Student Perception of How to Succeed in a Pre-Nursing Anatomy and Physiology Course

Marc Behrendt, PhD[1], Jodie Foster, MS, PT[2], Krisanna Machtmes, PhD[2]
[1]Celebration High School, 1809 Celebration Blvd, Celebration, FL 34747; Ohio University, Biological Sciences Department Adjunct Faculty
[2]Ohio University, Athens, OH 45701
Corresponding author: behrendt@ohio.edu

Abstract
Many university students begin the pre-nursing anatomy and physiology course unprepared for the pace and intensity. In a voluntary writing activity on the last day of the two-semester anatomy and physiology class, students were asked to write a letter to the next year's students to offer advice on how to pass the course, no further direction or guidance of what to write was provided. Data consisted of 283 open letters containing each student's voice, broken down into *in vivo* codes. Several themes emerged from the codes. Essays recognized the value of study and learning skills, while also voicing negative affective feelings towards the anatomy and physiology course, suggesting that many students were unprepared for this college level course. This study informs anatomy instructors of student preparation and attitude toward an anatomy and physiology course.
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Introduction
First year students who major in Science, Technology, Engineering or Mathematics (STEM), pre-med or pre-nursing programs, generally enter school with optimism and a feeling of self-confidence, and yet many students flounder during their first college level biology, chemistry, or physics courses (Mayner et al. 2013; Owens 2020; Sooun and Xiang 2008). Gwazdauskas et al. (2014) examined factors that affected student success in an anatomy and physiology (anatomy/physiology) program. Female biology majors earned the highest grades and non-majors scored the lowest grades. The investigators advocated that high school advanced placement biology courses need to better prepare students for a college level anatomy/physiology course. Half the students who took the 2004 ACT exam were not prepared for or capable of reading college level texts or literature, and less than half were prepared to take college level science courses (Lewin 2005). Colleges assume students are prepared for college level work. Students often lack knowledge of how to develop learning skills and supportive positive attitudes towards learning (Bosley 2008; Ding and Mollohan 2015; Hammer and Elby 2003; Kamenetz 2016; Moore and Rubio 2012; Wischusen et al. 2010; Wheeler and Wischusen 2014).

Anatomy/physiology courses by definition consist of intense, fast-paced lessons, requiring student dedication, time management, and honed study skills. Previous research has explored student preparedness for college-level anatomy/physiology courses by examining students' high school education, specific high school courses taken, high school GPA, and standardized test scores (Harris et al. 2004; House 2000; McKee 2002; Sadler and Tai 2001). Some studies explored university created models to evaluate program candidates (Stankus et al. 2019). However, there is a lack of understanding concerning what methods promote or correlate with success and failure of students specifically taking anatomy/physiology courses (Harris et al. 2004).

Green et al. (2009) described how entrance exam scores and high school performance could predict success in a college level physiology course. However college level anatomy/physiology courses required a unique set of learning skills and could not be predicted in this study. Harris et al. (2004) showed a correlation between the number of previous mathematics and science courses a student has taken and success in an anatomy/physiology course. Burns and Garrett (2015) examined preadmission variables such as grade point average and Medical College Admissions Test (MCAT) scores as predictors for success in a medical program, and found correlation between success and the MCAT microscopic anatomy results. Davis et al. (2018) observed that college health professional programs focused on prospective students with high grade point averages and high test scores, but some of those students struggled in college due to a variety of reasons, including burnout, lack of motivation, lack of interest, and lack of preparation (Hidi and Harackiewicz 2000).

Casual conversation among anatomy/physiology instructors at a recent conference revealed that student success and retention is problematic among freshmen anatomy/physiology students in pre-nursing and ancillary health programs at numerous universities. Yet, minimal literature is available that explores student preparedness for college level

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pre-nursing entry courses, or student withdrawal from college level pre-nursing programs (Mitchell 2012).

A high school diploma does not guarantee success at a four-year college. Only 56% of high school graduates manage to earn a college degree in 6 years (ACT 2010). Half to two-thirds of all high school graduates are unprepared for college and struggle to succeed in college (Balfanz 2009; Greene and Forster 2003). Colleges expect college-bound high school students to graduate with a foundation of reading comprehension, writing, and mathematics skills (Fletcher and Tienda 2009b). College faculty identified writing skills and research skills to be critical for student success (Conley 2003), but Conley (2014) identified additional factors that equally impacted first year college student success, such as development of interest and curiosity, development of time management and life skills, and insight to choose the correct college.

