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Allied Health Students' Perceptions of Class Difficulty: The Case of Undergraduate Human Anatomy and Physiology Classes

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ABSTRACT

Purpose: The Human Anatomy and Physiology (HAP) course is required of all allied health majors. Students need to earn a grade of "C" or better, and many students find this class academically challenging. This study investigated allied health students' perceptions of what makes the undergraduate class difficult. **Methods:** A 28-question survey targeted 403 students enrolled in three HAP sections taught by the same instructor. **Results:** Students returned 279 surveys (68% return rate). Qualitative and quantitative data supported a three factor model in making this class difficult: discipline, student, and teaching related factors. Students consider that discipline factors are more important than student and teaching factors. **Conclusions and Recommendations:** Results suggest that instructors can help students by paying more attention to diagrams and graphs, engaging students by using active methods of learning, and identifying students who consider this class "extremely" difficult.

INTRODUCTION

At a four-year large university in southeast Georgia, USA, the undergraduate Human Anatomy and Physiology (HAP) class is an introductory level course with lecture and lab components. HAP classes combine the anatomy and physiology of the various organ systems, which are divided between two lecture courses. HAPI covers chemistry, cytology, histology, and the anatomy and physiology of the following organ systems: integumentary, skeletal, muscular, nervous, and sensory. HAPII covers the anatomy and physiology of the endocrine, circulatory, digestive, respiratory, urinary, and reproductive systems. The lecture class enrolls an average of 150 students per section and uses Saladin's textbook, "Anatomy and Physiology: Unity of Form and Function."[1] The course has no prerequisites and is required of all allied health majors (including nursing, exercise science, nutrition, health and physical education, health education and promotion, and athletic training). Students taking HAP need to earn a grade of "C" or better to be admitted in their degree program.

Faculty have indicated that physiology is difficult because it makes connections among multiple disciplines, has boundaries that are not rigid, and is a subject with a rapidly increasing knowledge and complexity. [2-4] Among some topics considered difficult and likely to cause misconceptions, faculty included the mechanics of breathing and respiratory physiology, renal physiology, exercise physiology and biochemistry, and resting membrane potential. [5-10] A systematic study among faculty attempted to understand why faculty think physiology is difficult and identified a three-factor model that included discipline, teaching and student factors.[11] In this study, sixty-four faculty at various postsecondary institutions agreed that discipline related factors (ability to reason causally, think about dynamic systems, and understand different levels of organization simultaneously) are the primary factors in making physiology difficult.[11] Student-related factors (believing that learning and memorizing is the same, ignoring

graphs, tables and figures, and failure to appreciate the integrative nature of physiological mechanisms) placed second. Teaching-related factors were identified as the least important in the model.[11]

Similar studies examining both faculty and student perceptions were done in chemistry and also pinpointed a three component model.[12,13] Perceptions of chemistry difficulty were categorized into course-related (too much material, too abstract, too many exceptions to rules), student- related (not doing homework, not preparing for exams, not doing readings), and staff-related (not enough applications, poor texts/instructors, unreasonable grading). In this study, students and teachers in chemistry agreed that discipline factors are most important in determining the difficulty of these classes.[12, 13]

It is important to note that students and faculty do not always agree. In fact, student-faculty discrepancies exist in multiple areas, including but not limited to post-exam attendance, disruptive behaviors, and group work. [14-16] This has serious implications for instructors as they design their classes and evaluate student learning. Yet no previous studies have explored students' perceptions on the difficulty of the combined human anatomy and physiology class at the undergraduate level - a foundational class for any allied health major. Moreover, as more and more students enter the allied health field, the enrollment in these classes is skyrocketing with an increase in pre-nursing, exercise science, and nutrition majors. This increase in enrollment underscores the issue of attrition, since 30% to 50% of the students enrolled in the class fail to earn at least a "C" and must either retake the course, change their major, or drop out. Previous studies have examined the difficulty of physiology only and were limited to undergraduate sport and exercise science majors, medical school students, graduate students, or upper division undergraduates in physiology. [6-10] There is some evidence that nursing students traditionally experience difficulties with the science subjects in the nursing curricula, as well as some indication that HAP classes are difficult based on end-year student evaluations. However, little is known about *what factors* make this class difficult for these undergraduate students, as the prior literature has not investigated students' perceptions of a combined human anatomy and physiology class. It could be possible that HAP students have a very different perspective on the difficulty of this class compared to faculty.

