, 4.3%) specifically described learning as a process. This student, a female physical therapy student, defined learning as "a process of thinking about a concept and exploring it" (S5, SII, 35).

For many of the students, defining learning was a difficult task, and they initially described the purpose of learning. These ideas also revolved around learning as acquiring information for future use, such as applying to a new task (10/23, 43.5%) or for simply being able to access the information (3/23, 13.0%). Several students (6/23, 26.1%) indicated that the goal of learning was understanding.

> Understanding them at a different level than you had initially is very important.
>
> (S36, SII, 61)

Final

For the final interview, students were given their earlier definition of learning and asked if it had changed or if they wanted to expand on their definition. Thirteen of the 23 (56.5%) said that the given definition was the same as previously stated. Twelve students (12/23, 52.2%) indicated that memorizing was the main mode of learning.

> Start with memorizing facts, structures, then commit to memory for long term memory so you can pull it back out and use it.
>
> (S46, SFI, 46)

Four of the students (4/23, 17.4%) explained that there are different levels of learning.

> Memorizing is like cramming your short term memory, do over and over again, you can retain, but just for a short time, long enough to fill out answers on test, if you don't ever follow up on it, you won't remember it. I would say you learn it. You have to learn to be able to memorize. I'm not sure. I can give you a sentence right here but I don't know if that's learning. You might not be taking in the concept. You can memorize without learning the concept.
>
> (S63, SFI, 58)

As many students did initially, answers often revolved around the purpose of learning rather than a definition of learning. Fourteen students (14/23, 60.9%) described the purpose of learning as being able to use the knowledge for some future purpose. Three students (3/23, 13.0%) indicated that learning should allow someone to solve problems.

> If I were treating a patient, if they have some weakness, we'll have to know what nerve goes and where that is, what the problem might be, apply what you know to solve the problem…
>
> (S54, SFI, 46)

Three students (3/23, 13.0%) described the purpose of learning to be understanding and one student (1/23, 4.3%) indicated that learning allowed someone to be able to participate in a civil discourse.

> I think it is being able to hear and comprehend what but it's also being able to participate in the conversation, having knowledgeable input, or being able to disagree with what somebody is saying and having an explanation to back it up.
>
> (S58, SFI, 75)

Summary

When describing their ideas on learning in general, many students indicated the desire to work with expert individuals or to utilize a practice method of learning. Quite a few students, especially those in the survey, thought their ideal learning approach would involve repetition. When defining learning, many of the interviewed thought that learning was the acquisition of knowledge, while some had difficulty in defining learning. Instead, these students would often discuss the outcome of learning such as having information for future use. Most of the students stood by their definitions of learning in the end and some added the importance of memorization to learning.

Course Perceptions

Initial

Students were asked in both the surveys and the interviews to describe what they thought their anatomy class would be like, including describing what they thought they would learn. For the surveyed students, the largest specific response was that the class would be "interesting" (9/55, 16.4%) followed by "challenging" (8/55, 14.5%). Student perception of the course was also that it was going to be "fun" (4/55, 7.2%), "intense" (3/55, 5.5%), and "informative" (3/55, 5.5%). When asked what they thought they would learn, surveyed students said that they would learn anatomical structures (22/55, 40%), basic anatomy (16/55, 29.1%), functions of structures (8/55, 14.5%), and anatomical terminology (5/55, 9.1%). Five of the students (5/55, 9.1%) indicated that they would learn interactions and relationships among the structures and only two students (2/55, 3.6%) talked about anatomy concepts or "the big picture."

Of the interviewed students, 16 (16/23, 69.6%) expressed that they felt the anatomy course would be more difficult than most courses they have taken while four (4/23, 17.4) indicated the opposite. Seven students (7/23, 30.4%) mentioned the amount of information being greater than in other classes, while five (5/23, 21.7%) discussed the need for increased study time. When describing what they would learn, 17 of those interviewed (17/23, 73.9%) spoke of specific body systems or going over each system. Ten students (10/23, 43.5%) indicated that they thought they would learn interactions among systems or relationships within the human body.

> Where would that be located, what relates to what, if you move your wrist, what muscles follow with the movement, the neurons, action potential, all those kind of things, what happens in that section of your body, how it relates to the rest of your body
>
> (S58, SII, 25)

Several students also indicated that they would be learning anatomical names (3/23, 13.0%).

Final

Students were asked to discuss their course perceptions in both the surveys and interviews after the course had concluded. Questions asked students to describe how the anatomy class compared with other academic classes, how the students might improve the class, and how they would describe what this class was all about to someone else.

For the surveyed students, 13 (13/28, 46.4%) indicated that they learned in a way that was similar to learning in other classes, with six of those students specifically mentioned memorizing as a major part of learning in all classes. Fifteen (15/28, 53.6%) perceived it as different, with eight of those students mentioning that they had to rely more on memorization than in other classes. For interviewed students, four (4/23, 17.4%) thought that learning was the same in the anatomy class as in other courses while 16 (16/23, 69.6%) thought that learning was different in the anatomy class.

> The class, sports psychology, it's not as interesting to me because it's just talking, not like you can visualize anything, a bunch of theories, which makes it boring. It's harder to study, you can't go out and see this theory, a lot more difficult. Versus anatomy, can see it, there are plenty of diagrams, other classes aren't visual like that, and I'm a visual learner.
>
> (S12, SFI, 39)

Course improvements were varied among those surveyed and interviewed. Time spent on topics or pacing issues (7/28, 25.0% for surveyed, 8/23, 34.8% for interviewed) and issues related the level of guidance provided by the teacher (7/28, 25.0% for surveyed, 6/23, 26.1% for interviewed) were among the most cited areas needed for improvement. Six of those surveyed (6/28, 21.4%) and four of those interviewed (4/23, 17.4%) mentioned adding or modifying the laboratory component. Four of those interviewed (4/23, 17.4%) also mentioned alterations to assessments while only one of the surveyed (1/28, 3.6%) suggested adding more in the way of assessments.

As a way of gauging the students learning of anatomy, a question was specifically asked of both the surveyed and interviewed students. Each student was asked how they would describe the course to a friend or fellow student in order to determine what the

student thought they really learned in the class. Using the SOLO taxonomy (Biggs & Collis, 1982), 14 of those surveyed (14/28, 50.0%) and 17 of the interviewed (15/23, 65.2%) spoke only of specific content areas.

> It's a gross anatomy course that teaches you where the parts are and what their basic functions are. General information.
>
> (S9, SFS, 217)

> A lot of memorization of different systems of body so all the bones, joints, muscles, organs and nervous system, I would say be prepared to try and memorize a lot of stuff. Which I think a lot of people expect of anatomy class.
>
> (S20, SFI, 71)

Five surveyed students (5/28, 17.9%) and eight interviewed students (8/23, 34.8%) gave a multi-structured answer and spoke about how the different areas were related to each other as being an important aspect of what is learned in anatomy. Some examples of a multi-structured response were;

> A review of human anatomy focused on musculoskeletal aspects and the related neural and vasculature supply, including a human cadaver lab component. You study the relationships of the structures of the body and how the muscles create movement.
>
> (S5, SFS, 225)

> Learning all the structures of the body how they are called, how they are spatially related, important part of what we had to learn, we focus a lot on the muscles, it's different for a med student, we are doing some of the systems, being able to think about how different body systems deal with whatever they have to deal with, we're focusing on the GI tract right now, how you deal with food, how you process. How they are related, not so much functionally related. It's more spatial relationships, the language to describe the spatial relationships and the semantic categories, veins etc, being able to take the structures, categorize them, orient them, name them. I didn't think it was a functional course. It was more just becoming familiar with what and where.
>
> (S7, SFI, 33)

Summary

Students originally had diverse perceptions of what they thought the anatomy class would be like. Responses ranged from interesting, to challenging, to fun. Many of the students also believed they would be learning specific content such as anatomical

names or locations of structures. Many of the interviewed students believed that the anatomy course would be more difficult than other classes that they have taken. After taking the course, many of the students perceived the learning experience in anatomy to be similar to other courses. When making suggestions for improvements, many students mentioned the course needed better pacing or more guidance as to what was important. When asked what the course was all about, more than half of the participants spoke of only specific content areas and few gave multi-structured, relational answers.

Quantitative Results

Quantitative data was gathered from the student initial and final surveys. Fifty-five students completed the initial survey and 28 of those completed the final survey.

Demographic data for both groups are presented in Table 4 and the number of participants in each course is displayed in Table 5.

Table 4

Demographics of All Survey Participants

	n	Males	Females	Minorities[a]	Age[b]	GPA[c]
Initial	55	12	43	7	22.52±4.9	3.51±.32
Final	28	5	23	5	22.07±4.8	3.54±.32

[a]Minorities were defined as any participant not indicating "Caucasian/White" on the survey.

[b]Age presented in mean years and standard deviation.

[c]Grade Point Average (GPA) based on a 4.0 scale and presented in mean and standard deviation.

Table 5

Number of Survey Participants in Each Course

	Entry Level IP	Entry Level AC	Upper Level IP	PT
Course Enrollment[a]	214	114	46	35
Initial	16	17	6	16
Final	9	8	3	8

[a]Course enrollment numbers were collected at the end of the course and do not reflect the initial enrollment.

Statistical Tests

The following results are gathered from statistical analyses using SPSS 17.0. All analyses were conducted using an a priori alpha of .05 unless otherwise noted.

Demographic Tests

Statistical tests were initially conducted to determine if there were any statistically significant differences in the participants based first on gender and then based on course enrollment. An independent samples t-test was conducted to determine if males and

females had any statistically significant differences on reported GPA (one male student from the entry level IP course did not report GPA). This test was not significant at the .05 level, $t(52) = -.052$, $p = .960$. A one-way ANOVA was then conducted to see if there were any differences among the courses based on GPA. Follow-up tests were conducted using Tukey's HSD post hoc statistical test. The ANOVA results are presented in Table 6.

Table 6

Analysis of Variance for the Evaluation of Grade Point Average Differences Among Participating Courses

	SS	*df*	*MS*	*F*
Between Groups	1.030	3	.343	3.866*
Within Groups	4.440	50	.089	
Total	5.469	53		

*$p < .05$.

Tukey HSD follow-up indicated that the difference was between the entry level IP course (mean GPA = 3.36) and the PT course (mean GPA = 3.69), $p < .05$.

SPQ Results

The Study Process Questionnaire (SPQ; Biggs et al., 2001) was given to students as part of the survey portion of the research study. The questionnaire, made up of 20 Likert-scale type questions, calculates approach scores based on four scales. These scales are surface motive, surface strategy, deep motive, and deep strategy. The surface scores and deep scores combine to give an overall surface approach score and deep approach score respectively, for the student's preferred way of learning in this particular context.

Students utilizing surface approaches (SA) tend to favor rote memorization as they focus on content and are driven by a fear of failure. Students using deep approaches (DA) to learning are often going past the surface in an attempt to uncover the deeper meaning behind the content. These students have higher intrinsic interest for the subject and utilize more cognitive methods for learning.

Pearson bi-variate correlations were initially calculated on the SPQ scores for students completing both the initial and final surveys (Table 7).

Table 7

Intercorrelations Between SPQ Subscales for the Students Participating in Both Initial and Final Surveys

Subscale	Initial SA	Final DA	Final SA
		$n = 28$	
Initial DA	-.400*	.565**	-.489**
Initial SA		-.468*	.624**
Final DA			-.755**

*p < .05, **p < .01.

As expected, SA scores were positively correlated with each other (initial and final) as were DA scores. The SA and DA scores were negatively correlated with each other. For students only taking the initial survey ($n = 55$), the correlation between DA and SA was significant, $r = -.321$, $p < .05$.

