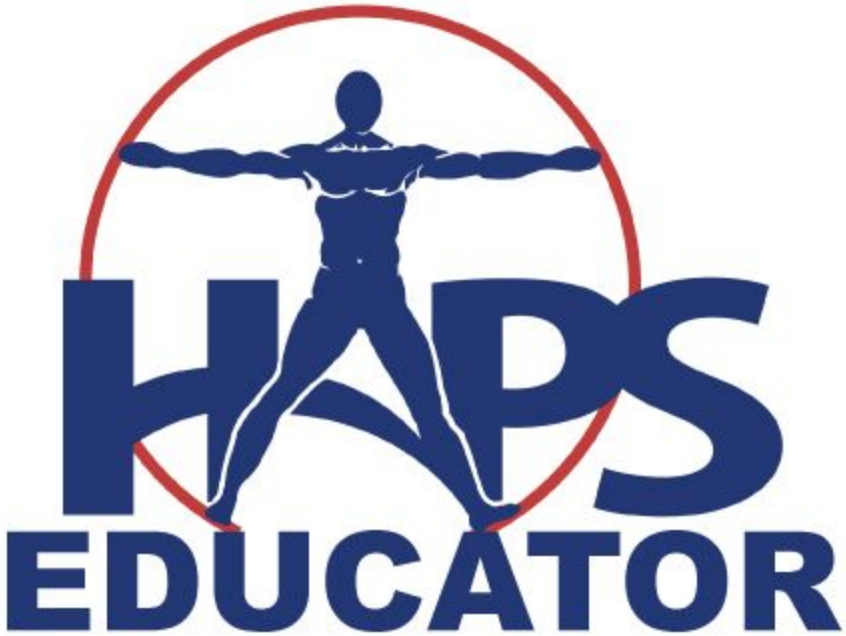
The Effects of Sex, Ethnicity, and Socioeconomic Status on Student Perceptions of Case-based Learning in Anatomy and Physiology Classes

Tirzah Birk, Valerie Lee, and Aaron Corbit

Corresponding Author: tbirk1@ivytech.edu

HAPS Educator. Vol 23 (2), pp. 385-95. Published August 2019.

https://doi.org/10.21692/haps.2019.022



Birk T, Lee V, and Corbit A (2019). The Effects of Sex, Ethnicity, and Socioeconomic Status on Student Perceptions of Case-Based Learning in Anatomy and Physiology Classes. *HAPS Educator* 23 (2): 285-95. https://doi.org/10.21692/haps.2019.022

The Effects of Sex, Ethnicity, and Socioeconomic Status on Student Perceptions of Case-based Learning in Anatomy and Physiology Classes

Tirzah Birk, MS[1], Valerie Lee, MS[2] and Aaron Corbit, PhD[2],
[1]School of Liberal Arts and Sciences, Ivy Tech Community College, Lafayette, IN tbirk1@ivytech.edu
[2]Biology and Allied Health Department, Southern Adventist University, Collegedale, TN vlee@southern.edu, acorbit@southern.edu

Abstract
Research has shown that a moderate to high level of Active Learning (AL) is helpful for all students, especially for disadvantaged students. In this study we measured student perceptions of case-based learning (CBL), a type of AL, in anatomy and physiology courses at a four-year university and a community college. We compared perceptions of CBL to student final grades and several demographic factors including sex, ethnicity, and socioeconomic status (SES). We found that students with higher final grades tended to feel that CBL increased their confidence with the course material and helped them build relationships with other students. We also found that students with lower SES were more satisfied with CBL activities and vice versa. Student populations with a higher proportion of disadvantaged students may benefit from higher levels of AL, while classes with more advantaged students may benefit from a moderate level of AL with mixed learning techniques. https://doi.org/10.21692/haps.2019.022

Key words: active learning, student perceptions, socioeconomic status, case-based learning

Introduction
Introductory Anatomy and Physiology courses have some of the highest attrition rates nationwide (Hull et al. 2016), making them an important area of educational research. Although a range exists, several studies have found attrition rates near 50%, which is higher than the science-wide attrition rate of approximately 30% (Gultice et al. 2015; Chace 2014; Hull et al. 2016). One of the paradoxes of education is that while higher education is one of the fastest ways to break away from poverty and rise in socioeconomic class, students who are in the greatest need are least likely to persist in higher education (Aragon 2000; Wells 2008; Wells et al. 2011; Smith et al. 2015). Obtaining jobs in nursing and allied health is one of the major ways that people can rise from lower to middle class and introductory Anatomy and Physiology courses serve as the gateway to these jobs (Hlinka et al. 2015).

Who are disadvantaged students in higher education?
Students most likely to give up on their education (Table 1) include those with low socioeconomic status (SES) (Number and percentage... 2013; Wapole 2003), and those with low social and cultural capital; specifically, those unlikely to use social networks to their advantage and those "without cultural indicators of symbolic wealth". The previous two groups often include minorities (Wells 2008). Students less likely to complete their education also include males since there are lower percentages of males of all ethnicities enrolling in college and earning degrees (Percent of recent... 2016; Wells et al. 2011). Recent medical school demographic surveys have suggested that some minorities are still under-represented (Smith et al. 2015).