Given the crucial importance of this class for all allied health majors and in an attempt to bridge the gap between student and faculty perceptions, we undertook this study with the goal to shed more light on student perceptions about the difficulty of HAP.

HYPOTHESES

Based on the findings of previous research studies, the following hypotheses were proposed:

- Hypothesis 1: Students will attribute difficulties to the same factors as faculty (discipline, student, and teaching factors).
- Hypothesis 2: Students will agree with faculty that discipline factors are most important in making this course difficult.
- Hypothesis 3: Students will agree with faculty that student factors are more important than teaching factors.

MATERIALS AND METHODS

Participants

Participants were 276 students from three sections of human anatomy and physiology courses. Total enrollment in the three courses was 403, reflecting a response rate of 68%, typical for daily attendance in those courses. Two of the courses were Anatomy & Physiology I (N=183) and one was Anatomy & Physiology II (N=93). Of the participants, 72% (N=198) were female, 23% (N=63) were male, with 5% (N=15) not reporting gender. Sixty-three percent (N=175) were White, 23% (N=62) were African-American, 3% (N=8) were Asian-American, 2% (N=6) were Hispanic, and 5% (N=15) were "Other," with 4% (N=10) not reporting ethnicity. For class standing, 46% (N=127) were sophomores, 40% (N=110) were juniors, 5% (N=14) were seniors, 1% (N=3) were freshmen, and 2% (N=5) were "other," with 6% (N=17) not reporting. Students' self-reported GPA was 2% (N=5) "< 2.0," 13% (N=35) "2.00-2.49," 21% (N=57) "2.50-2.99," 34% (N=93) "3.00-3.49," and 26% (N=72) "3.50-4.00," with 5% (N=14) not reporting. Students' majors were: 43% (N=118) nursing, 26% (N=72) exercise science, 6% (N=17) health education and promotion/community health, 4% (N=10) biology/pre-med, 3% (N=7) athletic training, 3% (N=8) nutrition, 1% (N=4) health and physical education, and 11% (N=31) "other," with 3% (N=9) not reporting. For 87% (N=239) of the participants, the course was specifically required as part of their degree program, and approximately 89% (N=244) of the participants indicated that they were "likely" or "very likely" to continue with their chosen major.

Materials

For this investigation, Michael's survey of physiology faculty that assesses factors that make physiology difficult to learn was adapted.[11] Questions were asked about the anatomy and physiology course combined. Also, the language of some of the questions (Qs. 2,3,5,8, and 16) was adapted to ensure that students understood the questions correctly. For example, the word "teleological" was replaced with "thinking about things in terms of their purpose" (see Appendix A). The survey consisted of 18 items divided into three categories: discipline (seven items), teaching (six items), and students (five items). Responses options were a Likert-type scale from "strongly disagree" to "strongly agree" with higher scores indicating higher levels of agreement.

Additionally, the questionnaire contained eight demographic questions (reported above in the participants section) and one question about the perceived difficulty of the course, which served as the independent variable: "How difficult is it to learn Human Anatomy & Physiology?" with response options of "not at all difficult," "somewhat difficult," "fairly difficult," "very difficult," and "extremely difficult." The question about the perceived difficulty of the HAP class was accompanied by an open-ended question asking participants, "Why might HAP be difficult for some students to learn? What is it about HAP that makes it difficult?"