Figures 1 and 2 demonstrate the average SPQ scores based on the anatomy course in which the students were enrolled (Figure 1) and their previous anatomy course experience (Figure 2). A significant difference was found only for the final SA score

based on previous anatomy course experience, $F(2, 28) = 3.632$, $p < .05$) with a Tukey HSD follow up revealing the significant difference between students with no previous experience (mean final SA = 27.80) and students with two previous anatomy experiences (mean final SA = 18.40), $p < .05$.

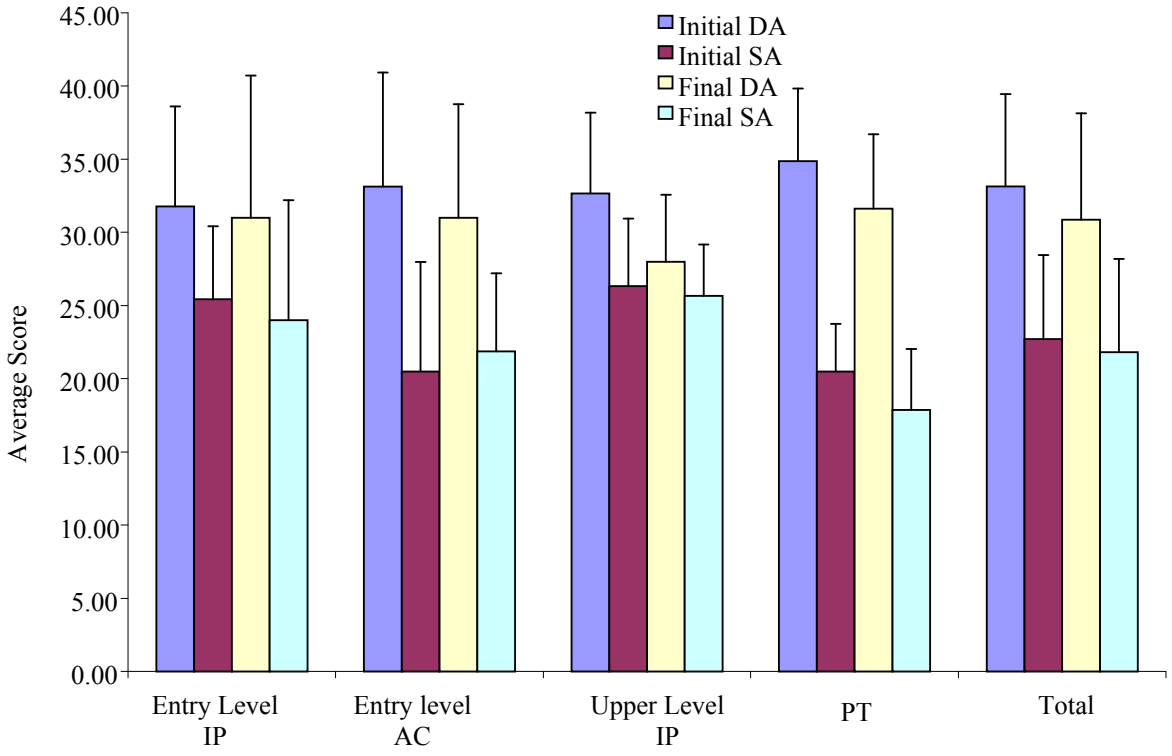

Figure 1. Average SPQ Scores by Course

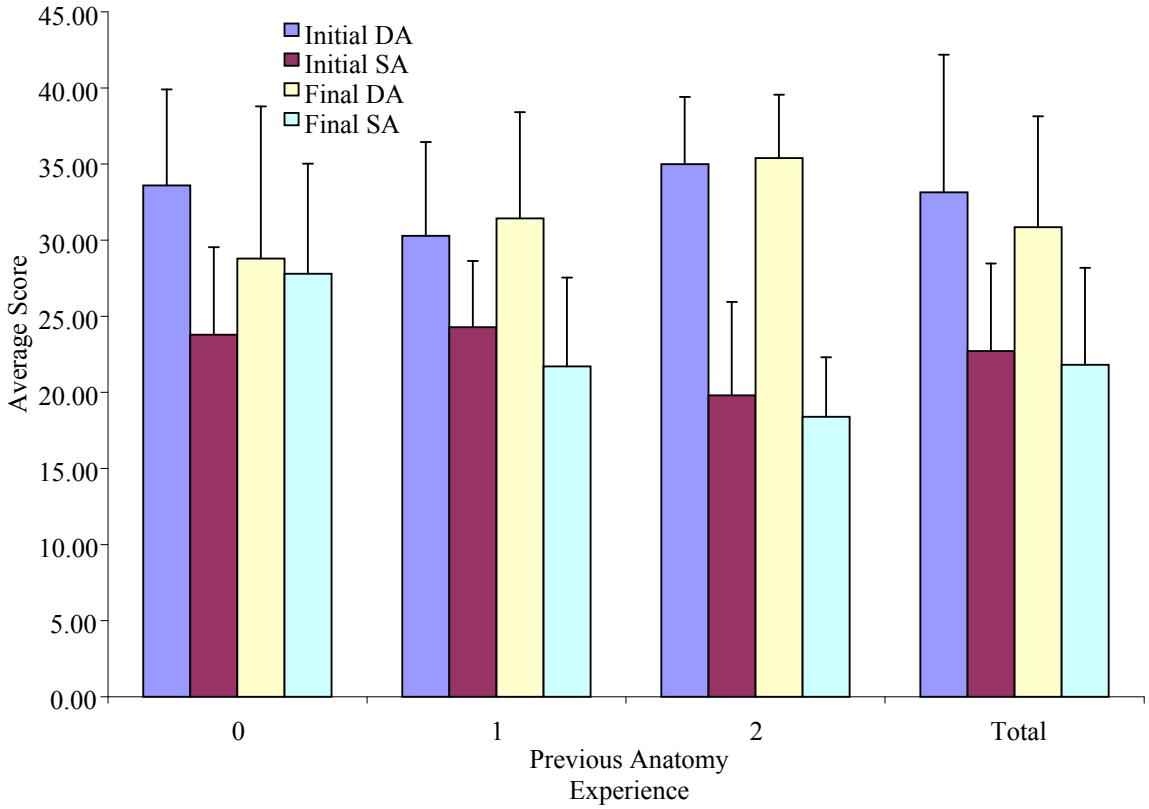

Figure 2. Average SPQ Scores by Previous Anatomy Experience.

Figure 3 and 4 present SPQ change scores from final to initial results. The results are presented by class and then by previous anatomy experience.

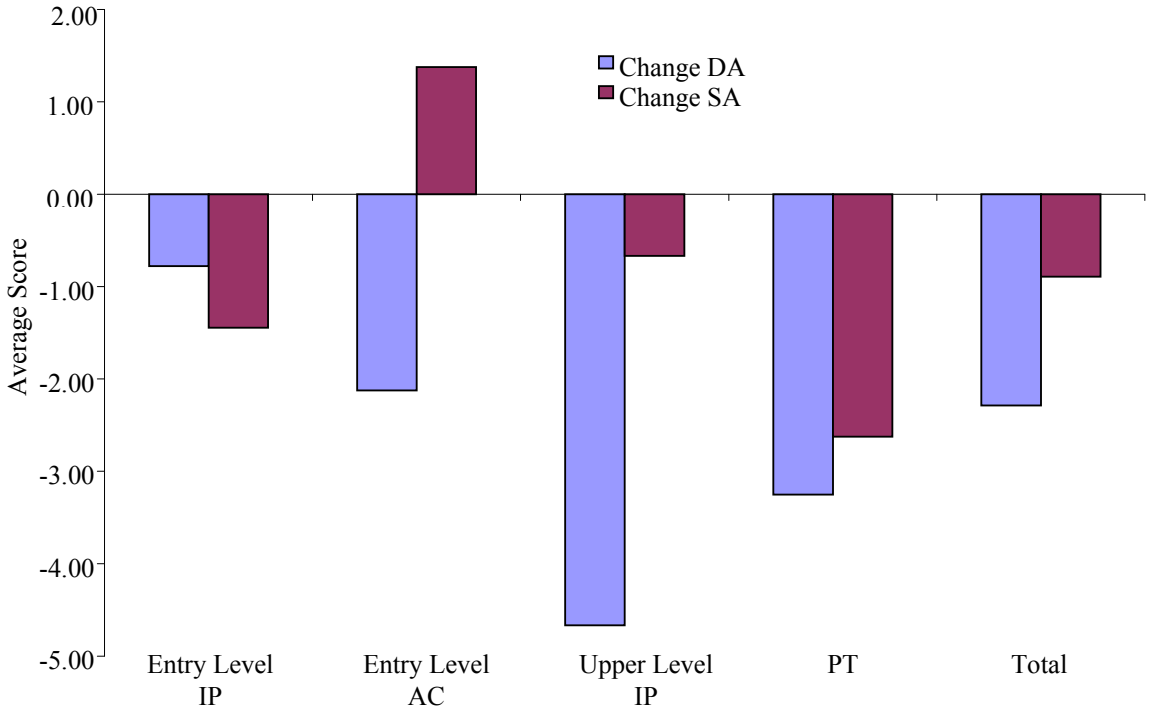

Figure 3. Average SPQ Change (SPQ final – SPQ initial) Scores by Course.

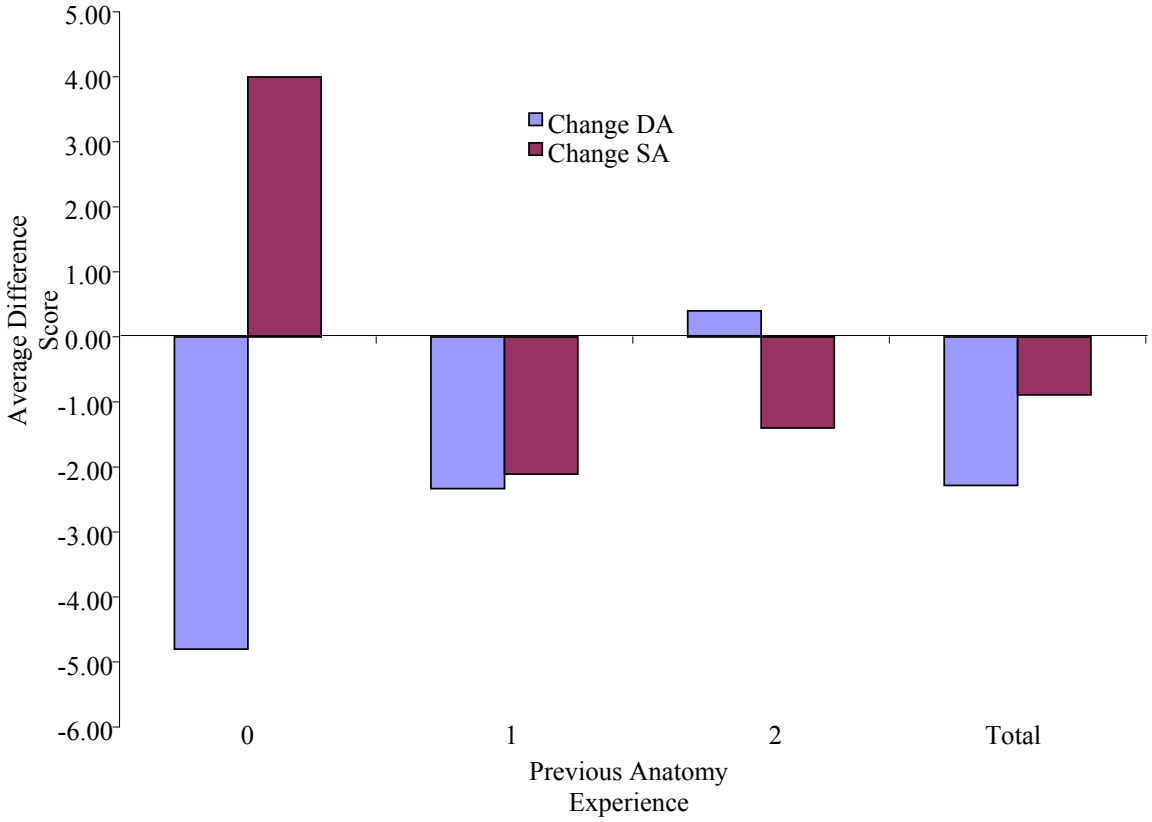

Figure 4. Average SPQ Change (SPQ final – SPQ initial) Scores by Previous Anatomy Experience.