Demographics of students less likely to obtain higher education
Low SES: low parent income, parent education & occupation (Number and percentage…2013)
Low social capital: parents and peers have low educational expectations (Wells 2008)
Low use of college enrollment strategies such as AP courses, SAT prep, and extracurriculars (Wolniak et al. 2016)
Fewer males than females earn college degrees (Percent of Recent… 2016), especially males from disadvantageous environments & ethnic minorities particularly black (Chetty et al. 2016; Autor et al. 2015)
Ethnicity: 56.5% of black students enroll in college after high school, compared to 70% white, 70% hispanic, & 87% asian (Percent of Recent… 2016)

Table 1. *Disadvantaged students in higher education*

continued on next page

With a growing aging population increasing the need for nursing and allied health jobs, the role of the Anatomy and Physiology instructor is vital not only to the livelihoods of our students but also to the care of our population. So the crucial question is: how do we help our students succeed in Anatomy and Physiology?

What helps students stay?
Many studies have been devoted to student retention. Vincent Tinto, one of the most influential early researchers in retention said, "students who learn are students who stay" (Tinto 1999). John M. Braxton's retention model suggests that social integration drives a student's commitment to their institution and thus contributes to the learning process (Braxton and Francis 2018). As an illustration of that, one study from Stanford University indicates that even a brief social-belonging intervention improved academic and health outcomes of minority students (Walton and Cohen 2011).

According to Braxton and Francis (2018) students will succeed when (1) expectations are clear, consistent and high (2) when support is available (3) when there is frequent assessment and feedback and (4) when students have high quality and frequent interactions with faculty, staff and peers. The focus of this study is to examine element four because "outsiders" in higher education are helped by increased interactions with faculty (Crosling et al. 2009) and peers through a variety of methods (Graham et al. 2013).

Rationale for using Active Learning
Active Learning (AL) is defined by Braxton et al. as "students doing things and thinking about the things they're doing" (2008). This is certainly not the only way to accomplish the goal of having high quality and frequent interactions with faculty and peers but it is one important way. AL includes a variety of specific learning approaches that range in duration and scope (Michael 2006). The strongest argument for the efficacy of AL is a meta-analysis, published in *PNAS,* of 225 AL studies in which the authors conclude that AL is effective because students in STEM courses with AL were 1.5 times less likely to fail and earned 6% higher grades compared to traditional counterparts (Freeman et al. 2014). The strongest argument against the efficacy of AL is that simply having an active activity does not always improve student outcomes and may actually be unhelpful. One study showed that medical students in an AL [Problem-Based Learning] course earned lower standardized test scores and another showed doctors who were trained using AL ordered more expensive/unnecessary tests (Kirschner et al. 2006; Alferi et al. 2011; Vernon and Blake 1993). Additionally, researchers surveying AL versus traditional lecture biology courses at institutions across the US saw no difference in scores on a standardized biology quiz for 33 courses that the authors suggest may be due to having poorly-designed exercises (Andrews et al. 2011). Simply using AL is not the same thing as teaching effectively as evidence exists that instructors do not always use AL techniques in the way they were designed (Andrews et al. 2011).

Therefore, the conclusion we make is that AL is effective if done well. Michael (2006) reviewing AL research in physics, chemistry, biology, and physiology provides a thorough description of what effective AL should include based on the current understanding of how we learn; we suggest that readers new to AL refer to this article. In fact, Weiman (2014) argues in *PNAS* that it is no longer acceptable to use traditional lecture teaching as the comparison standard and that research needs to be done on individual AL methods. It is even likely that AL, when combined with Braxton's other factors of student success, would lead to increased student retention (Graham et al. 2013). We emphasize the importance of thoughtful planning to prepare AL exercises according to suggestions in the literature (Table 2).

Principles of Effective Active Learning
Clearly related to topic; reduces extraneous, attention-draining processes (Van Meter 2015)
Begins with a clear statement of purpose (Van Meter 2015)
Faculty models process and ensures students understand (Michael 2006)
Activity directs attention to key concepts (Van Meter 2015)
Progress slowly, giving multiple opportunities to problem-solve (Michael 2006)
Ends with a debriefing to reinforce key ideas (Van Meter 2015)

Table 2. *How to make an effective Active Learning activity: a non-exhaustive list*

AL is an umbrella term which includes many specialized methods such as Team-based learning (TBL) and Case-based learning (CBL). We chose CBL as it lends itself to developing clinical thinking for introductory Anatomy and Physiology courses. CBL is defined as learning that is based upon the description of a patient's problem(s), analysis and interpretation of all the relevant data obtained from history, examination, and investigations, and planning further management of the patient (Bano et al. 2015). CBL develops critical thinking and metacognition, and can also help learners improve communication and collaboration skills (Savery 2006; Khosa and Volet 2013). While previous studies have found it hard to measure improvements in performance,

continued on next page

several studies have shown that students prefer CBL to other types of teaching (Bano et al. 2015; Forsgren et al. 2014; Srinivasan et al. 2007). One study found that CBL improved the patient assessment skills of undergraduate nursing students, better preparing them for clinical practice (Torreda et al. 2015).