Procedure

Students in three sections of HAP I and II were invited to take a survey of perceptions of what makes anatomy and physiology difficult after appropriate approval from the Institutional Review Board was obtained. The surveys were administered toward the end of the semester after students took three out of the five in-class tests. Students were told that the data would be anonymous and that there would be no incentive for participating or penalty for not participating. Students were given 15 to 20 minutes of class time to complete the survey. With the exception of the open-ended question to which they wrote their answer directly on the survey, answers to all other questions were entered via students "clickers" in the anonymous mode (i.e., wireless remote instruction system). At the end of the time period, the surveys were collected and sealed in envelopes.

RESULTS

Qualitative Analyses

Participants received one qualitative question to explore students' own perceptions about what makes HAP difficult. Student responses to the question (230 total statements) were entered into an Excel spreadsheet for analysis and were organized into three categories: discipline related, student related, and teaching related. If a statement fitted into multiple categories, it was placed in multiple categories. The qualitative analysis included actual statements and their total number and percentage for each category. All statements fitted into the above named categories and no other themes were identified.

Students from both sections agreed that discipline factors (90 statements for HAPI and 69 statements for HAPII) were most important in making this class difficult. Student statements included:

> *"The hardest parts of learning Anatomy are memorizing chemical names and breakdowns, while also trying to understand how every system/chemical works together."*
>
> *"It is a lot of information at one time & every detail builds upon something else."*
>
> *"It's much more than just knowing facts, but also understanding them and why things are the way they are."*
>
> *"It is difficult b/c some of the abstract concepts are hard to comprehend."*

Participants identified student factors as the second most important factor in making HAP classes difficult (29 statements for HAPI and 23 statements for HAPII). Some of the student comments indicated:

> *"Especially for AP I, I think [the] majority [of] the students try and memorize the facts and have little or no connection between major concepts."*
>
> *"I think students find it hard because everything in the body is connected to everything and instead of trying to figure out how things work together they just try to memorize it and crushing everything in their brain night before test."*
>
> *"It's difficult in different aspects. It takes time management and also perseverance. AP is really not that difficult to learn, it only becomes difficult when you don't put in the required effort."*
>
> *"If you want to do well, you have to put a lot of effort and time to master the material. In AP I & II, I went home after class and studied what we went over and it was extremely helpful."*

An interesting finding related to teaching factors emerged during analysis. Students in both sections ranked teaching factors as the least important component in the three factor model (10 statements for HAPI and 19 statements for HAPII). Students commented:

> *"The teacher expects too much to be learned at one time."*
>
> *"I would like it better if the teacher could explain everything more in simpler terms."*
>
> *"There is a lot of information. It is completely new to most people, but sometimes professors don't realize that. This information needs to be completely explained as if we are beginners."*
>
> *"Sometimes the info is not presented in a slow manner and is taught too fast and is not repeated enough or slowly enough to write extra info down."*

However, HAPII students had more comments on teaching than HAPI students. It seems that HAPII students placed more importance on teaching factors than their counterparts in HAPI. This correlates with an interesting finding in the quantitative data analysis below, which indicated that HAPII students perceive HAP to be more difficult than HAPI students.

Qualitative analysis also revealed that the language of the class and content overload are among the most important factors that make this class difficult.

> *"It is difficult to learn because to most of the students it's like learning a new language (just a scientific one)."*
>
> *"It's just lot of information to learn."*
>
> *"The sheer number of terms that is required of a student to remember is a bit extreme."*
>
> *"It is a lot of information (very specific details) that make it difficult to learn in a short time."*

Quantitative Analyses

Scale Analyses

Reliability analyses were conducted for each of the three subscales of the adapted Michael measure[11]: discipline (Chronbach's alpha = .64), teaching (alpha = .80), and student (alpha = .71). Pearson product moment correlational analyses indicated only small relationships between the subscales. See Table 1.