Several statistical tests were conducted using the results from the initial and final SPQ questionnaire. Paired sample t-tests were conducted to determine if there were differences in scores from the initial to the final survey. The only significant difference was indicated to be between the Deep Meaning sub-scale score from the initial (16.89 ± 3.5) and final (15.46 ± 3.8), $t(27) = 2.115$, $p < .05$.

Two ANOVAs were initially planned to determine if there were any differences among the SPQ results between these two sets of groups (courses and experience). The first ANOVA was not conducted because there were only three students in the upper-level Integrative Physiology course who completed both the initial and final SPQ. When previous experience was used as the grouping variable, a significant difference was found

between the groups for the final SA score, $F(2, 25) = 3.632$, $p < .05$. A Tukey HSD follow-up test indicated that a significant difference was found between the final SA score for those having no prior experience in anatomy (mean SA = 27.80) and those having two previous anatomy courses (mean SA = 18.40), $p < .05$.

In summary, initial statistical tests determined that groups were initially similar except for a difference in GPAs for the entry-level Integrative Physiology course and the Physical Therapy course. Across the different courses, DA scores decreased as did SA scores, except for the entry-level Anatomy and Cell Biology course, which showed an increase in SA scores. When grouped by experience, DA scores decreased or remained relatively unchanged. The SA scores increased for those with no previous experience. The only statistically significant difference was found for the final SA score, with students having no previous experience achieving higher scores than students with two previous experiences.

Case Studies

For illustrative purposes, three cases were chosen from among the eleven participants who completed all parts of the study; the initial and final interviews and the initial and final surveys. These three were chosen based on how they approached learning in anatomy based on their reported SPQ scores. To represent the range of attitudes towards learning anatomy, one was chosen for scoring relatively high deep approach scores throughout the study and another for scoring relatively high surface approach scores compared to others that completed all parts of the study. A third was chosen as an intermediate, someone that scored relatively high on one side, either deep or surface approach, and relatively low on the other while having these ideas change as reported at the end of the study by his or her final SPQ score. All three examples were chosen based on comparisons of SPQ scores to all participants that completed all portions of the study. Demographic information for these three cases is presented in Table 8.

Table 8

Demographics for Selected Cases

Name[a]	Gender	Course	Age	GPA	Learning Approach
Mara	Female	Entry Level AC	22	3.10	Deep
John	Male	Upper Level IP	24	3.70	Surface and Deep
Pam	Female	PT	23	3.40	Deep to Surface/Deep

[a]Names are given as pseudonyms.

Case #1 – Mara

Mara is a 22 year old Caucasian woman majoring in Psychology. She reported earning an above average score of 25 on her ACT college admissions examination (the national average score in 2007 was 21.2 and was 21.1 in 2008), and Mara is hoping to apply to nursing school after graduation. She aspires to receive her Master's degree in nursing and eventually work in child psychiatry. She has two previous anatomy experiences including a high school course involving cat dissection and an animal biology course taken during her undergraduate experience. Mara enrolled in the entry level Anatomy and Cell Biology course because it is a pre-requisite for entrance into nursing school. Mara's initial score on the SPQ was a 37 for DA and 11 for SA, indicating that she is more inclined to utilize deep approaches for learning anatomy. Her initial SA score was the lowest out of all of the scores reported at the beginning of the study.

Mara initially had a difficult time describing what learning was, instead describing aspects of the outcomes of learning.

> What I said about being able to repeat things to self or to other people, know the material and how it relates to other pieces of material and relates to a profession you're interested in, or other people's professions, like being a doctor or nurse or physical therapist, how anatomy fits in to all those things, being aware of it I suppose, it's a hard question.
>
> (S57, SII,43)

However, she described the importance of working with someone that is more knowledgeable and being able to work with things directly. She then described her preferred methods for learning:

> Then I like to read it or try it myself, take notes on emphasized concepts, then read over and over. I write things down multiple times also.
>
> (S57, SIS, 6)

While this statement is a mixture of surface strategies (reading over and over) and deep strategies (trying it herself and emphasizing concepts), she described learning as more of a process and called learning "progressive" further into the interview. She emphasized the importance of building off of previous knowledge.

> …like with psych classes, I didn't understand a lot about psychology until I was done with all of the classes, because like with the intro classes you just touch the surface of things, then classes that are more specific, then you can really learn even then you haven't learned about the other ones. So a combination of all the classes makes me feel like I've learned a lot but there's always more to learn. … When I was in high school, I learned biology but didn't really learn a lot, I didn't care as much. It wasn't as important, it was important and I did well in school but...now it means a lot more to me, last semester I took biology and I did well, my understanding of the material was, it was stuff I had learned before but now I really knew it. I was more confident.
>
> (S57, SII, 46)

She echoed these statements when describing her goals for the anatomy course and how she knows that she has learned something.

> I hope to learn everything so it will benefit me if I get into the MSN program [Master of Science degree in Nursing], it will be helpful for a tool when I start taking more difficult classes, that I know this information really well. I hope to do really well.
>
> (S57, SII, 37)

> When I learn things, I think about them outside of class, apply them to everyday life, not talking to other people but thinking to myself, using terms in my mind, making connections with it in the class, to other classes that I'm taking or will take in the future. You don't really know until you move forward.
>
> (S57, SII, 40)

For learning anatomy in this course, Mara focused on the importance of lecture and the previous knowledge she carried with her into the course.

> I think I will learn a lot by going to the lecture. I've had it before and it's very interesting to me so I think it will be easy to stay involved. I want to get an A, so I'll be very dedicated.
>
> (S57, SIS, 9)

> [It's] largely a focus on lecture, the notebook is basically the lecture, what she talks about. So far the book, the first chapter, seems like she leaves out a lot that's in the book, I'll continue reading because I like to know more and I think you get a better understanding if you know more of the subject that you're studying. I'm really interested in anatomy and looking forward to it and I don't foresee it being really difficult. I know she said to forget any high school anatomy you've had, but I find it hard to believe it won't be a little like that, more involved obviously but I'm excited.
>
> (S57, SII, 21)

After taking the anatomy course, Mara's DA score increased to 41, the highest for the group participating in all aspects of the study, and her SA score increased to 14, the lowest score for this group. She was asked to explain her definition of learning during the final interview by describing further about the process of learning. She described that learning was about "making connections in your mind, that's where learning is stored" (S57, SFI, 62). Mara spoke several times about memorization or repetition, so she was asked if learning was dependent on the ability to memorize.

> Not your ability, just that you do it [memorize]. Everyone can, its just the time you put into it, and the attention, attending to what's important. The ability, personal ability to weed out what's important and what's not, weed things out on your own. Repetition to make those connections.
>
> (S57, SFI, 53)

Mara was asked to describe the resources that she would primarily use to learn anatomy. In both the survey and the interview, she focused on the textbook and attending

lecture. She also expressed that the instructor made the learning environment more "real" for her.

> Being relaxed, made it easier to connect with students, not boring, she offered help. While she cusses sometimes, I don't mind, it makes things real. She emphasizes things that are important to know, goes over quickly what she went over in the lecture before.
>
> (S57, SFI, 8)

Mara compared the amount of time that she spent studying for this class with other classes that she has taken.

> [Anatomy was] more because I cared more, I wanted to do well and I was interested. I would put time in before class but didn't mind doing it, reading is the biggest thing because I hate reading but it's not that big a deal because the chapters are good. I would do homework at work, option is to stare at wall, so I do my homework, spent more time and wanted to be more dedicated.
>
> (S57, SFI, 35)

Her interest in the class as a comparison to other classes was also referred to in her survey response to comparing how she learned between this anatomy class and other classes.

> Sometimes-memorization has to occur in all learning. It was one of the more interesting subjects I've taken, so maybe that helped me learn faster.
>
> (S57, SFS, 12)

When asked how she would describe this class to others, Mara gave a very general answer in both instances. She did not focus on either content or relationships and plainly indicated that it was about learning "the human body."

Case #2 – John

John is a 24 year old Caucasian male majoring in Integrative Physiology. He was enrolled in the upper level Integrative Physiology anatomy lecture course and an anatomy laboratory course concurrently. At his time of enrollment, both of these courses were required by the Integrative Physiology program, although the courses were not required to be taken together.

John reported having a 3.7 GPA in his undergraduate work and was hoping to go to physical therapy school after graduation. He sees this course equally as preparation for physical therapy school and for his major requirements. His previous anatomy experience was very limited as he recalls that his only exposure to anatomy was in other science classes.

> I've never taken a course specifically in anatomy. I've taken physiology courses, neuro-biology, as you go through there's always a part where you have to learn anatomy of a specific system. When you're studying, you run into the anatomy portion but I've never taken a course entirely dedicated to it.
>
> (S67, SII, 25)

John's SA score was the highest of the group that completed all parts of the study at 29 although his DA score was also 29. His initial ideas about learning anatomy focused on memorization, although he explained that is not his preference. When he was asked about how difficult he thought the class would be, he replied:

> Pretty difficult, I don't like memorization, I can do it, but it's not my strong point. It takes me a lot longer to learn things, it's easier if I can learn a general concept I can understand and work down from there. Anatomy will be 'this is this tissue and this is what it's called and here's where it is' and unless I spend a couple of semesters studying Greek and Latin, it's going to be hard to apply understanding to.
>
> (S67, SII, 31)

When defining learning, John talked about repetition although that is not his entire focus when learning.

> I prefer repetition with time in between trials to reflect. This way I know what needs to be worked on, and it is more than simple memorization.
>
> (S67, SIS, 6)

> You take new information and get to the point where you can recall it on command when needed, hopefully over the course of a good period of time, because I don't think, if you sit down and look at vocabulary for a foreign language and can write out in 15 minutes, then if you can't say it a few days later, it's kind of useless. That's not learning, learning has a long term aspect.
>
> (S67, SII, 73)

However, John felt that learning anatomy is more about memorization than learning in other situations.

> I think it will be a lot of memorization and study through repetition. I'm going to try to have things tied together with big themes because I learn better that way but when it comes to it I'm just going to have to spend time memorizing.
>
> (S67, SII, 58)

When John was asked to compare how he thought he would learn anatomy to learning in other courses he stated:

> Different from most classes, in most classes I will try to nail down the main or broad concepts. After that I work into certain details I think will be important or I think I should know. That's different because I see anatomy as being more bulk information, some overall themes, but at the same time it's a lot of memorization. Not as many general concepts to latch on to.
>
> (S67, SII, 70)

John's post-anatomy course scores on the SPQ indicated a decrease in DA score to 24 and an unchanged SA score at 29. His SA score was the highest for all of those participating in all aspects of the study. John felt that learning anatomy required him to memorize more than usual but was thankful for being able to practice his memorization skills. He was asked why he thought the course was difficult:

> Just memorization, not good at memorizing. This class helped me with memorizing. Different techniques, taking notes, making study sheet, by the time I did that amount I knew it, it was impressive, polish it with study. I used to just look and quiz in my head without writing and that never worked that well. Needed to go the extra mile, say it out loud, write, type, see pictures, match pictures.
>
> (S67, SFI, 30)

> I do not enjoy memorizing large chunks of information. Although anatomy has more rhyme and reason to it than I initially thought, there is still a lot of information that you just need to memorize.
>
> (S67, SFS, 4)

John acknowledges in the interview that memorization was the real drive to his approach to learning in this class thanks in part to how he thought he would be successful in the course.