Previous research on active learning outcomes for disadvantaged students

Haak et al. (2011) compared three types of introductory Biology courses at the University of Washington: no AL, moderate AL (daily clicker questions, weekly practice exams), and high AL (little to no traditional lecture) and found that disadvantaged students were most helped in the high AL course. All students performed better, but AL disproportionately helped disadvantaged students, closing the achievement gap by 45% in the high AL course. Perhaps the reason that AL helps disadvantaged students is that they benefit from talking through problems aloud and experiencing interdependence with peers (Hettler 2015). AL has also been shown to help students perform better on critical thinking questions (Haak et al. 2011). The conclusion, therefore is that the best kind of course for disadvantaged students is one that is entirely AL. This raises a difficult issue however, since most science courses are still taught primarily as traditional lecture and it would be problematic to require instructors to change every single meeting. Preparing and using AL can be time and labor intensive since AL should be well designed and connected to an educational philosophy that benefits students (Andrews et al. 2011). Usually studies of AL's efficacy are done with the few best instructors at an institution (Eddy and Hogan 2014) who have been trained in educational research (Andrews et al. 2011). Since research findings at one institution may not be transferable in other contexts (Eddy and Hogan 2014), the NSF supports even repeating studies in different contexts (Widening Implementation and… 2013). Therefore, the aim of our study was to examine the effects of a low to moderate amount of AL, something doable for new instructors, on disadvantaged students.

One fourth of the higher education institutions are community colleges, and they educate one third of the students enrolled in higher education in the US (Wells 2008). Students who attend community colleges are more likely to be disadvantaged students (see Table 1) (Wells 2008). So it is fitting that research done with the goal of helping the disadvantaged in higher education be done not only at a university but also a community college. The NSF has recognized the value of community colleges and has recently provided a grant to encourage educational research in this setting (CAPER 2018).

Therefore, the goal of this study was to compare student perceptions of CBL across several demographics at a university and community college.

Methods

Four 50-minute class periods that had been traditional lectures were replaced with CBL in a second semester introductory (100-level) Anatomy and Physiology course at two institutions, a community college and a university. Two CBL cases were obtained for free from the *National Center for Case Study Teaching in Science*. The other two CBL cases were diagnostic games developed by the authors (Birk 2015). Since the other class periods were almost entirely traditional lecture, this is considered more than low-structure but less than moderate-structure AL (Andrews et. al 2011; Haak et al. 2011). We considered the Anatomy and Physiology lectures in both institutions to be low/moderate-structure AL. The classes at both institutions had required concurrent labs that were considered high-structure AL with multiple active learning components during each lab period.

Data were obtained during three semesters: fall 2015 through fall 2016, at two institutions: a public community college and a private four-year university. Data were collected in the form of student surveys given at the end of each semester. The surveys gathered demographic information, as well as information about student perceptions of the CBL in the form of nine Likert scale questions.

This study was approved by the Ivy Tech Community College Institutional Review Board, Protocol #15019. The research was determined to be exempt from further IRB review under Exempt Category 1: research conducted in established or commonly accepted educational settings. This study was also approved by the Southern Adventist University Institutional Review Board, IRB Tracking Number 2015-2016-007.
Participation was voluntary and informed consent was obtained from all participants.

For the Anatomy and Physiology case studies, students were assigned to work in groups of five (Parmelee et al. 2009). A study done by St. George's University used modified ***S***ubjective (chief complaint), ***O***bjective (measurements and tests done), ***A***ssessment (differential diagnosis), and ***P***lan (treatment and follow-up) (SOAP) notes, to help guide small group discussions in a Medical Physiology course (Kibble et al. 2006). SOAP notes are clinical notes that medical and mental health practitioners sometimes use to document a patient's visit and treatment on his/her medical chart. In order to make the cases in this study effective, SOAP notes were

continued on next page

used to direct attention to the main concepts and to tie the case studies together in the two Anatomy and Physiology courses (Van Meter 2015; Michael 2006). Students were given examples of SOAP notes to guide them in the process (Blake 2011; Ball and Murphy 2008). Students were given pre-class reading assignments and quizzes at the beginning of class to ensure they were prepared (see Table 3).

CBL structure (10pts total per CBL, out of 1000 points in the course)
Pre-class reading assignment given at the end of previous class
4 question Quiz given at the beginning of session covering the reading assignment (4pts)
SOAP notes made during class and submitted at the end (3pts)
Peer evaluation. An average was made of all peer evals (3pts)

Table 3. *Assessments used for each AL (CBL) activity. Four 50-min. lecture periods were replaced with CBL in the semester*

The surveys included modified Likert-scale statements that connected the SOAP notes, case studies, and diagnostic games to Satisfaction, Knowledge, and Peer Interactions (see statements in Table 5).