Adelman (2006) explained that successful new college students mastered the content and skills of their high school classes, while students who did not master content or skills often needed to take remedial courses and were less likely to earn a college degree. Evidence showed that only 30% of students requiring just one remedial reading course would earn a college degree in eight years (Adelman 2006).

> "A lack of mastery in math, writing, and especially reading skills seems to be an especially powerful indicator of un-readiness for college, no matter how many core courses the given student passed in high school" (Adelman 2006, p. 25).

Kanmetz (2016) explained that the national high school graduation rate is 82%, yet less than 40% of high school graduating students tested college and career ready on the National Assessment of Educational Progress (NAEP), which suggests that 40% of the graduating students were not prepared to succeed in college.

In this study, rather than trying to determine the factors predicting student success in an anatomy/physiology course, we examined student perception of what was necessary to succeed in our two-semester anatomy/physiology course, which is intended for pre-nursing and ancillary health majors. The primary research question was: From the point of view of students completing a two-semester anatomy/physiology course, what skills did the students perceive as important or necessary in order to pass the course? Secondary questions included: What gaps in pre-college preparation for the course were identified? How did the students perceive the course?

Methodology

Sampling and participants

This study took place at a Mideastern research level 1 university that offers a wide range of majors in the sciences and medical fields and, concerning this study, a popular four-year Bachelor's in Science degree in Nursing (BSN). Included in this study, in minimal numbers, were students aiming for BS degrees in nutrition, public health, and family services. All these majors required a two-semester anatomy/physiology course, which consisted of 2.5 hours of lecture and 1.9 hours of lab per week. At the beginning of the first semester, 2014 and 2015 respectively, there were 292 and 288 students registered on the class roster. At the end of the two-semester course, only 157 (54%) and 163 (57%) students remained on the roster.

The last week of class during the second semester, students celebrated their completion of the course. Conversation lead to why they were successful while roughly half of those who started the course failed or dropped out. Discussion turned into opportunity, and interested students were invited to write a one-page letter to the future students who would begin the course in the upcoming fall semester. The open letters would inform and advise incoming students about the course; no further guidelines were provided concerning the content of the letters. It was made clear that all the open letters would be made public and that all letters would be posted on the laboratory walls for perusal by the incoming students, staff, and visitors. For taking time to write the letter, participating students were to be awarded two extra credit points on their final exam. On the last day of class in 2015 (2014/2015 cohort), 137 students turned in letters; on the last day in 2016 (2015/2016 cohort), 146 students turned in letters.

The richness of the open letters had not been anticipated. The letters provided an authentic student perspective of the anatomy/physiology course; in particular, they described what students thought they needed to do in order to pass the course. The open letters presented an opportunity to understand the difficulties and challenges of the course from the students' perspectives, which would inform the teaching practices for future anatomy/physiology sessions. The next year, the same opportunity was made available for the 2015/2016 student cohort who completed the course, providing an opportunity to see how the comments compared. The two sets of essays provided the qualitative data examined in this study to explore how students perceived the anatomy/physiology course. This project was considered exempt and approved by the Institutional Review Board (IRB) of Ohio University (15E265), as this was a voluntary student project in which participants understood the letters were to be made public.

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Analysis

Evaluation of the data was compatible with qualitative analysis methods because the data was composed of the students' voices (Creswell 2013; Stake 1995; Stake 2010; Yin 2009; Yin 2011). A case study design was used to examine the students' perspectives of the anatomy/physiology course. This study utilized the open letters for analysis, to search for patterns of common meaning derived from the students' letters, ultimately resulting in a final description. The study was bounded by all the essays received, regardless of their content (Yin 2009). *In vivo*, or literal coding, was used because the intent of this study was to examine the student perspectives through the students' own words (Manning 2017; Saldana 2016). The participants' words became the codes. *In vivo* coding is appropriate when the participant's voice is the priority. All the essays were coded for insightful vocabulary and emergent themes, with the intent to identify each student's perception of the anatomy/physiology course, and how the anatomy/physiology course affected their lives. The emergent themes were examined and evaluated to help answer the research questions.