> The success rate was biggest influence. I came into the course knowing I'm not great at memorizing. Knew I would have to spend an ungodly amount of time or come up with a new method that worked better for me. So since my time was limited this semester, I want to find a new way that works better and in the long run can help me improve learning in the future. So that's what influenced how I study.
>
> (S67, SFI, 48)

John's approach to studying for the class centered on repetition and using multiple sources for studying the content.

> Taking extra notes, for large memorization parts, all muscles and functions, innervation, went through book, wrote down muscle, function, location, innervation, then typed the information into a spreadsheet, anything that needed extra work. For some things I could just go over notes, to refresh my memory but for tests, would go over, rewrite, type.
>
> (S67, SFI, 10)

When asked about what he liked about the course, he mentions things in lecture that gave him a variety of resources, particularly visuals that helped him learn the material.

> I liked that there were lots of pictures and diagrams to accompany the lectures. Visual aids make the lecture easier to follow and helps me to learn the subject matter easier.
>
> (S67, SFS, 3)

> Like how both [the professors] used a lot of pictures to go with lecture. The more ways to introduce things to yourself, better you remember, look at pics, read, hear, helps make it stick. On top of that I like the class design, flows well, body broken down into systems, in any one part of body there are several systems at work. If you go through, you get it step by step instead of throwing all at once.
>
> (S67, SFI, 7)

John compared how he learned anatomy as similar to how he learned in other courses with the exception that the anatomy course required a greater quantity of his studying efforts.

> Many of the tactics used above are things I do in all courses. The difference is that I never used to make study sheets or flash cards. I rarely found them necessary, but in this class they were immensely helpful.
>
> (S67, SFS, 12)

> Approach differently, most classes will go to lecture, take notes, read book go over notes again, re- read certain part of chapter, feel ready for test. This one I had to take extra notes, make myself study sheets, which I don't usually have to do. Spend more time, self quizzing or have other people quiz me, this is a little different, a lot more detail, make sure I've nailed down the details.
>
> (S67, SFI, 24)

Despite John initially mentioning how the body is well coordinated, his response to how he would tell a friend about this course focused on some of the basic content presented in the course.

> I would tell them it goes into a pretty decent amount of detail. The structure of human body, learn names and general function as you go along, whereas anatomy naming structures, detailed, the physiology is general. You break down which vessels go where, circulatory system circulates blood, not all detail, but aorta, arteries, arterials etc. That's a lot of what the class is.
>
> (S67, SFI, 45)

Case #3 – Pam

Pam is a 23 year old female in her first year of the Doctor of Physical Therapy program. She received her undergraduate degree from the same university in the Integrative Physiology department. She reported her undergraduate GPA as being 3.4 and achieved a 21 on her ACT examination. When she finishes her graduate degree she aspires to be a physical therapist in either an orthopedic outpatient clinic or a sports physical therapy clinic. Her previous anatomy experience was comprised of the courses she took as requirements for her Integrative Physiology degree, including the lecture and laboratory requirements. Although the course was a requirement for her, she stated that she is quite interested in the subject matter.

Pam's approach to learning as indicated by her SPQ results leans toward the DA side. Her initial DA score was 30 and her SA score was 18, tied for the second lowest SA score for the group of participants completing all parts of the study. Her ideas on learning tended to focus more on conceptual understanding than on content mastery.

> Understand the concepts and apply them. So, not just like regurgitate the information back that the professor gives you. Apply to different situation so if you learn something you can apply to unfamiliar situation by applying principles

> that you've learned. If you could teach it to someone else it would mean you've learned it.
>
> (S43, SII, 35)

Her preferred learning methods were simply stated as "hands-on" in her initial survey but she did expand on that in during the initial interview.

> For me, my perfect environment, I could go and have lecture be familiar, do some reading beforehand then apply it hands on and actually see the structures, after I already know the names of them, know where to expect, where to find the structures, we have to do that all at once.
>
> (S43, SII, 44)

Pam's experiences in undergraduate study appear to have been varied and she explains that she needs to adapt to the different learning situations.

> I'm always adapting to each class. I guess in undergrad, I have to base it in that; I've only had a few weeks of grad school. I would try to study my lecture notes. If they talked about it in class it was really important, go to the reading to clarify things. Most classes for my major were based mostly in notes and explained well enough so you wouldn't have to go to the reading. I would write things I thought were important, highlight things, verbalize things, talk with other people, memory too. Not all classes like that, sometimes you do have to do readings, test things not from lecture. I struggle with those courses; it's harder to pick out important information
>
> (S43, SII, 59)

For learning in anatomy, Pam hoped to go beyond the focus to detail that she experienced in her undergraduate courses.

> Hoping geared more toward the muscular and skeletal system, so far it has been. It will be most relevant for clinical purposes, later on. I'm hoping having lab component will be more hands on learning as opposed to lecturing and telling about it. I learn best by also being able to have something hands on to remember it.
>
> (S43, SII, 17)

> In that class [undergraduate anatomy] it was more focused, getting down the names of everything. It was so unfamiliar to me, I didn't have time to think what each muscle does, different actions, I was so focused on getting the information like origins, insertions, what the actual muscle is, the location. Hopefully the second time will have more time to think about the clinical applications.
>
> (S43, SII, 38)

However, when asked how she will study for this class, Pam describes that repetition and memorization will be her main methods of learning.

> Repetition, a lot of it will be memorizing where the muscles are, insertion, repeating that, several ways, verbalizing, writing it down, identifying structures in lab, by touching all those areas it will stick.
>
> (S43, SII, 62)

Pam's final SPQ scores showed the largest decrease in her DA score, dropping nine points to 21 and the lowest of all the students participating in all parts of the study, and the was tied for the largest increase in SA score, rising five points to 23. Pam was asked how she learned in this class:

> Repetition of things. Thinking about learning the sympathetic chain ganglia, had three times, when I heard it the third time, it sunk in, so having repetition.
>
> (S43, SFI, 16)

> Having the lab. Also just repetition of material, throughout the semester and within lectures.
>
> (S43, SFS, 3)

Pam's use of resources for learning anatomy was also varied.

> Class notes*** [her emphasis], grants atlas, clinical anatomy book, undergrad anatomy books, also she created a list of questions to ponder which was just another way of studying some of the material.
>
> (S43, SFS, 10)

When Pam compared learning anatomy to learning in other classes, her response focused on using alternatives to reading.

> Do more reading for other classes, but it's the nature of anatomy, a lot of memorization, doing the notecards and that sort of stuff. Reproducing diagrams, know I can do myself. Feel like there's more conceptual ideas, need to read about and understand, will be tested on. Like putting puzzle pieces together. In anatomy can't do that as much.
>
> (S43, SFI, 36)

Pam described the importance of using what she learned in anatomy in her other courses.

> … each week in kinesiology, the focus questions we worked on, if I had just had kinesiology and no anatomy, I wouldn't be able to answer the questions. Have to know what muscles, where, what it was about, more clinical application.
>
> (S43, SFI, 66)

When Pam talked about how she would describe this course to a friend, she elaborated more than the other cases and had more of a focus on the relationships among systems.

> Would say for our anatomy class, heavily focused on muscle, skeletal, nervous system, small portion on heart and lungs, so a lot was being able to figure out type of action the muscle produced, knowing where located, how tied into nervous system, where coming from, going along with that, focused on bones, landmarks, where muscles attach, so ours focused on muscular skeletal system, what we were mainly concerned with.
>
> (S43, SFI, 69)

Summary

This chapter has presented the results of the study gathered from both qualitative and quantitative data. Qualitative data indicated that students thought that repetition and memorization were the keys to learning anatomy. Many students also viewed this as the key to learning in general, although many others indicated that they preferred more active activities than repetitive, passive ones. Additionally, students had difficulty defining learning and often thought that learning was the acquisition of knowledge. When describing perceptions of the course, most students indicated the importance of the content of the course over the conceptual understanding behind the content. Three case studies were also presented to highlight students who had a relatively high deep approach to learning anatomy, students who utilized a surface approach, and students that had to adapt from their desired deep approach to a surface approach.

Quantitative data was gathered from the results of the SPQ given with the initial and final survey. Groups based on enrolled course and previous anatomy experiences were very similar, although students with no previous experience scored higher on the final surface approach score than did students with two previous anatomy experiences. Most surface and deep approach scores declined on average, with the exception of

students reporting no previous anatomy experiences and students in the entry level Anatomy and Cell Biology course. Both groups scored higher on their final surface approach score than the initial surface approach score.

CHAPTER 5: DISCUSSION

The discussion section begins by providing some brief answers to the research questions that were asked at the beginning of the study. The second part of the section discusses the results of both the qualitative data and the quantitative data in order to explain the themes that evolved from the data. Following this discussion is a conversation about the implications of these findings. This section concludes by identifying limitations to this study and possible research plans that may address some of the limitations and unanswered questions.

Answers to Research Questions

Research Question 1

The first research question asked "What are the different types of ideas students have about learning anatomy and how do these compare to their ideas about learning in general?" A sub-question was also asked, "How do these ideas about learning anatomy change from the beginning to the end of an anatomy course?" Although students had varied views of learning anatomy, over half of participants (52% for initial interviewees, 54% for those initially surveyed) indicated that they believed anatomy would be learned by memorization techniques through repetition. Only one of the interviewed students expressed the idea that learning anatomy meant focusing on the relationships that occur within the human body. As seen in the results of the Study Process Questionnaire, student approaches to learning anatomy, whether initially deep or surface, had a tendency to decrease. This may appear to be contrary to what students described in the interviews as they had mentioned more memorization was required to learn anatomy and one would think that surface approach scores would increase as well. The survey results indicate that students did not focus on deeper meaning or understanding throughout the course, but they also did not feel the need to approach the learning process as superficially as they thought. The exception to this was the students who had no previous experience

with anatomy courses; this group had a decrease in deep approach and an increase in surface approach. When comparing these views about learning anatomy to views about learning in general, many students preferred learning by gaining experience through hands-on means (60% of surveyed) or by working with an experienced individual (36% of surveyed, 70% of interviewed). However, the interviewed students primarily viewed learning as acquiring knowledge (78%) and would thus echo the thought of needing to memorize information. Few students saw learning as an ongoing process (one interviewed student) or as being about changing one's ideas through learning (17% of interviewed) than about acquiring knowledge.

Research Question 2

The second research question asked "How does the student's perception of the anatomy class relate to the idea of learning anatomy?" Many of the students viewed the anatomy course as an exercise in memorization and thought that they would be required to know many names of structures and anatomical terminology in order to be successful in their courses (74% of those interviewed). This meant that students had to devote much time, and in some cases more time than usual (22% of those interviewed), to their studying for the course. When comparing the perception of learning anatomy to learning in other courses, most students seemed to believe that the anatomy course was more content driven than other courses and thus required a memorizing and repetition approach to learning (75% of those interviewed indicating the same or more memorization than other courses). Fewer students at the end of the course (35% of those interviewed) identified the importance of the relationships found within anatomy than at the beginning of the course (45% of those interviewed). Although many students did see the value of learning about themselves as human beings, the tendency of the students was a decrease in attempts to go beyond the superficial to gain deeper understanding (2 point average decrease in deep approach score for surveyed students).