Table 1. Scale Data

Subscale	Discipline	Teaching	Students	*Mean*	*SD*
Discipline	—			3.68	.57
Teaching	.04	—		2.93	.81
Students	.21**	.14*	—	3.53	.66

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

Paired samples t-tests revealed mean scores on each subscale to be significantly different from the other two: discipline-teaching, t (266) = 12.90, $p < .001$, Cohen's d = 1.10; teaching-student, t (261) = -10.22, $p < .001$, d = 0.83; discipline-student, t (261) = 3.37, $p < .01$, d = 0.26. Students attributed the most difficulty to discipline factors, followed by student factors, followed by teaching factors. See Table 2.

Table 2. Item Rankings

Question #	Michael's Rank	Current Rank	*M*	*SD*	Subscale
5	14	1	4.11	1.00	D
3	1	2	4.11	0.92	D
4	3	3	4.07	0.84	D
14	2	4	3.83	1.04	S
2	5	5	3.77	1.01	D
7	11	6	3.71	1.04	D
15	7	7	3.71	0.88	S
16	6	8	3.69	1.02	S
18	9	9	3.30	1.13	S
13	13	10	3.27	1.13	T
1	8	11	3.22	1.10	D
8	10	12	3.16	1.05	T
11	12	13	3.13	1.24	T
17	17	14	3.09	0.94	S
12	16	15	2.94	1.19	T
6	4	16	2.80	0.92	D
9	11	17	2.70	1.05	T
10	15	18	2.38	1.18	T

Note. D=Discipline, S=Student, T=Teaching.
Numbers are based on a 5-point Likert-type scale

MANOVA Analyses

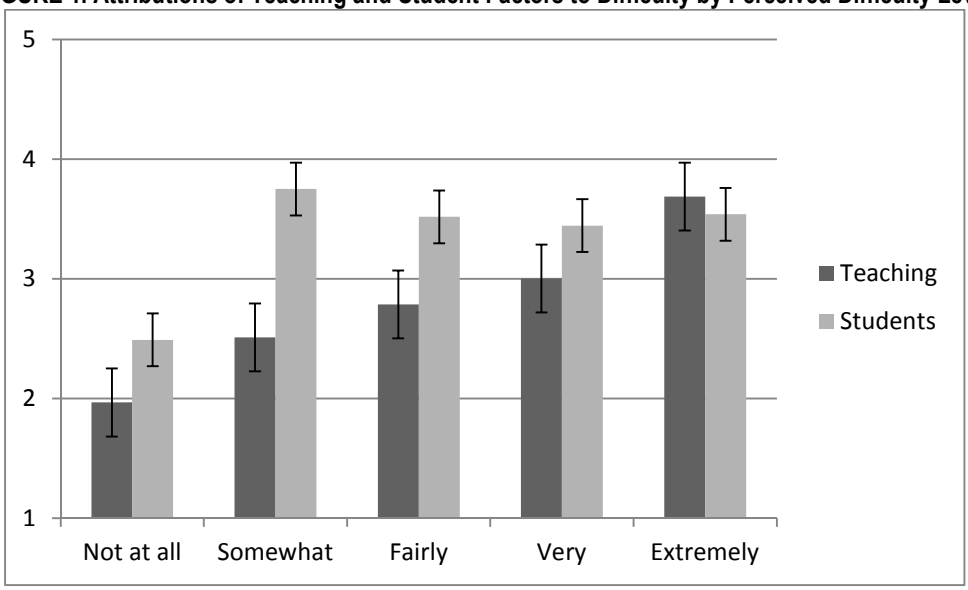
A MANOVA with the discipline, teaching, and student subscales as dependent variables and the perceived difficulty question as the independent variable revealed a significant effect, Pillai's Trace = 0.28, F (12, 741) = 6.25, $p < .001$, partial $\eta^2 = .09$. Follow-up univariate analyses revealed significant models for teaching, F (4, 252) = 14.44, $p < .001$, partial $\eta^2 = .19$, and students, F (4, 252) = 4.79, partial $\eta^2 = .07$, but not for discipline, F (4, 252) = .73, *ns*. LSD post hoc analyses are presented in Table 3 and Figure 1. The general pattern of results for the teaching subscale was linear, with students who perceived higher levels of difficulty in the material also reporting higher scores on the subscale. The pattern of results for the student subscale indicated a large and significant difference for students who perceived the lowest level of difficulty in the material reporting substantially lower scores on the subscale than students who perceived higher levels of difficulty.

