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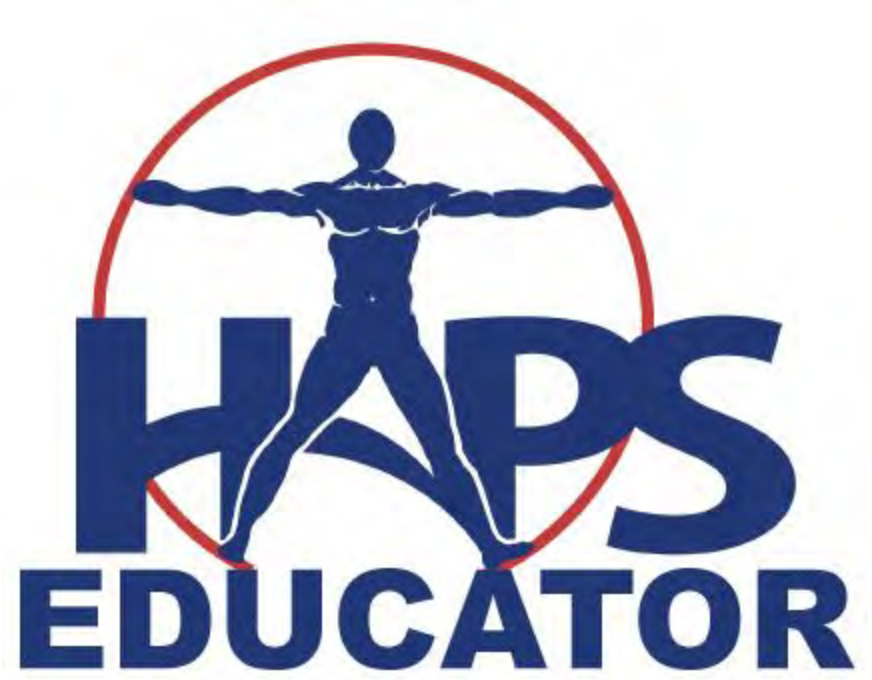

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Assessment of Motivation in Human Anatomy and Physiology Students

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Abstract

Motivation is one of the keys to success in challenging courses such as human anatomy and physiology (A&P) and may occur in the form of intrinsic motivation (IM, motivation for enjoyment), extrinsic motivation (EM, motivation for reward), and/or amotivation (AM, lack of motivation). The goal of this study was to identify ways of supporting student success in A&P by identifying sources of motivation correlated with increased performance and determining if motivational efforts change. Three surveys, including the Motivated Strategies for Learning Questionnaire developed by Pintrich in 1990, were administered to students enrolled in A&P I at the University of Mississippi during the fall semester of 2021. Relevant survey questions were categorized to source of motivation and summed motivation scores for each student were analyzed for correlations with student performance on major assessments in the course. EM was not correlated with any assessment score while AM (assessed only on the second survey) was negatively correlated with all assessment scores. IM scores from survey 1 were not correlated with any assessment score. IM scores from survey 2 were positively correlated with exam 1 and 4 scores as well as the total earned course score. IM scores from survey 3 were positively correlated will all assessment scores. For students accustomed to the rewards from EM, IM may be a latent variable that is only accessed by the individual when needed. Further, educators can promote student achievement by guiding students to identify and use IM early and consistently throughout the course.
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Key words: motivation, MSLQ, anatomy, physiology, human, education, performance