Discussion

The data analyzed for this research can be interpreted in diverse ways; however the focus of this discussion is to highlight the students' ideas about learning and how these ideas related to their ideas about learning anatomy and their perceptions of the anatomy course. There are several major themes that will be discussed: the approach that students thought they would use to learn anatomy and the approach that they reported using, the relation of experience to learning approach, and how students perceive learning in different aspects of life. Finally, a summary of these discussion points will be made pertaining to how these reflections relate to each other.

One of the biggest findings from this research study is the idea that students who believed anatomy should be studied with a surface approach discovered that this idea was usually supported by their perception of the course as it progressed. The surface approach to learning focuses on learning only the content and so students utilize strategies focused on rote memorization such as reading a text multiple times, rewriting notes, and constructing flashcards and memory cues. With a deep approach to learning, more emphasis is made on understanding the meaning behind the content. This approach is driven by an intrinsic interest, and students will often use learning strategies that are more engaging and cognitive in nature, such as group discussions, writing reflections, designing and conducting experiments, and metacognition.

Students in this research study generally entered their anatomy classes thinking that memorization was the key to learning anatomy, perceived throughout the course that they needed to memorize to learn anatomy, and thus exited the course with the understanding that anatomy was primarily about the content or knowing all of the structures and anatomical terminology that was presented. This appears to support their earlier ideas about memorization as being the key to learning anatomy. John's case study was highly typical of this; although he generally had cognitive views of learning, he

believed that he would have to memorize to learn anatomy and this is what he reported doing at the end of the course.

Because of the surface approach that many of these students utilized in learning anatomy, they often sought passive means to study which epitomizes the surface approach to learning. Many students reported using methods of studying that called for little direct critical thinking, such as reading textbooks and other references, attending lecture, and studying their own notes or the course provided notes. They felt that this was the way they were supposed to learn anatomy and thus utilized surface approaches to learn as seen in this quotation from Pam's case study:

> …but it's the nature of anatomy, a lot of memorization, doing the note cards and that sort of stuff.
>
> (S43, SFI, 36)

This does not mean that students only approached the learning of anatomy with a passive mind; however, very few students identified the need to think about the material outside of the memorization methods that many employed and few identified the importance of the concepts behind the factual content of the course. Some students did identify the importance of social learning with classmates and others responded favorably to discussion questions, but these students were a small minority.

Much of the previous research conducted on student approaches to learning has focused on one specific time point, either at the beginning or the end of a particular course. Some recent studies have attempted to determine if changes in approaches to learning can happen at the individual course level (Case & Gunstone, 2002; Cope & Staehr, 2005; Reid et al., 2005). Studies covering a single course timeframe experienced little changes to approach scores even in the courses designed to promote a deeper approach (Case & Gunstone, 2002; Reid et al., 2005). In a study by Cope and Staehr (2005), a course in information systems was continuously modified in order to elicit deeper approaches to learning. Significant results were only seen after five years of

annual adjustments to the course, and even then, the authors indicate that significant results were achieved by decreasing the workload which allowed students to focus on applying deep learning approaches.

While these research studies have tried to increase deep approaches to learning through instruction, the current study sought to examine changes in learning approach without an instructional intervention. This is significant in that it shows that the type of learning environment supports students whose approaches to learning match the class, and does not support students in changing their approach to learning, especially when only surveying and interviewing the students over a single semester. The courses used in this study were predominantly teacher-centered and focused on having students remember factual information, which would have supported surface approaches to learning. In the previous studies, the environment was designed to elicit change towards deep approaches, although it was a long and resource-heavy process to continuously adapt the course being studied. For the classes studied in this research study, the learning environment was more conducive to the surface approach to learning and thus there was no drive for students to move towards a deeper approach, although this may be what instructors desire. It appeared that students who already possessed a cognitive idea of learning had to adapt to utilize more surface approaches in order to succeed in their anatomy class as exemplified by Pam's case study. Pam possessed cognitive ideas of learning in general but had to adapt as she perceived the anatomy course to require surface approaches to learning. These results would suggest that if instructors desire students to approach the material in a deeper and more meaning-oriented manner, then the environment must be set up for this change to occur. Without that, the students will be faced with the decision to adapt their approach to learning to coincide with the environment or else risk their chance of being successful in the class.

Another important aspect of the students' ideas about learning anatomy is the relation of experience to the use of surface approaches for learning. In this study,

students without any reported experience in anatomy saw an average increase in surface approach scores of four points and an average decrease in deep approach scores of over four and a half points. Students reporting one or two previous experiences saw only an average decrease in surface approach scores. This would imply that students who do not have experience in anatomy have their perceptions shaped more by the initial experience towards a surface approach to learning in the course. Students with prior experience may tend to know what to expect and thus smaller changes in their approaches to learning occurred for these students. One may expect to see increases in deep approaches as these students may already have a strong base of prior knowledge of the subject and show a subsequent decrease in surface approach. This appeared not to be the case for these groups of students, as there was a minimal change to deep approaches by any of the experienced groups. It may be that the need to rely on more cognitive processes (e.g. deep approaches) either did not occur or was not supported in these particular anatomy classes. Again, these ideas support the need for the instructors to set up the environment towards a more cognitive and student-centered experience that move away from memorizing factual information and towards conceptual understanding. If it is desirable to have students seek deeper meanings of the subject matter, then instructors must shape these ideas early and throughout the entirety of the class by aligning their teaching approach with the desired deep learning approach.

The results of the current research study with respect to these ideas about students' approaches to learning tend to both confirm and conflict with some previous research. Several authors have indicated that undergraduate students increase their surface approach while decreasing their deep approach to learning throughout their education (Biggs et al., 2001; Kreber, 2003). These ideas are debated in a review by Richardson (1994b) who indicated that other studies show an increase in deep approaches to learning by older students, particularly a study by Harper and Kember (1986). However, the current study did not reflect the idea of older students utilizing a deeper

approach to learning. Students in the physical therapy anatomy class (who are generally older) did have the lowest final surface approach score of all of the groups but had essentially the same deep approach score as both of the entry level classes. The more telling indicator of changes in approach scores was the factor of previous experience, and only for the surface approaches.

The idea of experience, while potentially meaningful for decreasing surface approaches, may not have much of an effect on increasing deep approaches. In this research study, the environment appeared to support the surface learning approach and thus students either fit right in with their ideas about learning or had to adapt to a more surface approach in order to learn anatomy. Even though some authors have indicated that learning approach moves towards deep approaches with experience (Harper & Kember, 1986; Richardson, 1994b), this may be due to the fact that as undergraduate students progress in their fields of study, they move away from large lecture foundational courses and begin to take more specialized courses that are focused on conceptual understanding and utilizing cognitive learning strategies. However, anatomy is usually seen as a foundational course (Cottam, 1999; Dahle et al., 2002; Drake, 2002; Drake et al., 2002; McLachlan et al., 2004) no matter when it is taught in a curriculum. This lends more support to the idea that the environment has more influence on the students' approaches to learning than experience.

Another theme that was apparent, especially in the qualitative data, was the idea that students perceive anatomy learning as different from other types of learning. While students' approaches to learning are highly contextualized by several factors including the learning environment and previous experience (Biggs, 1987b), students in this study seem to believe that learning is a distinct entity in different situations as shown in this quote by a student describing differences in learning among academic classes:

> With other [classes], if you understand, you can conceptualize on a test and get answer. If you don't memorize for this one and it's on the test, you won't know the answer.
>
> (S54, SFI, 37)

Additionally, some students expressed the idea that there are different levels to learning or that there is good and bad learning. Perhaps they were influenced by the structure and pattern of the interview questions, but students' responses to their preferred ways of learning and how they thought they would learn anatomy were often very different. Many students in the survey expressed a preference towards hands-on learning in an ideal situation but indicated that they thought they would be utilizing repetitive passive methods to learn anatomy such as attending lecture, reading textbooks and taking notes. Interviewed students were more apt to identify the need to utilize repetition and memorization in their general ideas of learning.

This contradiction between ideal learning approach and learning approach in anatomy may offer some insight into the difficulties that students have with the idea of learning. Students may never have been asked to think about what learning is and so formulate the idea based on their previous academic experiences. If these experiences are mainly teacher-centered in nature, then the students would probably form ideas based on rote memorization and passive learning activities. Learning experiences outside of the academic environment are often viewed as fun and effortless, something that may be considered somewhat rare in school unless students are taking courses in which they have a particular interest. This would lead to the disconnect in students' responses in preferred ways of learning and how they learn in academic settings as they see these environments as being separate and perhaps incompatible.

The other issue with this is the difference between the idea of learning as a process and the idea of learning as a product. Students with difficulty defining learning tended to relate ideas based on acquisition of knowledge, in that learning was the gaining of something tangible. Again, this may be because of their previous experiences in which

students are a part of teacher-centered environments. The teacher is seen as the holder of the information, and it is the job of the students to acquire the information. These ideas of learning lead to the student viewing knowledge as a tangible item and learning results in positive extrinsic rewards such as grades. The researcher would suggest that learning outside of the academic setting is seen as more of a process because of the intrinsic interest that drives the learning process. Students want to learn because they are interested in something and want to become experts in a particular field, whether it is a basic subject such as biology or math, or a hobby such as a personal collection or sporting activity. This means that in order to drive deeper approaches to learning, instructors need to realize that the environment that is set must attempt to drive the intrinsic interest of students, and thus conceptual understanding of the content, rather than drive external interests where the focus is predominantly on memorizing content.

One of the similarities across different learning theories is that the process of learning is seen as the same, no matter what the context. The process of learning does not change from situation to situation nor does it vary from person to person, although the way one approaches learning may be different. A person who believes the behaviorist theory of learning understands that all people learn in accordance with behaviorist theory in all situations that are experienced or else the experience would not be labeled as learning. The rationale for the students' thinking in this study may be that they do not see academic learning as being the same as learning in other areas. Ideal learning situations are seen when learning a hobby or pursuing some outside interests, while academic situations are seen more in a competitive light or as preparatory for future endeavors.

In order to examine how these ideas relate to each other, a pathway was constructed to illustrate the relationships between student ideas about learning, ideas about learning anatomy, and perceptions of the anatomy learning environment. Figure 5 depicts a flow chart of these ideas and how they are thought to proceed in this group of students.

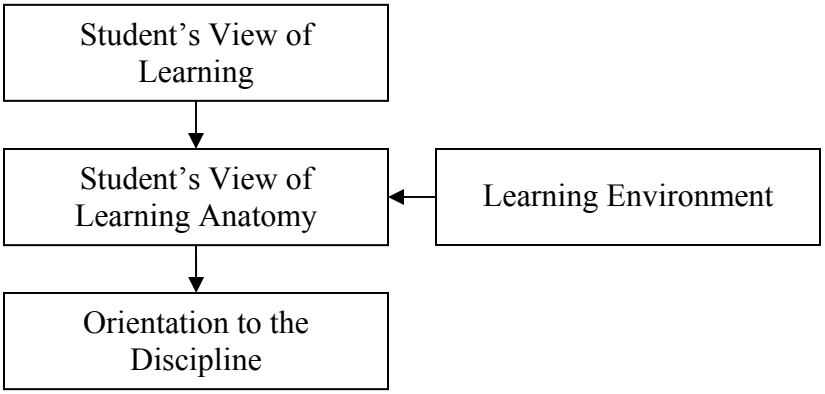

Figure 5. Proposed General pathway of student perception of learning anatomy and orientation to the anatomy discipline.