Likert-scale statements for each of the three elements above were stated both positively and negatively. This was done to prevent students from being fed positive answers and to prevent students from filling out the same number for every answer (see statements in Tables 7 and 8). We modified the Likert scale to include a neutral as follows: 1= strongly disagree, 2= disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree.

Informed consent was obtained by verbal explanation. A student handout described the voluntary nature of the surveys and stated that participation would have no impact on a student's grade. Faculty were required to leave the lab while students completed their surveys. A student volunteer gathered all of the survey papers and delivered them to the Department Office where the receptionists placed the surveys in a locked cabinet until after final course grades were submitted for each semester.

Statistical Methods

Analysis of the Likert data was facilitated by the use of factor analysis. This type of analysis condenses correlated variables into a single variable called a factor. This allowed us to reduce the number of variables and determine the underlying structure of the data. Of particular interest was whether the way we classified the questions was reflected in the way the students responded to them. The factor analysis was performed using Principle Component Analysis, Varimax rotation, and Keiser normalization. Factors were retained if their eigenvalues were greater than one.

Once the factor analysis was completed the factor scores were used as the dependent variables in several linear models. The dependent variables included in each model were SES score (numeric), final grade (numeric), sex (factor), and ethnicity (factor) as well as the interaction between sex and ethnicity. We did not include the type of educational institution (public community college vs. four-year university) as a separate variable in these models since: 1) preliminary data analysis (not shown) did not detect any differences between community college and four-year university students and 2) this information was largely included in the SES score since most students began their college career at the type of institution they were attending when this study was conducted (see below).

SES score was calculated by adding up the dummy variables assigned to the following demographic categories (Wells 2008): Financial Aid (0=yes, 1=no), parental degrees (0=0 parents with college degrees, 1=1 or 1 parents with college degrees), educational expectations (0= certificate or other less than associates degree, 1= expect associates or higher), peer expectations (0= none, a few, some friends expect degree, 1= most, all friends expect degree), parent expectations (0= no parent expects degree, 1= 1 or 2 parents expect degree), begin college at 2-year or 4-year institution (0=2-year, 1=4-year), begin college part or full time (0=part time, 1=full time).

We conducted statistical analysis using SPSS v. 24 (IBM Corp., Armonk, NY, USA), with alpha for hypothesis testing set at 0.05. For each linear model, we computed effect sizes as partial eta-squared (η^2). Partial eta-squared can be interpreted as percent of variance explained with values of ~0.01, ~0.06, and ≥ 0.14 corresponding loosely to small, moderate, and large effects, respectively (Cohen 1988).

continued on next page

Results

General Results

Eighty-one students completed the survey. See Table 4 for student demographics and Table 5 for average Likert scores to each question. The total attrition rate at both institutions for the three semesters of second semester Anatomy and Physiology course was 7.03% (9 out of 128 students received a D, F, or W), which is lower than the nationwide science attrition rate of 30% or the approximate 50% attrition rate for Anatomy and Physiology courses (Gultice et al. 2015; Chace 2014; Hull et al. 2016).

Sex	**Male** 24	**Female** 57						
Age Group	**18-22** 66	**23-27** 9	**28-32** 3	**33-37** 1	**37+** 2			
Ethnicity	**Asian** 10	**Black** 4	**White** 45	**Hispanic** 19	**Pacific Islander** 1	**Other** 2		
School	**Two-Year** 24	**Four-Year** 57						
SES Score	**0** 0	**1** 0	**2** 6	**3** 4	**4** 8	**5** 13	**6** 16	**7** 11
Final Grade	**A** 22	**B** 32	**C** 25	**D** 2	**F** 0			

Table 4. *Demographics information on students who completed the case-based learning (CBL) survey. N=81*

Question	Mean	SD
1. The doctor diagnosis game in class helped me get to know my classmates.	3.74	0.88
2. Being familiar with SOAP notes has helped me to model the clinical reasoning process.	4.17	1.00
3. I feel that using guided case studies helped me feel more confident about class material.	4.01	0.78
4. I feel the doctor diagnosis game was a waste of my time.	1.98	1.05
5. Being familiar with SOAP notes has helped focus our group discussion	4.02	0.76
6. I feel that using guided case studies in class helped me get to know my classmates.	3.47	1.06
7. Being familiar with SOAP notes has been a useful review tool before examinations.	3.78	0.96
8. I feel the doctor diagnosis game helped me feel more confident about class material.	3.95	0.79
9. I feel that using guided case studies was a waste of my time.	1.84	0.95

Table 5. *Mean and SD of five-point Likert scale questions measuring student perception of case-based learning (CBL) with "strongly disagree" coded as 1 and "strongly agree" coded as 5. N = 81.*

continued on next page

Factor Analysis

Four factors were retained that grouped together the Likert questions assessing student perceptions of the SOAP notes and other AL strategies. The manner in which the analysis grouped these Likert questions is shown in Table 6. This analysis suggested that the way students responded to these questions did not completely correspond to our original question classifications. Both factor one (26.64% of the variance) and factor two (22.47% of the variance) were associated with questions related to knowledge and peer interaction. This suggested that these were closely associated in the minds of the students and that students who felt that the AL aided in their knowledge also felt that these activities increased their interaction with peers.