Table 3. Means and Standard Deviations by Perceived Difficulty and LSD Post Hoc Analyses

Dependent Variable	Perceived Difficulty									
	Not at all difficult		Somewhat difficult		Fairly difficult		Very difficult		Extremely difficult	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Teaching	1.97_a	.66	2.53_a	.68	2.80_b	.72	3.00_c	.77	3.71_d	.72
Student	2.49_a	.21	3.75_b	.64	3.52_{bc}	.56	3.44_c	.69	3.54_b	.77

Note. In each row, means with different subscripts are significantly different at $p < .05$.

FIGURE 1. Attributions of Teaching and Student Factors to Difficulty by Perceived Difficulty Level



DISCUSSION

This study sought to investigate students' perceptions of the difficulty of the human anatomy and physiology class at the undergraduate level. This study was different from previous research in that it examined students' perceptions, examined students' perceptions for a combined anatomy and physiology class, examined students' perceptions at the undergraduate level, surveyed both classes (HAPI and HAPII), included ALL allied health disciplines, and examined large classes. Previous studies focused exclusively on physiology classes and faculty, student perceptions in medical students, graduate students or upper division undergraduates, and only targeted students in one major, like exercise science. [7-11]

Results supported all three hypotheses. The analysis showed that students find HAP to be a difficult class, and there is consensus on this among both HAPI and HAPII students. These difficulty issues seem to be universal, as the data did not show any significant gender, ethnicity, major, or class standing differences among the targeted population. This data supports faculty perceptions about the difficulty of physiology as well as the findings from the chemistry studies.[11-13] The results also indicated that students in HAPII perceived HAP to be more difficult, although we could not identify any factors explaining this difference in our data. This almost seems counterintuitive, as one would assume that students who passed HAPI already possess certain skills that would make HAPII less difficult. However, it is possible that this dichotomy is explained by the less tangible character of topics in HAPII in comparison to HAPI topics -- topics that are more complex when it comes to the physiology of organ systems in HAPII or the fact that students do change their perspective on the difficulty of the class as they enter HAPII. This could warrant further investigation in trying to understand a possible change in perspectives from one class to another.

Hypothesis 1 was fully supported. Quantitative and qualitative data attributed students' difficulties to same factors as faculty and subscribed to the three factor model.[11-13] As the subscales were only moderately intercorrelated, they seem to measure the three distinct parts that make HAP difficult.

Hypotheses 2 and 3 were also supported. Students agreed with faculty and placed discipline and student factors as more important than teaching factors. Previous research on faculty ranked the top 10 factors and included five discipline factors, four student factors, and one teaching factor.[11] Students in this current study mirrored these results by placing five discipline, four student, and one teaching factor in the top 10 list. There was, however, a discrepancy in terms of the order the factors ranked. The biggest discrepancy was noted with question five ("Anatomy and Physiology, like other life sciences, seems to encourage thinking about things in terms of their purpose") and question six ("Much of our understanding of physiological mechanisms is communicated graphically or in other mathematical way"). Students ranked Q. 5 as the top most important reason in making HAP difficult, whereas faculty placed it 14th (out of 18 questions). Question 6 seemed less important for students, who ranked it 16th, whereas faculty placed more importance on it by ranking it at number 4. It is important to note that since several questions in the survey were adapted for use by students that could account for some of this discrepancy. However, these findings could also indicate that students do not place enough importance on visual aids in the textbook or during the lecture, and faculty can emphasize this more to students.