Validation and Credibility

All essays were coded for data and none were excluded for any reason. The first step was to create a thick, rich description of this anatomy/physiology course from which the students generated their experiences. The goal of this paper is to provide context to help the readers understand the students' perspectives. The readers can then transfer those findings to their own personal perspective and then interpret the data for themselves (Creswell 2013; Patton 2002; Polkinghorne 1989). This study utilized reflexivity to bracket or separate the researcher's biases from the data (Creswell 2013; Moustakas 1994; Patton 2002; Polkinghorne 1989; Yin 2011). Negative case analysis examined data that did not fit with the identified patterns and themes and discussed why the negative data did not fit (Creswell 2013; Polkinghorne 1989). Finally, a science education academic professional who had no connection to the study performed an external audit. The external auditor examined the accuracy of the study's data, process, analysis, and conclusions (Creswell 2013; Patton 2002).

Limitations

There were three limitations in this study. First, the participants were limited to the students who finished both semesters of the anatomy/physiology course. The study did not include students from the first semester who did not take the second semester portion, or students who withdrew from the course. Second, time was a limitation since this study is examining only two years. Third, the data is limited to only one university. Limitations were dictated by the boundaries of this study, which were originally intended to inform the students and faculty of this course. Despite the limitations, this study offers insight towards student perspectives from the required anatomy/physiology courses for non-biology majors, including nursing, nutrition, public health, and family science majors.

Results

A priori categories were explored as themes or categories that were being developed. Braund and Reis (2006) discussed five primary themes after exploring hands-on, experiential learning activities: Social involvement, Hands-on, Surprise, Novelty, and Knowledge acquisition. These themes can be extrapolated from the results of our study and parallels can be seen; however, the comparisons are strained. In our study, surprise and novelty were not obvious in the students' comments, although social involvement, hands-on, and knowledge acquisition were easily evident. However, these categorizations do not relate to the unique story of each individual's perceptions of what is needed to successfully complete an anatomy/physiology course.

In vivo coding, using a student's own words to remove researcher interpretation bias, attempted to capture each student's intended perception through his or her comments. Tables 1- 6 illustrate the categories and specific codes identified from the essays. The essays from 2014/2015 and 2015/2016 presented similar numbers of codes under each category; therefore both sets of data were combined as one full data set.

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Table 1 shows the codes relating to lectures. Roughly half of the students recognized that the daily clicker quiz was important for their grade, while only a fifth of the essays suggested attending every lecture. Only 2% suggested putting away their phones.

Code	2015	2016	Total	% of n
Clicker Quiz - study for/important	64	66	130	46%
Always attend lecture	27	32	59	21%
Need/use colored pencils, highlighters	17	6	23	8%
Print notes for lecture	9		9	3%
Take notes	8		8	3%
Put phone away	3	3	6	2%
Draw charts, pictures, flowcharts for understanding	5		5	2%
Record Lecture	3	2	5	2%
Sit in front of class	3	1	4	1%
Need blank paper to draw on in lecture	3		3	1%
Prepare self for next lecture/class	2		2	1%
Practice exams in book	2		2	1%
Know chapter two	2		2	1%
Wish was told pointers and tips	2		2	1%
Do not leave lecture early	1		1	<1%
Print guided notes in color	1		1	<1%

Table 1. *Codes Relating to Lecture n = 283*

Table 2 shows the codes relating specifically to exams, which were the primary basis for the final grade. The only significant comment was to begin studying a week prior to the announced exam. There was little consensus concerning study skills.

Code	2015	2016	Total	% of n
Begin studying 7 days or more before next exam	29	31	60	21%
Exams based on notes	4		4	1%
Begin studying less than 7 days in advance	4		4	1%
No all-nighters	2	1	3	1%
No going out for fun weekend before exam	2		2	1%
Make practice exams	1		1	<1%
Review exams for finals	1		1	<1%
All-nighter necessary before exam		1	1	<1%

Table 2. *Codes Relating to Exams n = 283*

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Table 3 shows the codes specific to studying and study skills. Several codes were regularly identified. Nearly half the students recommended study groups or studying with friends. One third of the students recommended studying every day and reading the textbook. Not waiting until the last moment to study or cramming for exams was mentioned by 28% of the students. The remaining codes provide insight into how students prepare for exams.