Factor three (14.66% of the variance) mostly confirmed our original classification as it was only associated with questions related to satisfaction. However, one of these satisfaction questions was also strongly associated with factor one and its negative loading factor suggested that students who felt that the AL strategies increased their knowledge and peer interaction generally did not feel that the doctor diagnosis game was a waste of time. Factor four (14.58% of the variance) also generally confirmed our original classification as it was largely associated with the single question on group discussion.

Question	Classification	Factor 1	Factor 2	Factor 3	Factor 4
Being familiar with SOAP notes has helped me to model the clinical reasoning process.	Knowledge	0.892			
I feel that using guided case studies in class helped me get to know my classmates.	Peer Interaction	0.661	0.556		
I feel that using guided case studies helped me feel more confident about class material.	Knowledge	0.545			0.421
The doctor diagnosis game in class helped me get to know my classmates.	Peer Interaction	0.542	0.560		
I feel the doctor diagnosis game was a waste of my time.	Satisfaction	-0.706		0.577	
Being familiar with SOAP notes has been a useful review tool before examinations.	Knowledge		0.788		
I feel the doctor diagnosis game helped me feel more confident about class material.	Knowledge		0.785		
I feel that using guided case studies was a waste of my time.	Satisfaction			0.896	
Being familiar with SOAP notes has helped focus our group discussion-	Group Discussion				0.927

Table 6. *Principle component analysis loadings and original classifications for the Likert questions assessing student perceptions of the case-based learning (CBL) exercises. Values less than 0.4 are omitted.*

continued on next page

Linear Models

The results of this analysis are shown in Table 7. Two significant relationships were detected here. The first was that students with higher final grades tended to report that the guided case studies and SOAP notes increased confidence in their knowledge and that it helped them get to know their classmates (Factor 1, $F(1, 46) = 5.06$, $p = 0.029$, Partial $\eta^2 = 0.10$, $\beta = 0.55$). The second was that higher SESs were associated with greater dissatisfaction and feelings that these educational strategies were a waste of time. The reverse is also true: lower SES students reported stronger feelings that the cases were not a waste of their time (Factor 3, $F(1,46) = 4.48$, $p = 0.040$, Partial $\eta^2 = 0.09$, $\beta = 0.20$).

Independent Variables	Factor 1		Factor 2		Factor 3		Factor 4	
	p	Partial η^2	*p*	Partial η^2	*p*	Partial η^2	*p*	Partial η^2
Socio-Economic Score	0.289	0.02	0.797	<0.01	**0.040**	0.09	0.114	0.05
Final Grade	**0.029**	0.10	0.397	0.02	0.981	<0.01	0.300	0.02
Age Group	0.197	0.04	0.940	<0.01	0.607	0.01	0.201	0.03
Sex	0.494	0.01	0.189	0.04	0.854	<0.01	0.634	0.01
Ethnicity	0.531	0.07	0.912	0.02	0.571	0.06	0.463	0.07
Sex × Ethnicity	0.626	0.04	0.650	0.04	0.114	0.12	0.686	0.03

Table 7. *SOAP notes P- and partial η^2 values for multivariate linear models. P-values in bold are significant at $\alpha = 0.05$.*

Discussion

Difference by performance

Students with higher final grades felt more confident in their knowledge of the course material and that the cases helped them get to know their classmates. Although we cannot definitively say what the cause of this correlation is, it is likely that students who earn higher grades are already the kind of students who are looking to be involved, determined, and committed to their education, reaping multiple benefits. It seems likely that students who earn high grades would be predisposed with an eagerness to get to know their classmates and those earning low grades may be less interested. One implication of this finding may be to scaffold the importance of peer interactions by presenting early in the semester that studies show that students who have high quality peer and faculty interactions are more likely to stay in higher education (Braxton et al. 2008; Crosling et al. 2009; Graham et al. 2013). It is also likely that students earning a high grade have a positive bias towards the course in that they may feel more confident in their knowledge and with the relationships they made in the class simply because they were happy with their grade.

Satisfaction

The correlation indicating that students with lower SES were less likely to feel that AL activities were a waste of time may indicate that intentionally using guided case studies may be better received by disadvantaged students. This is consistent with the finding that disadvantaged students benefit from an interdependence with their peers and explaining their

continued on next page

answers aloud, while advantaged students are better helped by writing answers down (Hettler 2015). An increase in self-reported satisfaction with low/moderate amount of AL is a promising sign as Braxton and Francis (2018) showed that when students feel satisfied with a class they are more likely to stay in higher education. Since low SES students are at a higher risk for leaving higher education (Number and percentage... 2013; Wapole 2003), adding CBL may be a good start for instructors wanting to help disadvantaged students succeed.