It is also interesting to note that student factors emerged as consistently more important than teaching factors. This holds true for all students, with the exception of those who report that HAP is "extremely difficult" to study as seen in Table 3. This could indicate that students tend to "blame" their instructors more as they encounter more difficulties with HAP topics. However, it is also possible that the way instructors teach becomes more important for understanding the material as the difficulty perception of the class increases. If possible, identifying these students in the beginning of class and offering tutorial help could mediate the issue.

The results of the study raise some important issues for the teachers of undergraduate HAP who are facing large classes, high DFW rates, and a "difficult" class. One of them is the issue of the discipline itself. Students are concerned that they have to learn a "different" language encompassing new terminology and buzz words, while they are struggling to understand a lot of new information. Rightfully so, the volume of HAP textbooks is increasing, as there is an increase in knowledge and research in the discipline.[17] There is also little consensus as to what students should know.[17, 18] Instructors could learn more about their students and their needs, focusing on designing effective curricula with well-developed learning outcomes and a reduced amount of factual information to memorize, and learning more about how their students learn in the HAP classroom.

Another issue that transpired during the qualitative analysis was the issue of student ownership. It is evident that students acknowledge their contribution to making this class difficult, even more so than the responsibility they place on their instructors. This suggests the possibility for instructors to "reach" these students and help them succeed. Instructors can share students' perception when starting a new class, manage a discussion board where students can share "survival" tips or create "guides to success" to overcome the difficulties of the class. Based on the qualitative data obtained from the students in this study, these are some tips that students identified as useful in studying for this class.

> "Learn what study habits work and which ones don't!"
>
> "Be disciplined! Study in advance! Study on a regular basis! Study every day! You can't study the night before and be okay".
>
> "Learn the early chapters, because the later chapters don't make much sense without them."
>
> "Don't memorize, try to understand!"
>
> "Stay ahead on your reading!"
>
> "Come to class and take notes."
>
> "Take Chemistry, Medical terminology and Biology prior to HAP!"

A troublesome finding in the current study was the disconnect between students' intentions and their success in class. Approximately 89% of the participants indicated that they were "likely" or "very likely" to continue with their chosen major, yet 30% to 50% of the students enrolled in the class will fail it. So, on one hand, students understand that this class is difficult and take their share of responsibility for making it difficult. On the other hand, most of them do not expect to fail a prerequisite without which they cannot progress in their majors. Curiously, the pass rate of 50-70% is very close to the 62% of students reporting a GPA>3.0 in this study. This, in turn, raises several issues for HAP instructors. The first one is low motivation in subsequent classes, as the degree of difficulty/heavy demand on studies is an important factor in explaining low motivation in students.[19] At our institution there is no formal policy on the number of repeat HAP classes or any prerequisites for entering the HAP classes. The study seems to suggest that requiring a minimum GPA could reduce the DFW rate, address issues of low motivation, and reduce the perception of difficulty for students taking the class. More research is also needed to understand if requiring other science classes before taking HAP changes students' preparedness for HAP and whether that can affect their perceptions of the degree of HAP difficulty.

Lastly, although teaching factors consistently lag behind the discipline and student factors, they are still an important component of the model. They seem to be especially important for students who find this class "extremely" difficult. Reducing passive teaching strategies and teaching with active methods can help students understand abstract concepts, while mastering new terminology to explain them. [20-23]

Limitations

Although the findings reported above support previous data on faculty perceptions in physiology, they should be interpreted in light of several limitations. First, the data for the study comes from one single university, so results might not be generalized to other populations. The sample was large and included multiple sections from both HAP I and II; however, white females from the pre nursing major were overrepresented. Although this composition is typical of classes at this university, other universities might be more ethnically or gender diverse. Second, this sample only included students in HAP sections taught by the same instructor, who is active in the Scholarship of Teaching and Learning. Examining students from classes taught by multiple instructors with different teaching philosophies and strategies could bring forth more details on the importance of teaching factors in student perspectives. Third, the study targeted large lecture classes where the predominant teaching strategy is the lecture. Small classes that have a more hands-on approach could change students' perceptions. Last, future research should focus on exploring student perceptions at different times throughout the semester, as well as expand to graduate allied health students, because perceptions could change from the beginning of the semester to the end and from the undergraduate level to the graduate level.