Code	2015	2016	Total	% of n
Study Group/ friends	58	69	127	45%
Study every day	65	37	102	36%
Read book	34	52	86	30%
Don't procrastinate/cram	31	47	78	28%
Didn't know how to study/ need to learn how to study	7	26	33	12%
Rewrite notes	17	16	33	12%
Review notes after class asap	26		26	9%
Must understand the material, not memorize	9	12	21	7%
Find a successful way to study	14		14	5%
Use Quizlet	5	8	13	5%
College different from high school	5	8	13	5%
Flash cards	9		9	3%
Record the lecture	4	1	5	2%
Keep a big binder for all papers	3		3	1%
Read notes at least one time a week	2		2	1%
Don't read book - except to answer a question/ waste of study time	2		2	1%
Read previous class notes prior to lecture	1		1	<1%
Study at least a couple times a week	1		1	<1%
Learn the intro chapters	1		1	<1%
Google slides	1		1	<1%

Table 3. *Codes Relating to Study Skills n = 283*

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Table 4 shows codes relating to the laboratory, a weekly two-hour activity-based scheduled class. Less than a quarter of the students commented on preparing in advance for each lab. Anatomy and Physiology Revealed (APR), a virtual dissection program that constituted a part of each weekly prelab activity (McGraw Hill, 2020), was identified, but with various meanings. Students suggested doing the APR assignments, some students went further to indicate that they not only did the assignment, but they created PowerPoint documents using the APR images. A few students perceived APR as optional, annoying, and tedious.

Code	2015	2016	Total	% of n
Power point with APR to study	25	41	66	23%
Do APR	32	23	55	19%
Do prelabs	17	30	47	17%
Lab Quizzes matter	18	31	49	17%
Take pictures/ record models, slides etc.	22		22	8%
Open lab	5	11	16	6%
Stay in lab the entire time	4		4	1%
Participate in lab/ no phones/ do dissections	4		4	1%
Use lab to learn lecture concepts	4		4	1%
Unpleasant smells and/or images	4		4	1%
APR is tedious and annoying	2	1	3	1%
APR is optional	1		1	<1%
Don't skip models	1		1	<1%
Gloves are gross	1		1	<1%
Don't take Tuesday lab	1		1	<1%

Table 4. *Codes Relating to Laboratory n = 283*

Table 5 shows codes relating to available resources for support to help students through the course. Student Instructor (SI) sessions in the evening and office hours with the lead professor were recognized in one third of the essays. Other options mentioned were meeting with the professor but not during office hours and using multiple library support options.

Code	2015	2016	Total	% of n
SI sessions	33	60	93	33%
Attend office hours	38	51	89	31%
Talk to professors	32	26	58	20%
Review sessions	16	36	52	18%
Alden Library	18	23	41	14%
Use resources available	19	21	40	14%
Tutoring at library	8	12	20	7%
Get help	16		16	6%
TA	6	3	9	3%

Table 5. *Codes Relating to Resources n = 283*

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Table 6 shows the codes in which students made statements explaining what one needs to do to pass the course. One third of the essays recommended making an effort and studying every day. One fifth of the essays recommended attending every class and doing pre-labs. An additional group of essays acknowledged studying without offering any time recommendations. The remainder consists of specific recommended actions students should follow to succeed in the course.

Code	2015	2016	Total	% of n
Put in time and effort	36	57	93	33%
Study every day	57	37	94	33%
Always attend lecture	27	32	59	21%
Study - no time given		60	60	21%
Do prelabs	17	30	47	17%
Didn't know how to study/ need to learn how to study	7	26	33	12%
Need to focus/ prioritize, dedicate self	28		28	10%
Keep up with work	15		15	5%
Find a successful way to study	14		14	5%
College different from high school	5	8	13	5%
Take notes	8		8	3%
Put phone away	3	3	6	2%
Keep up with other courses	2	2	4	1%
Stay in lab the entire time	4		4	1%
Participate in lab/ no phones/ do dissections	4		4	1%
Prepare self for next lecture/class	2		2	1%

Table 6. *Codes Identifying Essential Student Expectations of How to Pass the Course n = 283*

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Table 7 identifies the key words in the essays. More than half of the essays identified the course using the word "difficult" or "hard", followed by challenging. One third commented on the teachers' caring and concern about students succeeding in the course. There is a mix of negative and positive words. The fourth most common word involved crying, followed by need to relax, and stressful, while the fifth most common set of terms suggesting the course was interesting and amazing.