For students coming into the anatomy class with teacher-centered ideas of learning, the results of this research indicate a tendency to view learning anatomy in a similar way. Students expect the need to memorize information and utilize passive learning strategies in order to master the content of the course. The learning environment in the particular courses that were studied appears to highlight or even amplify these ideas for the students, reinforcing the supposed need of the student to memorize the content presented the course. This in turn may lead to a student having a reinforced notion of the discipline as being predominantly content oriented and thus may see anatomy as nothing more than labels and terminology.

However this pattern is not evident for students who enter the anatomy course with a more cognitive view of learning. Even though these students may have a more student-centered view of learning in general, they may or may not see learning anatomy as being centered on the student. This may not matter as their views of learning in general do not appear to be supported in the environments that experienced while

enrolled in this study. Therefore a student who believes that anatomy is a more cognitive learning endeavor may need to adapt to use more surface approaches to learn the material when the environment is more suited to teacher-centered ideas. Students who have cognitive views of learning but perceive learning anatomy as more content-oriented may follow the pattern described for students having surface views of learning but the data from this research study do not necessarily support this idea.

Implications

The biggest implication for this study is the finding that many of the students enter an anatomy class believing that the class is predominantly content driven and thus that it requires memorizing processes in order to learn. Even when students have more cognitively centered ideas for learning, they think of anatomy as being more about lists of names and terminology than about conceptual and relational understanding. Even when students have multiple experiences in anatomy, they still have a tendency to utilize surface approaches for learning instead of attempting to achieve a deeper understanding of the ideas presented in the course. These thoughts raise some large issues about the instruction of anatomy in the current context.

First is the idea that traditional classes have a tendency to support or amplify the idea of needing to memorize the content to learn anatomy, even though instructors may indicate that they do not want students to memorize. Delivery of content may need to move away from a focus of identification of specific structures individually and move towards identifying structures in relation to one another. Instructors could utilize case studies and clinical applications focused on anatomical structures in order to get the students to think more about the body as a whole and not as individual structures and terminology.

While traditional teachers and possibly clinicians may argue that anatomy is about names and terminology, they should understand that our future health professionals need

to be able to think about the problems they will face during their careers in relation to the anatomy and not solely worry about identification. Even for students not wishing to pursue a health career, knowledge about how the body's structure is full of relationships may be more useful for these individuals than being able to pick out separate facts and names. It is important that the students learn names or structures and use proper terminology for communication of their ideas, but these things can be done in a student-centered environment without ignoring the importance of learning the language of anatomy.

It is important to note that much of the research in anatomy education, and in general medical education, does little to align with a particular learning theory. Problem-based learning, although not a new instructional method, does attempt to make that bridge in that its development is structured around a learning theory and not just around medical curriculum (Barrows & Tamblyn, 1980). It appears that much of the focus on anatomy and medical education is on the content and how best to deliver it to the students. It should be noted that based on some of the results in this research study, research exploring methods of aligning the practice of teaching with the desired learning outcomes could be potential fruitful, especially when based on a particular learning theory.

Many students, especially in the survey, indicated that they have a preference for hands-on learning, and instructors should be knowledgeable about how to incorporate more hands-on activities for their students. While some of the students included in this study were concurrently enrolled in dissection laboratories, not all courses have the resources to make dissection available to their students. Strictly lecturing to the students about anatomy can only reinforce the idea that anatomy is about the factual content and thus support the need for memorization to learn anatomy. Instructors should attempt to bring alternative modes of instruction to the classroom such as small group discussion, case-based scenarios, and individual or group projects with class presentations. As many

of the students in this research study indicated, there is a preference for hands on activities and exploring the real-life implications of the subject matter than they are attempting to learn. These activities can help get students out of the realm of being passive recipients of knowledge and into a more active mode of learning where they are at the center of the learning environment.

Limitations

This research study does have several limitations that need to be addressed and discussed. The first is the issue of bias in the data, as both qualitative and quantitative data were used for analysis. With mixed methods research, potential biases can compound as the data are analyzed together. In this project, the researcher presented the data as the perceptions of students. This is limited as we cannot know exactly what the students are thinking but only report how the students have verbalized their thoughts to the researcher. Analyses was made by the researcher using the current data but is slanted by the researchers biases, both known and unknown. This would include the researcher's understanding of learning to be based on Constructivism theory and the researcher's own use of student-centered teaching techniques. The researcher attempted to triangulate the data by utilizing different ways to ask the same questions (interview and survey), follow up with students to ask for clarification, and work with other researchers to discuss ideas and patterns that emerged from the data.

Another limitation was the relatively low number of students who participated in the survey portion of the study. The percentage of participants for the questionnaire was very low, less than 15% of total class enrollment, and there was a large decline of survey respondents from initial to final survey. The low response rate also made it difficult to calculate reliability measures such as using factor analysis with the SPQ data in order to determine if the factors in this study were comparable to the questionnaire's intended factors. Cronbach's alpha was calculated for the initial data set and the given factors

were deemed acceptable although the surface approach factor fell just below traditional cutoffs (α=.70). Additionally, students who had cognitive views of learning appeared to have a more strategic approach to learning and thus a different questionnaire instrument may have been appropriate. The original Study Process Questionnaire (Entwistle & Ramsden, 1982; Ramsden & Entwistle, 1981) (the questionnaire used in the study was a revision of this) or the Approaches to Studying Inventory (General Medical Council, 1993) may have been more suitable as they included a third category known as "Achieving" or "Strategic" in which the student attempts to maximize grades through organization and effective use of time. However, one may argue that this third category does in fact exemplify a surface approach as students still tend to focus on the content rather than attempt to maximize meaning.

For the interview data, major limitations would not be with the number of respondents as 23 students were determined to be plentiful for this study. There are several limitations to the interview portion with the first occurring because of the types of students who volunteered to participate in this study. The researcher recognizes that there is no evidence to indicate that the sample used in the interviews was a representative sample of the class. However, generalization is not permissible in qualitative research and the researcher has attempted to indicate that the results presented are the views of the students that participated in the research study and not of the entire class. In order to get a more representative sample, the researcher may have attempted to utilize focus groups, or increased the number of interviewees. Both of these methods would have been difficult as the focus groups would have required a number of students to volunteer who had a similar schedule for group interviews. Increasing the number of participants in the interviews may not have been possible either as the researcher has limited resources for the interview process and increasing the number of participants also increases the potential for data saturation (a condition where no new ideas become

apparent despite increasing sample numbers), which the researcher believed he had reached.

Another important limitation was the timing of the interviews, especially the initial interview. The researcher attempted to begin the interviews before the anatomy class had met; however, this was difficult as many students were not available for an interview prior to the beginning of the semester and some had not volunteered until after the class had an initial meeting. This adds a word of caution to the results as students began to have their perceptions shaped by their first scheduled meeting. The researcher attempted to minimize this by trying to get students to reflect on their ideas before they had any class experiences but acknowledges that identifying a perception before it has been shaped would have been difficult for the students, especially if the anatomy class was a relatively unique experience for them. The decision was made to finish the initial interviews prior to the first examinations, as it was felt that the examination experience would have solidified or drastically changed the student's perception of the course based on how the student performed.

Finally, the interviews may be a potential limiter of the findings as is apparent with some of the struggles the participants in this study had with some of the questions, especially when asked to define learning. The researcher reiterated the questions but there were still some aspects that some of the interviewees did not understand. Additionally, there were issues with student meaning when analyzing interview results. The researcher attempted to get clarification during the final interview or by contacting the student after the semester but met with limited success in gathering additional responses.

Future Directions

While the results of this study have shed some light on the subject of student ideas about learning anatomy, there must be more done to uncover some of the factors that

influence these perceptions. Future directions include gathering data from high school students and practicing clinicians and educators from a variety of settings, as well as preparing and implementing curriculum and teaching interventions aimed at introduced a more student-centered environment in the anatomy classroom.

Future data collection focused on high school students taking anatomy courses would allow the researcher to identify student ideas regarding formal anatomy classes at the beginning. While not all high schools offer a stand-alone anatomy course, many of the students in this study identified an individual anatomy course or biology course with an emphasis in anatomy as their first experience with anatomy education. A study that examines the students' ideas and perceptions about learning anatomy before and after their first experience would show some of the initial factors that influence how these students perceive the subject early on. This can help identify how an initial experience shapes the ideas that students have about learning anatomy even before they begin career training in college.

Talking with clinicians and educators about their ideas regarding how they learned anatomy would also be beneficial in that these individuals often set the stage for how anatomy is taught in higher education. This would allow access into the thinking of how and why anatomy education is the way it is at and provide a framework for where anatomy education can progress in the future. These ideas about anatomy learning will also be an important platform to compare student ideas regarding learning anatomy in an effort to make some headway into resolving any differences that may be present between student and professional ideas about anatomy.

Finally, while being able to describe ideas about learning anatomy may be beneficial; there is a need to progress anatomy education and teaching to a level that is beyond the traditional aspects that many people currently expect. With drives to move anatomy education to a more student-centered environment (Drake, 2002; Terrell, 2006), there must be an effort to train current and future educators about these ideas regarding

anatomy education. Implementing and studying curricular changes aimed at changing perceptions of anatomy is a positive step in moving the learning environment to match the goal for a more modern anatomy education experience (Biggs et al., 2001).

Summary

This research study attempted to examine the perceptions that students have about anatomy and learning anatomy before and after taking an anatomy course. The following research questions were asked:

1. What are the different types of ideas students have about learning anatomy and how do these compare to their ideas about learning in general?
    a. How do these ideas about learning anatomy change from the beginning to the end of an anatomy course?
2. How does the student's perception of the anatomy class relate to the idea of learning anatomy?

In order to address these questions, a mixed method model of data collection and analysis was used. Participants from four different anatomy courses volunteered to participate in this study. Data were collected using initial and final interviews and initial and final surveys. Interviews were semi-structured to allow the students to express their ideas in an open manner and allow the course of the dialogue to proceed on its own. Surveys included open ended questions about what the students would expect and then experienced in the anatomy course. The survey also included a quantitative questionnaire, the Study Process Questionnaire, which was designed to identify student approaches to learning.

Several interesting results emerged from the data. The first was that students often saw anatomy as being driven by the content and so they focused on surface approaches to learning, such as rote memorization. Students who viewed anatomy learning as a passive, teacher-centered experience were often supported by how the

courses were taught and thus had their perception of anatomy as content encouraged by the learning environment. Students with ideas of learning that were more cognitive in nature either had to adapt to the style of the anatomy class or had views of learning anatomy that were different from how they believed learning occurred in other areas. Finally, experience in the course tended to minimize the reliance on surface approach strategies as the surface approach scores did not increase as they had for students with no experience in anatomy. However, the opposite was not found to be true; experienced students did not improve their deep approach scores and thus did not attempt to seek deeper meaning as expected.

Implications of these results focus on how anatomy is perceived as an academic subject made up of factual information and terminology. Students enter the anatomy class expecting a content-based course with little regard to the deeper concepts and relationships. Traditional anatomy courses support the perceptions of needing to learn anatomy through memorization and repetition and so it is difficult to move anatomy education towards more modern methods of instruction. It may be beneficial to have anatomy instructors focus on deeper ideas of learning and promote them in their classrooms in order to help shape students' views of learning anatomy. By having an understanding of where these students are coming from and where they potentially may end up in regards to their perceptions of anatomy, educators can help advance the educational environment so that students are more apt to see anatomy as more than just names and terminology but as a set of related structures and concepts that help make the human body what it is.