The finding that high SES students were more likely to feel that AL was a waste of time seems consistent with the report that those who have high social and cultural capital, often those with high SES, feel entitled to higher education (Wells 2008), a kind of "spoiled brat" effect. The implications of this may depend on the instructor's goals and the student population. As previously discussed, research on the efficacy of AL in general has concluded that AL is helpful for all students if done well (Freeman et al. 2014; Michael 2006; Andrews et al. 2011). AL is disproportionately helpful for disadvantaged students (Haak et al. 2011; Hettler 2015). For institutions that attract primarily disadvantaged students, such as community colleges, having more AL would be better. But for institutions that have primarily advantaged students or a broad range, perhaps using a moderate amount of AL (a few daily and weekly AL activities) would be best. We suggest a variety of techniques for such an audience as writing out answers benefits advantaged students, while discussing aloud benefits disadvantaged students (Hettler 2015).

Future studies

As shown by Braxton et al. (2008), when students report more positive feelings toward a course, they are more likely to be committed to their education and stay at their institution. Such studies were done at four-year residential institutions which include inherent social integration components that lead to student retention (Braxton et al. 2008), so it is a promising sign that this improvement in the satisfaction of low SES students was seen both at the university as well as the community college. Future studies should verify if student perceptions lead to student retention and increased graduation rates across higher education.

Limitations

There are a number of limitations to this study that should be taken into consideration. As pointed out by Hull et al. (2016), these findings rely on student perception data, which is subjective and may not reflect their ability to learn and retain knowledge of the material. Additionally, it is likely that a positive bias may exist for the students who completed the survey. Out of 128 total students enrolled in Anatomy and Physiology during the study period (including nine who received a D, F, or W), only 81 filled out the survey. The orientation toward group discussion, peer interactions, etc. of the missing students might change these results.

Conclusion

The two key findings were: (1) low SES students were more satisfied with the course while the opposite was also true and (2) higher grades were associated with greater confidence in student knowledge and positive peer interactions. From these findings, we suggest that instructors may want to consider the demographics of their student population when designing their courses; aiming to give student populations with a higher proportion of disadvantaged students higher levels of AL, while giving populations with more advantaged students a moderate level of AL. In the classroom we recommend incorporating a variety of AL techniques to benefit all students such as brief writing (e.g., minute essay) or other individual assignments that target students who benefit from independence as well as paired or group discussions (e.g., think-pair-share, pre-assigned teams for cases) to target students who benefit from interdependence. Outside of class we recommend a targeted approach for lower SES students. This could include offering additional peer- or TA-led AL activities such as those found on the HAPS listserv. With high attrition rates in Anatomy and Physiology courses and the growing demand for nursing and allied health professionals, we as instructors should consider designing AL activities that will help our students succeed.

About the Authors

Tirzah Birk, MS, teaches anatomy and physiology and biology as an adjunct faculty member of Ivy Tech Community College in Indiana.

Valerie Lee, MS, taught anatomy and physiology and biology as a full-time faculty member in the biology department at Southern Adventist University in Tennessee for almost six years.

Aaron Corbit, PhD, is currently a full-time faculty member in the biology department at Southern Adventist University in Tennessee where part of his teaching load includes anatomy & physiology.

continued on next page

Reference List

Alfieri L, Brooks PJ, Aldrich NJ, Tenenbaum HR. 2011. Does discovery-based instruction enhance learning? *J of Educ Psyc*. 103(1): 1-18. doi:10.1037/a0021017

Andrews TM, Leonard MJ, Colgrove CA, Kalinoski ST. 2011. Active learning *not* associated with student learning in a random sample of college biology courses. *CBE Life Sci Educ*. 10(4): 394–405.doi: 10.1187/cbe.11-07-0061

Aragon S. 2000. Methods and models for increasing retention and learning among minority students. New Dir Com Coll. Jossey-Bass Higher and Adult Education Series. 112

Autor D, Figlio D, Karbownik K, Roth J, Wasserman M. 2015. Family disadvantage and the gender gap in behavioral and educational outcomes. Nat Bur Econ Res. Working Paper No. 22267. doi:10.3386/w22267

Ball D, Murphy B. 2008. Taking SOAP Notes: Clean up your client documentation using a system favored by the medical community. *IDEA Fit J* 5(4):32-35. Available from: https://www.ideafit.com/fitness-library/taking-soap-notes

Bandura A. 1997. Self-efficacy: The exercise of control. New York (NY): WH Freeman.

Bano N, Arshad F, Khan S, Safdar CA. 2015. Case based learning and traditional teaching strategies: where lies the future? *Pak Armed Forces Med J*. 65(1):118-24.

Birk T. 2015. Now you're the doctor - a diagnostic game. Annual Conference of Human Anatomy and Physiology Society Workshop.