Code	2015	2016	Total	% of n
Difficult/hard	75	90	165	59%
Challenging	40	62	102	36%
Teacher cares about student success	21	71	92	33%
Crying	18	29	47	17%
Interesting/ fascinating/ amazing	27	12	39	14%
Need to relax/ do fun stuff	22	12	34	12%
Cannot play/ no partying/ no free time like friends	20	14	34	12%
Stressful	18	15	33	12%
Praises professor		33	33	12%
Important/ valuable		30	30	11%
Time management	15	13	28	10%
Be optimistic/ positive/ believe in self	16	12	28	10%
Requires hard work	29		29	10%
Rewarding	18	9	27	10%
Overwhelming	13	10	23	8%
Prepare for future	21		21	7%
Will fail along the way	20		20	7%
Fun	15	3	18	6%
Loss of sleep	1	12	13	5%
Worth it in the end	6	9	15	5%
Want to quit at times	8	7	15	5%
Question one's major		14	14	5%
Do not be discouraged	12		12	4%
Have fun in class		12	12	4%
Best class ever had	1	8	9	3%
Major sacrifices		9	9	3%
Failed because did not do the work		8	8	2%
Frustrating		7	7	2%
Discouraging	6	1	7	2%
Grade due to own effort		6	6	2%
Learn amazing things	6		6	2%
Don't panic	6		6	2%
Late nights	4		4	1%
Get used to low grade	5		5	1%

Table 7. *Most Common Key Terms used in Essays n = 283*

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Table 8 identifies the less common key words identified in the essays. Although only one to four essays provided these words or concepts, many of these lesser-used terms provide a glimpse into student perceptions of students who may have struggled in the course.

Code	2015	2016	Total
Haunt	1		1
Compared to having a child	2		2
Don't cheat	2		2
Intimidated	1		1
Learn about self, self-identification	1		1
Beneficial	3		3
Appears impossible and scary	1		1
Good feeling at end of course	3		3
Don't compare self to others	2		2
Passion/passionate	3		3
Terrified	2		2
Wished would have put in more time	2		2
Need to be organized	3		3
Trust the professor	1		1
Exhausting	1		1
Scary	5		5
Hell	1		1
Terrible	1		1
Drop the course if you need to	1		1
Hell - but worth it	2		2
Appreciate material		4	4
Great experience		4	4
No fun in college life		1	1
Freaking out		1	1
Prepare for failure		1	1
Depths of hell		1	1
Need to be focused		3	3
Ridiculous course speed		2	2
Don't drink/ get caught/ dropped from nursing program		1	1
Share what learned with parents		1	1
Seems impossible at times		1	1
Want to give up		1	1
Makes you feel stupid		1	1
Course not impossible		1	1
Be prepared every day		1	1
Can succeed		1	1
No social life		2	2

Table 8. *Less Common Key Terms used in Documents n = 283*

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Table 9 is intended to show the most positive and the most negative student perceptions. The columns are unique and stand-alone but show an intense separation of positive and negative insights.

Positive	*Negative*
Teacher cares about student success	*Crying/ Freaking out/ screaming*
Need to relax/ do fun stuff	*Cannot play/ no partying/ no free time like friends/ no fun*
Praises professor	*Stressful/ overwhelming/ frustrating*
Important/ valuable	*Hell/ Depths of Hell*
Be optimistic/ positive/ believe in self	*Will fail along the way/ want to quit*
Rewarding	*Question one's major*
Fun	*Loss of sleep*
Worth it in the end	*Terrible/ discouraging*
Great experience	*Makes you feel stupid*
Have fun in class	*Get used to low grade*
Best class ever had	*Exhausting*
Good feeling at end of course	*Compared to having a child*
Interesting/ fascinating/ amazing	*Appears impossible and scary*
Beneficial	*Prepare for failure*
Learn amazing things	*Seems impossible at times*
	Don't drink and get caught or dropped from nursing program

Table 9. *Compare and Contrast of Key Terms from Students in the Same Course*

Table 10 identifies five words or concepts of concern, indicating how often that term was used. We do not know if these students passed or failed, but the terms clearly suggest that these students struggled.