APPENDIX A

HUMAN ANATOMY RESEARCH STUDY INITIAL QUESTIONNAIRE

Instructions: Thank you very much for agreeing to participate in this research study. We would like you to fill out these initial questionnaires. Please respond as completely as you can. All responses are voluntary and you are not obligated to answer any of the following questions. An ID number will be generated for you to protect your anonymity. If you have any questions or concerns, please ask a member of the research team. It will take approximately 15 minutes to complete these two questionnaires.

Name: _____

Please answer the following questions:

Age:

Gender:

Ethnicity:

Approximate grade point average:

Academic Major:

Career Goals:

Previous anatomy courses taken:

For what reasons are you taking this class (ie. Pre-requisite, interested in topic)?

Everyone has a preferred way of learning in a variety of situation such as in school and in our everyday lives. What are your preferred learning styles, methods, and/or conditions for learning something outside of school that is interesting to you, such as a hobby or other personal interest?

Do you use these styles, methods, and/or conditions for learning in school?

How do you think these ways of learning are the same or different?

What do you think this particular anatomy class will be like? What do you think you will learn?

How do you think you will learn the content that is covered in this course?

How will you determine when you have adequately learned some piece of content for this course?

Do you think that the way you learn content for this course will be different for this course than for other general courses that you have previously taken? Explain.

On a scale of 1-10 (1 being very easy to 10 being the most difficult), how difficult do you think this class will be?

Revised Study Process Questionnaire (R-SPQ-2F)*

This questionnaire has a number of questions about your attitudes towards your studies and your usual way of studying.

There is no *right* way of studying. It depends on what suits your own style and the course you are studying. It is accordingly important that you answer each question as honestly as you can. Try to relate your answers to the way you generally approach a course.

Please indicate your answer to the right of each question based on the following five responses.

A—this item is *never* or *only rarely* true of me
B—this item is *sometimes* true of me
C—this item is true of me about *half the time*
D—this item is *frequently* true of me
E—this item is *always* or *almost always* true of me

Please choose the *one* most appropriate response to each question. Do not spend a long time on each item: your first reaction is probably the best one. Please answer each item. Do not worry about projecting a good image. Your answers are CONFIDENTIAL.

Thank you for your cooperation.

Question	Response
1. I find that at times studying gives me a feeling of deep personal satisfaction.	_____
2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.	_____
3. My aim is to pass the course while doing as little work as possible.	_____
4. I only study seriously what's given out in class or in the course outlines.	_____
5. I feel that virtually any topic can be highly interesting once I get into it.	_____
6. I find most new topics interesting and often spend extra time trying to obtain more information about them.	_____
7. I do not find my course very interesting so I keep my work to the minimum.	_____
8. I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.	_____
9. I find that studying academic topics can at times be as exciting as a good novel or movie.	_____
10. I test myself on important topics until I understand them completely.	_____
11. I find I can get by in most assessments by memorizing key sections rather than trying to understand them.	_____

A—this item is *never* or *only rarely* true of me
B—this item is *sometimes* true of me
C—this item is true of me about *half the time*
D—this item is *frequently* true of me
E—this item is *always* or *almost always* true of me

Question	Response
12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.	_____
13. I work hard at my studies because I find the material interesting.	_____
14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.	_____
15. I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.	_____
16. I believe that lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.	_____
17. I come to most classes with questions in mind that I want answering.	_____
18. I make a point of looking at most of the suggested readings that go with the lectures.	_____
19. I see no point in learning material which is not likely to be in the examination.	_____
20. I find the best way to pass examinations is to try to remember answers to likely questions.	_____

*Modified from: Biggs, J., Kember, D., & Leung, D. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. British Journal of Educational Psychology, 71(1), 133-149.

APPENDIX B

HUMAN ANATOMY RESEARCH STUDY FINAL QUESTIONNAIRE

Instructions: Thank you very much for your participation in this research study. Your final task for this study is to fill out these final questionnaires. Please respond as completely as you can. All responses are voluntary and you are not obligated to answer any of the following questions. If you have any questions or concerns, please ask a member of the research team. It will take approximately 15 minutes to complete these two questionnaires.

Your Name: _____

Please answer the following questions:

What were some aspects of this class that you enjoyed?

What were some aspects of this class that helped you learn?

What were some aspects of this class that you did not enjoy?

What were some barriers to your learning?

Did you learn everything that you think you should? Is there anything else that you would have liked to have learned?

Has this class increased or decreased your enthusiasm for learning human anatomy? Why?

How would you improve this class?

What methods did you use in order to learn the content that is covered in this course?

How did you know when you adequately learned some piece of content for this course?

Did you learn in a way that was similar to learning ideas in other courses? Explain.

On a scale of 1-10 (1 being very easy to 10 being the most difficult), how difficult do you think this class was?

Revised Study Process Questionnaire (R-SPQ-2F)*

This questionnaire has a number of questions about your attitudes towards your studies and your usual way of studying. Unlike the first questionnaire, please relate all of your answers to how you studied for this anatomy course.

It is important that you answer each question as honestly as you can.

Please indicate your answer to the right of each question based on the following five responses.

A—this item is *never* or *only rarely* true of me
B—this item is *sometimes* true of me
C—this item is true of me about *half the time*
D—this item is *frequently* true of me
E—this item is *always* or *almost always* true of me

Please choose the *one* most appropriate response to each question as it pertains to how you studied for this anatomy course. Do not spend a long time on each item: your first reaction is probably the best one. Please answer each item.

Do not worry about projecting a good image. Your answers are CONFIDENTIAL.

Thank you for your cooperation.

Question	Response
1. I found that at times studying gave me a feeling of deep personal satisfaction.	_____
2. I found that I had to do enough work on a topic so that I could form my own conclusions before I am satisfied.	_____
3. My aim was to pass the course while doing as little work as possible.	_____
4. I only studied seriously that which was given out in class or in the course outlines.	_____
5. I feel that virtually all topics in this course were highly interesting once I get into it.	_____
6. I found most new topics interesting and often spent extra time trying to obtain more information about them.	_____
7. I did not found this course very interesting so I kept my work to the minimum.	_____
8. I learned some things by rote, going over and over them until I knew them by heart even if I did not understand them.	_____
9. I found that studying these topics were at times as exciting as a good novel or movie.	_____
10. I tested myself on important topics until I understood them completely.	_____
11. I found I got by in most assessments by memorizing key sections rather than trying to understand them.	_____

A—this item is *never* or *only rarely* true of me
B—this item is *sometimes* true of me
C—this item is true of me about *half the time*
D—this item is *frequently* true of me
E—this item is *always* or *almost always* true of me

Question	Response
12. I generally restricted my study to what was specifically set as I think it was unnecessary to do anything extra.	_____
13. I worked hard at my studies because I found the material interesting.	_____
14. I spent a lot of my free time finding out more about interesting topics which were discussed in class.	_____
15. I found it was not helpful to study these topics in depth. It confused me and wasted my time, when all I needed was a passing acquaintance with the topics.	_____
16. I believe that lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.	_____
17. I came to most classes with questions in mind that I wanted answering.	_____
18. I made a point of looking at most of the suggested readings that went with the lectures.	_____
19. I saw no point in learning material which was not likely to be in the examination.	_____
20. I found the best way to pass examinations was to try to remember answers to likely questions.	_____

*Modified from: Biggs, J., Kember, D., & Leung, D. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. British Journal of Educational Psychology, 71(1), 133-149.

APPENDIX C

INITIAL SURVEY SCHEDULE

1. Introduction
    a. Who am I?
        i. Name
        ii. Indentifying information
            1. Graduate student in Science Education
            2. Part of PhD dissertation research project
    b. Purpose of study
        i. Explain study – what are they being asked to do
        ii. Refer to letter of consent approved by IRB
        iii. General purpose of the study
    c. Use of information
        i. Use as part of dissertation study only
        ii. Use of names and confidentiality
            1. No one will be identified by name or directly associated with quotations
            2. Quotes used to illustrate a point, given pseudonym
            3. Details that could lead to identification will be masked
        iii. Participation and answers are voluntary
    d. Why am I interviewing you?
        i. Enrollment in an anatomy class
        ii. General email to all enrolled in anatomy class with instructor's permission
2. Biographical
    a. Name, age, year in school, major, career goals, GPA, ACT score
    b. Reasons for taking the course
    c. Previous anatomy experiences
3. Guidelines for open-ended interview
    a. Allow the participant to establish the agenda.
    b. Note key quotes and the participant's language.
    c. Use procedural probes to elicit specific responses.
        i. Obtain names of persons and places; ask for specifics.
        ii. Definitions ("What do you mean by…?").
        iii. Examples ("Could you give me an example of what you mean by…").
        iv. Differences ("How did that differ from…?").
        v. Changes ("How did things changes after…?").
        vi. Is…should (If the participant's response is "is," ask, "What do you think it should be?" If response is "should," ask, "What is the current situation?").
4. Central, Open-ended questions
    a. Discuss what you think the class will be like.
    b. Discuss your perceived difficulty of the course.

c. Discuss what you think you will learn in the course and/or what you hope to learn.
d. Discuss your goals for the course.

5. Focused questions
    a. How will you learn anatomy?
    b. How will you know that you have learned something in anatomy?
    c. How will you study anatomy?
    d. What resources do you plan to use?
6. Checklist items
    a. Ideas on learning in general
        i. Definition of learning
        ii. Requirements for learning
        iii. Ideal learning situations
        iv. Characteristics of
            1. teacher
            2. student
            3. environment
    b. Ideas on learning anatomy
7. Follow-up – Ask for permission to contact the participant for further information or clarification.

APPENDIX D

FINAL INTERVIEW SCHEDULE

1. Guidelines for open-ended interview
    a. Allow the participant to establish the agenda.
    b. Note key quotes and the participant's language.
    c. Use procedural probes to elicit specific responses.
        i. Obtain names of persons and places; ask for specifics.
        ii. Definitions ("What do you mean by…?").
        iii. Examples ("Could you give me an example of what you mean by…").
        iv. Differences ("How did that differ from…?").
        v. Changes ("How did things changes after…?").
        vi. Is…should (If the participant's response is "is," ask, "What do you think it should be?" If response is "should," ask, "What is the current situation?").
2. Central, Open-ended questions
    a. Talk about the things that you liked about this class.
    b. Talk about the things that you did not like about the class.
    c. Was there anything that kept you from learning the subject matter?
    d. Did you learn everything that you think you should? Is there anything else that you would have liked to have learned?
    e. Talk about the things that helped you learn.
        i. In class areas
        ii. Personal approaches – methods used to learn
    f. How did you know when you adequately learned some piece of content for this course?
    g. Did you learn in a way that was similar to learning ideas in other courses? Explain.
    h. Talk about how your perception of anatomy as a subject has changed as a result of your involvement in this course.
    i. How would you improve this class?
    j. Was this class as difficult as you expected?
    k. Learning statement: "Getting knowledge, gaining understanding" (Reference individual answers to learning definition question from initial interview)
        i. Talk about your perception of that statement now.
            1. How do you "Get knowledge?"
            2. What is "gaining understanding?"
        ii. Talk about how this applied to your learning anatomy.
    l. Tell me how you would describe what this course is about to a friend. (What was this course about?)
3. Follow-up
    a. If I have a need to follow-up with anything, may I contact you in the future?

b. Thank you.