Blake Y. 2011. SOAP notes. sportEX dyn 47(Jan): 7-9.

Braxton J, Francis C. 2018. The influence of academic rigor on factors related to college student persistence. *New Dir High Educ*. doi:10.1002/he.20272

Braxton J, Jones W, Hirschy A, Hartley H. 2008. The role of active learning in college student persistence. *New Dir TeachLearn*. 115: 71-83. doi: 10.1002/tl.326

Chace Z. 2014. The toughest class in nursing school is the first one. Nat Pub Rad. Available from: https://www.npr.org/sections/money/2014/09/02/344042884/the-toughest-class-in-nursing-school-is-the-first-one

Chetty R, Hendren N, Lin F, Majerovitz J, Scuderi B. 2016. Childhood environment and gender gaps in adulthood. Nat Bur Econ Res. Working Paper No. 21936. doi:10.3386/w21936

Cohen J. 1988. Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates. Taylor and Francis. doi:10.4324/9780203771587

Community College Anatomy & Physiology Education Research (CAPER). 2018. National Science Foundation Grant. Available from: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1829157&HistoricalAwards=false

Crede M, Tynan MC, Harms PD. 2017. Much ado about grit: a meta-analytic synthesis of the grit literature. *J Pers Soc Psychol.* 113(3): 492-511. doi:10.1037/pspp0000102.

Crosling H, Heagney M, Thomas L. 2009. Improving student retention in higher education: improving teaching and learning. *Aus Univ Rev* 51(2). doi:10.4324/9780203935453

Davidson LK. 2011. A three-year experience implementing blended TBL: Active, instructional methods can shift attitudes to learning. *Med Teach*. 33(9): 750-753. doi:10.3109/0142159x.2011.558948

Eddy SL, Hogan KA. 2014. Getting under the hood: how and for whom does increasing course structure work? *CBE Life Sci Educ*.13(3): 453–468. doi: 10.1187/cbe.14-03-0050

Forsgren S, Christensen T, Hedelmalm A. 2014.Evaluation of the case method in nursing education. *Nurse Educ Prac*. 14(2): 164-169. doi:10.1016/j.nepr.2013.08.003

Freeman S, Eddy SL, Mcdonough M, Smith MK, Okorafor N, Jordt H, Wenderoth MP. 2014. Active learning increases student performance in science, engineering, and mathematics. *Proc Nat Acad Sci*. 111(23): 8410-8415. doi:10.1073/pnas.1319030111

Graham M, Frederick J, Byars-winston A, Hunter A, Handelsman J. 2013. Increasing persistence of college students in STEM. *Sci Educ*. 341(6153). doi: 10.1126/science.1240487

Gultice A, Witham A, Kallmeyer R. 2015. Are your students ready for anatomy and physiology? Developing tools to identify students at risk for failure. *Adv Physiol Educ*. 39: 108 –115. doi:10.1152/advan.00112.2014.

Haak DC, HilleRisLambers J, Pitre E, Freeman S. 2011. Increased structure and active learning reduce the achievement gap in introductory biology. *Science*. 332(6034): 1213-1216. doi:10.1126/science.1204820

Hettler PL. 2015. Student demographics and impact of team-based learning. *Int Adv Econ Res*. 21:413–422. doi:10.1007/s11294-015-9539-7

Hlinka K, Mobelini DC, Giltner T. 2015. Tensions impacting student success in a rural community college. *J Res Rur Educ*. 30(5): 1-16

continued on next page

Hull K, Wilson S, Hopp R, Schaefer A, Jackson J. 2016. Determinants of student success in anatomy and physiology: do prerequisite courses matter? A task force review 2016. *HAPS Eduucator.* 20(2): 38-45. doi: 10.21692/haps.2016.005

Khosa DK, Volet SE. 2013. Promoting effective collaborative case-based learning at university: a metacognitive intervention. *Stud High Educ.* 38(6): 870-889. doi: 10.1080/03075079.2011.604409

Kibble JH, Hansen PA, Nelson L. 2006. Use of modified SOAP notes and peer-led small-group discussion in a medical physiology course: addressing the hidden curriculum. *Adv Phys Ed*. 30: 230-236. doi:10.1152/advan.00038.2006

Kirschner PA, Sweller J, Clark RE. 2006. Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educ Psych*. 41(2): 75-86. doi: 10.1207/s15326985ep4102_1

Lardieri A. 2018. Study: many americans report feeling lonely, younger generations more so. US News & World Report. Available from: https://www.usnews.com/news/health-care-news/articles/2018-05-01/study-many-americans-report-feeling-lonely-younger-generations-more-so

Michael J. 2006. Where's the Evidence that Active Learning Works? *Adv Physiol Educ* 30: 159–167. doi:10.1152/advan.00053.2006.