Vocabulary	# Times Word Used
Stressful/ overwhelming/ frustrating	63
Crying/ Freaking out/ screaming	50
Cannot play/ no partying/ no free time like friends/ no fun	35
Will fail along the way/ want to quit	35
Hell/ Depths of Hell	4

Table 10. *Words and Terms of Concern*

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Each essay constituted a data set. At the end of the two-term course, students were told to write a letter to students beginning the anatomy course in the fall, to communicate what they had learned about how to pass the course. Because no other guidelines were provided, there was a wide range of topics and commentary. Data consisted of themes and vocabulary identified through qualitative coding. Although each essay is an individual student's voice, the focus of this study was to identify themes. Individual students were not recognized in this analysis, although representative statements have been provided as examples.

Peer Teaching

A topic common to 45% of the essays involved some sort of peer teaching, which included study buddies, student formed study groups, and scheduled teacher assistant and student instructor (TA/SI) sessions:

> (Student Essay 14)
> I wouldn't have survived without my friends in (the course.) This doesn't mean you have to study with them all the time, because you may be like me and study better on your own, but it's always helpful when they can quiz you on the material.
>
> (Student Essay 150)
> My first exam I thought I could study by myself and would be fine, but then reality hit when I got a D on the first exam. I found a friend in my learning community who has been my study buddy all the way until the end of the course. It helps to read your notes to each other and ask questions about it. Challenge each other!

The participants through their essays explained that study buddies from class provided an understanding partner who was experiencing the same lectures and labs. Other essays recognized the value of peer teaching:

> (Student Essay 171)
> Develop friends and study buddies and study groups. You will need to study on your own, but going over notes and talking about important topics with another person will help you, and the people you study with, understand the material much more easily.

The formal peer teaching SI sessions were recommended by 33% of the participants in their essays:

> (Student Essay 191)
> SI sessions give you the opportunity to meet with people in your class and go over the notes in question form. Any questions you may have can be answered by the SI leader. They truly do their best to help.

Professor as a resource

Another common topic involved the professor's availability outside of the classroom: 33% of the essays explained that the professors cared about students succeeding, 31% of the essays recommended attending open office hours, and 20% recommended talking to the professors:

> (Student Essay 50)
> (Professor) is an extremely fair teacher, don't talk s--- about her because you'll just look stupid. She knows her stuff and wants you to know your stuff as well. Her expectations are high, you don't want to let her down because it is very rare to have a professor in college that believes in you like she does. A professor that cares, and strives to do her absolute best so her students see the benefits.
>
> (Student Essay 13)
> Go to office hours to get your questions answered. Many people believe that this is "brown nosing" but this is college now and some of the best relationships you can make will be with your professors.
>
> (Student Essay 211)
> This is one thing that I did not do but wish I had. Learn from my mistake and visit (Professor) often. She is very intelligent, easy to talk to, and really wants her students to do well.

Time management and life balance

Time management was a common theme throughout the essays, although there was no specific topic. Most common was the general idea to study every day (36%). Other time management comments focused on participation in social activities:

> (Student Essay 12)
> …cannot play/no partying/no time for friends/ need to relax and do fun stuff.
>
> (Student Essay 30)
> You are not going to be able to go out as much as your friends…There will be kids in our class that go out almost all the time and you will see them fail the class.

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Affective effects – emotions – trauma- life changing
Many of the essays contained strong negative affective vocabulary:

(Student Essay 33)
You probably heard how horrible, difficult and time consuming this class is. As bad as that sounds, it will feel 10x worse. Most of you will have a couple mental breakdowns, want to give up.

(Student Essay 18)
There are going to be times where you feel like giving up, but you must remind yourself that all your hard work and struggle will pay off in the end. It is okay to have a breakdown or shed a few tears.

(Student Essay 205)
Work hard, shed tears, pull all-nighters, be great!

(Student Essay 285)
There may be times you want to bang your head against the wall multiple times, or rip all your notes apart, but do not give up. There may be times you have to sacrifice going out with your friends or watching Netflix that night, but it has to be done!

Student preparedness for course
A considerable volume of research has been conducted concerning student preparedness for college. However, through the essays, students revealed their perceptions of their own preparedness for this college course:

(Student Essay 72)
I wish someone would have given me a heads up or tips on this class before I started. The best tip I have is to study, study, study.