APPENDIX E

INITIAL INTERVIEW AND SURVEY CODE BOOK

Question Area	Code	Code Description	Inclusion/Exclusion Criteria
What do you think this class will be like? (CP)	CP1; Content	Perception of course content	Description of the anticipated course content
	CP2; Learning Strategies	Learning strategies that may be used to learn the content	Description of how the student will learn the content of the course
	CP3; Instructor Characteristics	Perception of instructor characteristics	Description of what the student expects the instructor to be like, may include current perceptions as they may already know the instructor
	CP4; Class Characteristics	Perception of course characteristics	Description of what the course will be like, outside of content, difficulty and/or time commitment
What are your goals for this course? (GA)	GA1; Grade	Achieving a good grade	Description of anticipated performance characteristics
	GA2; Retention	Retention of content	Description of retaining the information for some amount of time, specified or unspecified
	GA3; Understanding	Gain some deeper level of understanding	Description of getting some deep meaning from the content
	GA4; Facts	Knowing some set of factual information	Description of learning some set of factual information, to be able to identify or name some set of things
	GA5; Application	Being able to apply the information	Description of being able to apply what has been learned to some situation such as a career
	GA6; Other	Some other goal	
How do you view learning in general? (includes ideal ideas of learning situation)			
Cognitive Processes of Learning (CPL)	CPL1; Repetition	Perception of learning through repetition	Description of learning by repetition and/or practice
	CPL2; Active learning	Learning through active	Description of learning by actively participating in a

		participation	learning activity, hands on
	CPL3; Social	Learning through social interaction	Description of learning through some sort of social interaction such as a study group
	CPL4; Questions	Learning through asking questions	Description of being able to learn by asking questions
	CPL5; Application	Learning by applying to other areas	Description of being able to apply ideas to new situations
	CPL6; Thinking	Learning by thinking	Description of learning by thinking and reflecting on ideas
	CPL7; Passive	Learning through passive means	Description of passive activities of learning such as sitting and listening to a lecture
Tools for Learning (TL)	TL1; Teacher	Perception of needing a teacher to learn	Description of requiring a teacher, mentor, or someone more knowledgeable
	TL2; Reading	Perception of learning by reading	Description of reading will lead to learning
	TL3; Notes	Perception of learning through taking and reviewing notes	Description of learning by taking notes in and out of class and reviewing them
	TL4; Visuals	Learning by looking at visuals	Description of needing visual material for learning
	TL5; Other	Learning by various means	Description of needing various tools for learning such as attending class, games
How do you know that you have learned? (KTYL)	KTYL1; Tangible Evidence	A tangible entity that indicates learning has taken place	Description of how test performance or retention of information is an indicator of learning
	KTYL2; Quantity	Some quantifiable factor	Description of some quantifiable factor that indicates learning such as time spent or some amount of material
	KTYL3; Application	Can apply to another situation	Description of being able to apply information or a concept to some other situation such as being able to teach someone or solve a problem
How will you learn anatomy?			

Cognitive Processes of Learning Anatomy (CPLA)	CPLA1; Memorize	Learning anatomy by memorization	Description of learning anatomy through some form of memorization
	CPLA2; Repetition	Learning anatomy through repetition	Description of learning anatomy through repetition
	CPLA3; Relate to self	Learning anatomy by relating to self	Description of using and applying knowledge to oneself to learn anatomy
	CPLA4; Relationships	Learning anatomy by exploring relationships	Description of learning anatomy through the explorations of the content, how things relate and fit together
	CPLA5; Application	Learning anatomy by exploring application of content	Description of learning anatomy through examining the application of the content to some other situation
Tools for Learning Anatomy (TLA)	TLA1; Notes	Learning anatomy by taking and review notes	Description of learning anatomy by taking notes in and out of class and reviewing them
	TLA2; Reading	Learning anatomy by reading	Description of learning anatomy by reading some material, either assigned or unassigned
	TLA3; Visuals	Learning anatomy by studying visuals	Description of learning anatomy by reviewing visuals such as diagrams or pictures
	TLA4; Key ideas	Learning anatomy by focusing on key ideas	Description of learning anatomy by focusing on what is determined to be important
How do you define learning? (LD)	LD1; Acquiring information	Learning is acquiring information	Description of learning being the acquisition of some set of information
	LD2; Future use	Learning is having something for future use	Description of learning as being able to have some set of information for future use or application
	LD3; Access	Learning is being able to access	Description of learning as having information available

		information	when it is needed
	LD4; Understanding	Learning is understanding	Description of learning as being able to understand some aspect
	LD5; Changing ideas	Learning is changing a previously held idea	Description of how learning is changing an idea, either directly or by incorporating new ideas
	LD6: Thinking	Learning is thinking	Description of learning by thinking and reflecting on a concept or idea
What previous anatomy experience do you have? (PE)	PE1; High School	Had some form of High School anatomy	Description of having a course in anatomy in high school
	PE2; Undergraduate	Had some form of undergraduate anatomy class	Description of having a course in anatomy in undergrad
	PE3; Other	Had some other anatomy experience	Description of having some non-formal anatomy experience
Why are you taking this course? (WTC)	WTC1; Requirement	Required course	Description of course being a requirement for major or some pre-requisite
	WTC2; Interest	Interested in course	Description of having some inherent interest in the course
	WTC3; Career	Needed for career	Description of how the course will benefit future career plans

APPENDIX F

FINAL INTERVIEW AND SURVEY CODE BOOK

Question Area	**Code**	**Code Description**	**Inclusion/Exclusion Criteria**
How do you compare this course to other courses? (CC)	CC1; Similar	Course was similar	Description of the course being similar to courses that were previously taken
	CC2; Different	Course was different	Description of the course being different to courses that were previously taken
How would you improve this course? (CI)	CI1; Time	Improvement by adding time spent on courses	Description of being able to spend more time with the material, either the general content or some specific area
	CI2; Balance	Improvement by adjusting the organization of the course	Description of modifying the balance of content, more or less content in a specific area
	CI3; Guidance	Improvement by giving the students more guidance on what is required	Description of wanting guidance from the instructor on what is important
	CI4; Lab	Improvement by having a laboratory component	Description of wanting some type of hands-on component
	CI5; Assessments	Improvement by adjusting the assessments	Description of modifying how the course is assessed
What are your perceptions about this course? (CP)	CP1; Satisfaction	Perception of the course giving some kind of satisfaction	Description of how the course was or was not interesting, giving some level of satisfaction
	CP10; Text	Perception of the text used in the course	Description of how the text, required or not, aided in the course
	CP2; Relevance	Perception of the relevance of the material to life or future career	Description of how the content was related to life or career
	CP3; Content	Perception of the content of the course	Description of the content of the course

	CP4; Teacher	Perception of the teacher or instructor	Description of learning by repetition and/or practice
	CP5; Difficulty	Perception of the difficulty of the subject matter	Description of the level of difficulty of the course
	CP6; Learning Strategy	Perception of how the student will need to learn the content	Description of how the student thought that learning should take place in the course
	CP7; Assessments	perception of the course assessments	Description of the course assessments
	CP8; Success	Perception of what is needed for success in the course	Description of what was needed to be successful in the course
	CP9; Relationships	Perception of understanding the relationships in the material	Description of how the content related to itself or to other areas
How do you explain your original definition of learning? (LDE)	LDE1; Levels	Learning has different levels	Description of learning as having multiple levels, simple and complex, surface and deep
	LDE2; Memorize	Learning through memorization, repetition	Description of learning through memorization and repetition
	LDE3; Problem Solving	Learning through problem solving	Description of learning as being able or working through problems
	LDE4; Argument	Learning through argumentation, claims, evidence	Description of learning as setting up an argument using claims and evidence
	LDE5; Future Use	Learning by application, being able to use in the future	Description of learning by being able to apply knowledge at some point in the future
	LDE6; Same	Learning definition is the same	Description of learning definition being the same as previously described
	LDE7; Changing	Learning as changing ideas	Description of learning as changing of ideas
	LDE8; Understanding	Learning as understanding the material	Description of learning as understanding the material, not just memorizing

What was this course all about? (LO)	LO1; Content	Description of different content covered	Description of the learning outcome as being just the content areas covered
	LO2; Relationships	Description of how content is related to itself or to outside areas	Description of the learning outcome as being the relationships within the content or to other areas
What learning strategies did you use? (LS)	LS1: Attend	Attending class	Description of learning by attending class or lecture
	LS2; Notes	Taking or reviewing notes	Description of learning by taking and reviewing noted
	LS3; Read	reading the textbook or other material	Description of learning by reading
	LS4; Memorize	memorizing, repetition	Description of learning through memorization and repetition
	LS5; Relationships	relationships within the content, making connections	Description of learning by making connections between the content
Tools for Learning Anatomy (TLA)	LS6; Visuals	using visuals, pictures, diagrams	Description of learning by using visual aids, pictures, diagrams
	LS7; Social	Social learning, group work	Description of learning through social interaction such as group work or study sessions
	LS8; Organization	Organizing the material in a personally efficient way	Description of learning by organizing the content in a new way
What motivated you to learn in this course? (MO)	MO1; Content	Motivated by the content	Description of being motivated by the content of the course
	MO2; Assessments	Motivated by assessments and performance on assessments	Description of being motivated by the assessments
	MO3; Classmates	Motivated by classmates	Description of being motivated by classmates in the course
	MO4; Future	Motivated by future use or prospects	Description of being motivated by future use of the content in life or in

			career
	MO5; Teacher	Motivated by the teacher or instructor	Description of being motivated by the instructor or teacher

APPENDIX G

MEANS AND STANDARD DEVIATIONS OF STUDY PROCESS QUESTIONNAIRE

Group	n	Deep Approach	Surface Approach
Initial Survey Responses for All Participants			
Total	55	33.53±5.76	22.55±5.23
Course			
Entry Level IP	16	33.68±6.33	23.50±5.42
Entry Level AC	17	34.06±7.15	21.11±6.15
Upper Level IP	6	32.50±4.23	26.17±5.42
PT	16	33.19±4.23	21.75±3.11
Both Entry Levels	33	33.88±6.66	22.27±5.84
Both Upper Levels	22	33.00±4.14	22.95±4.23
Experience			
None	15	35.80±5.54	22.20±6.60
1 Experience	24	32.13±5.70	23.79±4.66
2 Experience	16	33.50±5.70	21.00±4.38
Only High School or None	30	33.17±5.88	23.37±5.75
Undergraduate or Multiple	25	33.96±5.70	21.56±4.44
Group	n	Deep Approach	Surface Approach
Initial Survey Responses for Participants Completing Final Survey			
Total	28	33.14±6.31	22.71±5.75
Course			
Entry Level IP	9	31.78±6.83	25.44±4.98
Entry Level AC	8	33.13±7.81	20.50±7.48
Upper Level IP	3	32.67±5.51	26.33±4.62
PT	8	34.88±4.97	20.50±3.25

Both Entry Levels	17	32.41±7.11	23.12±6.59
Both Upper Levels	11	34.27±4.94	22.09±4.37
Experience			
None	5	33.60±9.04	23.80±9.55
1 Experience	18	32.50±6.16	23.22±4.36
2 Experience	5	35.00±4.42	19.80±6.14
Only High School or None	17	31.71±6.58	24.18±5.93
Undergraduate or Multiple	11	35.36±5.41	20.45±4.87
Group	n	Deep Approach	Surface Approach
Final Survey Responses			
Total	28	30.86±7.28	21.82±6.37
Course			
Entry Level IP	9	31.00±9.72	24.00±8.20
Entry Level AC	8	31.00±7.76	21.885.33
Upper Level IP	3	28.00±4.58	25.67±3.51
PT	8	31.63±5.07	17.88±4.16
Both Entry Levels	17	31.00±8.58	23.00±6.87
Both Upper Levels	11	30.64±5.01	20.00±5.27
Experience			
None	5	28.80±9.99	27.80±7.23
1 Experience	18	30.17±6.98	21.11±5.83
2 Experience	5	35.40±4.16	18.40±3.91
Only High School or None	17	29.53±7.47	24.24±5.91
Undergraduate or Multiple	11	32.91±6.79	18.09±5.32

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