National Center for Case Study Teaching in Science. Available from: http://sciencecases.lib.buffalo.edu/cs/

Nider GL, Parmelee DX, Stolfi A, Hudes PD. 2005. Team-based learning in a medical gross anatomy and embryology course. *Clin Anat*. 18(1): 56-63. doi:10.1002/ca.20040

Number and percentage distribution of spring 2002 high school sophomores, by highest level of education completed, and socioeconomic status and selected student characteristics while in high school: 2013. National Center for Education Statistics. Table 104.91. Available from: https://nces.ed.gov/programs/digest/d17/tables/dt17_104.91.asp

Parmelee DX, DeStephen D, Borges NJ. 2009. Medical students' attitudes about team-based learning in a pre-clinical curriculum. *Med Educ*. 14: 1-7. doi:10.3885/meo.2009.Res00280.

Percentage of recent high school completers enrolled in college, by race/ethnicity: 1960 through 2016. National Center for Education Statistics. Table 302.20. Available from: https://nces.ed.gov/programs/digest/d17/tables/dt17_302.20.asp?current=yes

Radford B. 2008. Teen self-esteem may be too high. Live Science. Available from: https://www.livescience.com/3111-teen-esteem-high.html

Rettner R. 2018. People across the globe feeling more sad, stressed and in pain than ever. Live Science. Available from: https://www.livescience.com/63563-world-emotions-gallup-survey.html

Savery JR. 2006. Overview of problem-based learning: definitions and distinctions. *Interdisc J Prob-Bas Learn*. 1(1). doi:10.7771/1541-5015.1002

Searle NS, Haidet P, KellyPA, Schneider VP, Seidel CL, Richards BF. 2003. Team learning in medical education: Initial experiences at ten institutions. *Acad Med*. 78: 55-58. doi:10.1097/00001888-200310001-00018

Smith M, Rose SH, Schroeder DR, Long TR. 2015. Diversity of united states medical students by region compared to US census data. *Adv Med EducPrac*. Volume 2015(6): 367—372 doi:10.2147/AMEP.S82645

Srinivasan M, Wilkes M, Stevenson F, Nguyen T, Slavin S. 2007. Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. *Acad Med*. 82(1): 74-82. doi:10.1097/01.acm.0000249963.93776.aa

Tinto V. 1999. Taking retention seriously: rethinking the first year. *NACADA J*. 19(2). doi:10.12930/0271-9517-19.2.5

Torreda MR, Pujol JO, Romero-Collado A, Malagon-Aguilera MC, Maso JP, Bague AB. 2015. Case-based learning and simulation: useful tools to enhance nurses' education? nonrandomized controlled trial. *J Nurs Schol*. 47(1): 34-42. doi: 10.1111/jnu.12113

Van Meter P. 2015. How we teach: the myths and facts of learning styles, critical thinking, and active learning. Annual Conference of Human Anatomy and Physiology Society Workshop.

Vazsonyi AT, Ksinan AJ, Ksinan Jiskrova G, Mikushka J, Javakhishvili M. Cui G. 2019. To grit or not to grit, that is the question! *J Res Pers.* 78: 215-226. doi: 10.1016/j.edurev.2018.01.001.

Vernon DT, Blake RL. 1993. Does problem-based learning work? A meta-analysis of evaluative research. *Acad Med*. 68(7): 550-562. doi:10.1097/00001888-199307000-00015

continued on next page

Walton G, Cohen GL. 2011. A brief social-belonging intervention improves academic and health outcomes of minority students. *Sci Educ*. 331(6023). doi: 10.1126/science.1198364

Wapole M. 2003. Socioeconomic status and college: how SES affects college experiences and outcomes. *Rev High Educ*. 27(1): 45-73 doi: 10.1353/rhe.2003.0044

Weiman CE. 2014. Large-scale comparison of science teaching methods sends clear message. *Proc Nat Acad Sci*. 111(23): 8319-8320. doi:10.1073/pnas.1407304111

Weiner H, Plass H, Marz R. 2009. Team-based learning in intensive course format for first-year medical students. *Croat Med J*. 50: 69-76. doi: 10.3325/cmj.2009.50.69

Wells R. 2008. Effects of social and cultural capital on student persistence. *Comm Coll Rev*. 36(1). doi:10.1177/0091552108319604

Wells R, Seifert TA, Padgett RD, Park S, Umbach PD. 2011. Why do more women than men want to earn a four-year degree? Exploring the effects of gender, social origin, and social capital on educational expectations. *J High Ed*. 82: 1-32. doi: 10.2307/29789503

Widening implementation and demonstration of evidence-based reforms (WIDER) Division of Undergraduate Education. National Science Foundation. 2013:13–552. Available from: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504889

Wolniak G, Wells R, Engberg M, Manly C. 2016. College enhancement strategies and socioeconomic inequality. *Res High Educ*. 57(3): 310-334. doi: 10.1007/s11162-015-9389-4

Young K, Pitoniak A, Griewisch KR, Lehning EJ. 2019. An investigation of potential correlations between student self-efficacy, mindset, and demographics with final grades in a community college anatomy and physiology I course. *HAPS Educator*. 22(4): 278-297. doi:10.21692/haps.2019.007

Back to TOC