(Student Essay 33)
For the first semester I had no idea how to study, so I was constantly digging myself out of a hole.

(Student Essay 205)
College is such a new, shiny, confusing place. You get so many people telling you what you should and shouldn't do but you really won't know what college is until you've done it.

(Student Essay 11)
The first time I took it, I didn't take the class seriously. I didn't put in the time to understand the material before each lab and lecture. I thought that I could get by through cramming the day before an exam. I learned the hard way that getting by is not the way to succeed in this class. Nobody wants to be treated by a medical professional like a nurse who just "got by" in their classes. The second time I took (the course), I entirely changed my tactics. I worked on my study skills, dedicated hours and hours every week towards rewriting lecture notes, had group study sessions, made countless PowerPoints for lab, and made sure to not neglect the clicker and lab quizzes.

(Student Essay 213)
NEVER start studying for an exam the night before. This is nothing like high school, if you do that you will not do well. You have to be willing to put the time in to studying so that you actually understand it, not just memorized it.

Student perceptions for success techniques
Related to perception of preparedness, the essays also revealed students' perceptions of what should be done to succeed in passing anatomy/physiology:

(Student Essay 12)
I tended to cram the night before and would get a 83% so if you can cram I would 10/10 recommend it!

(Student Essay 20)
You are not just trying to pass a class – you are learning so that you can save lives.

(Student Essay 16)
Do not use your phone in class! You seriously will miss something important. I learned that the hard way!

(Student Essay 48)
I was pretty proud that I didn't miss a class all semester, but I realized that's what the successful students do.

(Student Essay 41)
Get down and dirty in lab – participate! Hold the organs, look at the cadaver, be hands on!

(Student Essay 72)
I wish I would have utilized (professor's) office hours and recitation.

(Student Essay 147)
You are not given a grade…you earn a grade here.

Student Essay 285)
If you want to succeed you need to actually learn and understand the material. DO NOT just memorize, trust me. I did that at first! Everything ties together and if you do not actually know the material, you are screwed.

(Student Essay 12)
Don't drink alcohol in a public space bk you will get caught by undercovers and will be unable to join the nursing program.

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Discussion

The essays provided a means to observe students' thinking and perspectives of the anatomy/physiology course, and provided evidence of each student's perspective of priorities, skills, and understandings that they possessed or lacked. The general categories, identified from the codes from essays that illustrated each student's voice, were examined to help answer the research questions.

What skills did the students perceive as important or necessary in order to pass the course? Evidence to respond to the primary question was empirically derived directly from the essays. Students recognized the need to study, which needed to be focused and performed daily. There was a strong acknowledgement to attend each lecture and to prepare prior to each lecture for a daily opening quiz. Study skills were identified in small segments. Test preparation should begin seven or more days before the next exam. A small group recommended rewriting notes, while a smaller subset recommended keeping up with the work. Supported by Fletcher and Tienda (2009a), who describe the value of peers and college success, many students recognized the importance of working with peers through study groups and peer teaching.

What gaps in pre-college preparation for the course were identified? This can be answered by looking at student perceptions about what is needed for success. The skills described are basic study skills, and although some students seemed to understand these expectations, many students commented as if this was a new concept for them. "Do not use your phone in class! You seriously will miss something important. I learned that the hard way!" (Student Essay 16). "I was pretty proud that I didn't miss a class all semester, but I realized that's what the successful students do" (Student Essay 48). Twelve percent of the essays indicated that the writer did not know how to study and needed to learn how to study.

These students were not new to academia. They needed to graduate from high school with better than a 3.0 grade point average and needed to have taken a pre-college course load. Most of these students were striving to earn a nursing or nutrition BS degree, which required a C or better grade in anatomy/physiology. The combined 2014/2015 and 2015/2016 first semester anatomy/physiology course drop out and failure rate was 29%. If the failures include the letter grade D, which earned the student credit for the course but is still considered failing, the drop out and failure rate was 46%. This supports the suggestion that many students entering college lack learning skills and do not understand how to develop learning skills (Ding and Mollohan 2015; Hammer and Elby 2003; Moore and Rubio 2012).