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KEY TERMS
Allied Health, Perceptions, Difficult, Anatomy and Physiology, Undergraduate

Appendix A
Human Anatomy & Physiology Difficulty Survey

Indicate your opinion about the following statements using the response scale as follows:
1 SD = Strongly Disagree
2 D = Disagree
3 Neither = Neither Agree or Disagree
4 A = Agree
5 SA = Strongly Agree

What is it about the subject matter of AP that makes it hard to learn? [Discipline]	
1. Understanding AP is based on (built upon) an understanding of physics and chemistry.	SD D Neither A SA
2. Physiological phenomena need to be understood at a number of different organizational levels at the same time* (from the molecular to the whole organism).	SD D Neither A SA
3. Understanding AP requires the ability to think in terms of cause and effect.	SD D Neither A SA
4. Understanding AP requires at least some limited ability to think about dynamic systems.	SD D Neither A SA
5. AP, like other life sciences, seems to encourage thinking about things in terms of their purpose.	SD D Neither A SA
6. Much of our understanding of physiological mechanisms is communicated graphically or in other mathematical ways.	SD D Neither A SA
7. The language of AP is a mixed one, with many commonly used words taking on specific, scientific meanings that are different from (sometimes opposite from) their lay meanings.	SD D Neither A SA
What is it about the way that AP is taught that makes it hard to learn? [Teaching]	
8. Textbooks typically present factual information, not explanations of phenomena or concepts.	SD D Neither A SA
9. Neither authors nor teachers stress the commonalities of function across organ systems ("common themes" or general models).	SD D Neither A SA
10. Teachers do a poor job of defining and communicating learning objectives (what students should be able to do at the end of the class).	SD D Neither A SA
11. Teachers expect too many memorized facts and too little understanding at the same time.	SD D Neither A SA
12. Teachers and authors use language imprecisely, use too much jargon, and use too many acronyms, all to the detriment of learning.	SD D Neither A SA
13. In class, teachers talk (AP) too much and students talk (AP) too little.	SD D Neither A SA
What is it about the way that students attempt to learn AP that makes it hard? [Students]	
14. Students believe that "learning" is the same thing as "memorizing".	SD D Neither A SA
15. Students compartmentalize (pigeon-hole) everything, failing to look for, or see, commonalities across organ systems or phenomena.	SD D Neither A SA
16. Students fail to appreciate how physiological mechanisms work together; they don't think about the respiratory system while learning acid/base balance because they studied it months ago and have already passed the test on that subject.	SD D Neither A SA
17. Students assume that ALL physiological responses must benefit the organism.	SD D Neither A SA
18. Students tend to ignore graphs, tables and figures, and when they attempt to use them they don't understand the meaning to be found there.	SD D Neither A SA

* All underlined statements were adaptations of the original survey (Michael, 2007)
Q. 2. "At the same time" replaced "simultaneously" from the original survey
Q. 3. "In terms of cause and effect" replaced "to reason causally" from the original survey
Q. 5. "Thinking about things in terms of their purpose" replaced "teleological thinking" from the original survey
Q. 8. "Present factual information, not explanations of phenomena or concepts" replaced "descriptive compendia of facts, not mechanistic descriptions of phenomena or concepts" from the original survey
Q. 16. "Physiological mechanisms work together" replaced "integrative nature of physiological mechanisms" from the original survey
In all questions, where appropriate, "Anatomy and Physiology" replaced "physiology" from the original survey