Further insight was provided by the third question, how did the students perceive the course? The majority of essays began with a statement inferring that the course was difficult and challenging. Table 9 compared and contrasted vocabulary. The positive words were more cognitive, the negative words were more affective: Teacher cares about student success, Need to relax/ do fun stuff, etc., compared to Crying/ Freaking out/ screaming, Cannot play/ no partying, etc. The negative vocabulary suggests that students may have been struggling, although some may have done well but disliked the course. Those who struggled may have lacked the scaffolding required to feel comfortable with the course's depth, breadth, and speed. This supports the possibility that their high school courses lacked rigor; a concept supported by previous research. Lewin (2005) indicated that less than half of college bound students were prepared to take college level science classes. Incoming college students lacked the knowledge of how to develop learning skills (Ding and Mollohan 2015; Hammer and Elby 2003; Moore and Rubio 2012), and roughly two-thirds of all high school graduates are unprepared for college and struggle to succeed in college (Balfanz 2009; Greene and Forster 2003).

Interest and curiosity, time management skills, and general life skills are also recognized as important factors determining student success (Conley 2014). However, in this study, interest and curiosity were minimally observed among the vocabulary words and codes. The only codes that suggested interest and curiosity were interesting/fascinating/amazing (14%), fun (6%), learn amazing things (2%), appreciate the material (1%), and great experience (1%). Many students did not understand the commitment and time management required to enter a program leading to a professional career. Twelve percent of students decried that they had little time to go partying with friend and 10% recognized they needed to develop time management skills. Essentially, the essays suggested that many students needed to develop necessary learning skills as the course proceeded.

These insights can help the anatomy/physiology faculty better prepare for the incoming students' personal beliefs and understandings of what those students think is necessary to successfully pass the course. The results of this study promote the question: Should faculty dedicate time at the beginning of the course to encourage and nurture a paradigm shift among student thinking in order for the students to succeed in the course?

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Conclusion

Much of the data acquired from the essays suggests that there is a gap between the present high school course framework and competencies required to take college level anatomy/physiology, and for many, to enter the nursing program. Our findings align with studies that demonstrated how students entering engineering programs could not meet the competencies required by practicing engineers (Jang 2015). STEM courses are required to enter college science major programs, yet, this study and other research suggest that the high school STEM courses need to be redesigned to teach learning skills and develop higher rigor competencies if students are to succeed in a college level anatomy/physiology course and nursing program. These results indicate a need for improvement in both high school and community college student preparation and support.

With a nursing shortage already documented (Rosseter 2019), the importance of university nursing programs has been highlighted by the COVID-19 pandemic of 2020 (Connolly et al. 2020; Pearce 2020). In order to enter a nursing program, students are required to have STEM core knowledge and learning skills. When half of those qualified students fail their first anatomy/physiology course, the program has wasted considerable resources, and perhaps turned away viable program candidates at the screening level. The data in this study provides nursing programs and instructors a new lens through which to consider how an anatomy/physiology course may be able to generate and increase student learning success.

Issues Identified

- Many incoming college students entering anatomy/physiology courses were unprepared for college.
- There is a need for student support to compensate for inadequacies and affective needs.
- Successful students have appropriate learning skills and develop pride in their accomplishments.

Future Research

Future research will be necessary to understand the full depth and breadth of entering college freshmen preparedness in general and when taking anatomy/physiology courses. What is the pattern of student realization that the present study methods are not working? How do study skills develop from the beginning of the first semester to the end of the second semester? A longitudinal study might examine the high school background of students who succeeded from the beginning. Would a pre-college skills camp enable student success in college science courses?

From a broader perspective, how prepared are urban versus rural high school students when they advance to college level science courses? Are students who take advance placement courses better prepared to take college-level science courses? Is there any difference in high school student preparedness for science courses between public, private, and charter high schools? Finally, looking at secondary education objectives, do school systems concern themselves with student efficacy at the university level?

About the Authors

Marc Behrendt, PhD, an adjunct faculty member with the Biological Sciences Department at Ohio University, presently teaches Honors Anatomy and Physiology at Celebration High School in Florida. Jodie Foster, MS PT teaches Human Anatomy and Physiology at Ohio University. Krisanna Machtmes, PhD, Associate Professor, teaches Program Evaluation and Questionnaire Design at Ohio University.

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continued on next page

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Back to TOC