Introduction

Human anatomy and physiology (A&P) can be a difficult and daunting course for college students and has a high DFW rate (letter grade of D, F, or withdrawal from the course; Sturges et al. 2016). This could be due to large, complicated amounts of information to learn and understand, or the pressure to succeed in order to continue with a student's program and career goal (Meguid et al. 2019). A&P requires demonstrated knowledge of organs, tissues, and body functions and an ability to learn and understand intricate details about the human body. Studies suggest that learning outcomes in anatomy education are not covered heavily enough, thus increasing the burden for students to participate in self-directed learning in order to cover topics (Meguid et al. 2019). This could be attributed to the fact that there are so many topics to cover, making it hard to spend large amounts of time on any one learning outcome. Maurer et al. (2013) stated (without providing data) that up to 50% of students enrolled in their A&P courses fail to earn at least a C, and must either retake the course, change their major, or drop out. Published reports with data on the success rate (e.g., at least a C or better) in A&P I range from a low of 36% (Abdullahi and Gannon 2012) to a high of 73% (Young et al. 2019). The average success rate internally at the University of Mississippi and across published reports is approximately 61% (Britson 2022) with data from over 16,000 students.

Succeeding in an A&P course requires, in part, motivation, and this manuscript explores students' motivational efforts and how they impact academic habits and performance. Deci and Ryan's (1985) self-determination theory (SDT) does not define motivation as a unitary concept (Maurer et al. 2013), but divides motivation into three types: intrinsic motivation (IM), extrinsic motivation (EM), and amotivation (AM). IM is the "most self-determined type of motivation, in which activities are accomplished for the sake of enjoyment" (Sturges et al. 2016). IM can further be divided into three subscales: IM to know, IM toward accomplishments, and IM to experience stimulation (Vallerand et al. 1992). IM to know is when an individual experiences fulfillment when learning or understanding something new. IM toward accomplishments "occurs when an individual engages in a behavior for the pleasure experienced while trying to accomplish a task or create something." IM to experience stimulation occurs when an individual participates in something to allow "stimulating or exciting sensations" (Vallerand et al. 1992). IM is not motivated by any type of reward, just for the success of learning and enjoyment.

EM is when a behavior is driven by a reward or incentive beyond the actual task. EM is further divided into three subscales: EM identified, EM introjected, and EM external (Sturges et al. 2016). EM identified occurs when someone

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values the result of the task, though they do not enjoy doing it. EM introjected occurs when someone only participates in the undertaking "to maintain personal expectations or avoid guilt." EM external occurs when someone only participates in a task "solely as a means to obtain an external reward or avoid punishment" (Sturges et al. 2016). The rewards involved in EM pertaining to A&P may be a good grade in the course or on an exam, entry into a professional school, etc. AM is at the opposite end of the self-determination theory from being intrinsically motivated, where motivation is lacking completely.

Studies show that students are shifting from an intrinsic to extrinsic motivational approach in A&P courses (Sturges et al. 2016) and that "instructors can influence students' motivation on the extrinsic motivation subscales through an attendance policy, in-class assignments and other activities, but have little control over a students' intrinsic motivation" (Maurer et al. 2013). However, "students whose motivations are more intrinsic do better in school, have lower rates of withdrawal, absenteeism, and dropout, and have lower feelings of anxiety about school with higher levels of academic performance" (Sturges et al. 2016). Griffin et al. (2013) showed that the leading factor in advancement of overall academic performance is a student's level of intrinsic motivation. Botnaru et al. (2021) further researched the link between academic motivation and performance in undergraduates enrolled in general chemistry, organic chemistry, and anatomy and physiology. Their results suggested that students in lower-level STEM courses reported relatively high levels of motivation that remained stable over time. However, there still exists a relative lack of research on motivation in lower-level STEM courses, particularly A&P (Britson 2022) and student outcomes, leading to this study on identifying the impact of the intrinsic motivations on performance by A&P students.

This study focuses on students enrolled in human anatomy and physiology I at the University of Mississippi. A&P is a requirement for many science majors and a pre-requisite for many professional schools, so most students in the course are enrolled in a pre-health major and are interested in a future in the healthcare field. We want to determine when or if motivational efforts change during the semester and identify how to better develop intrinsic motivation in students. We will also explore possible relationships between demographics (e.g., race, gender, year in school, and/or cultural background) and motivation. We hypothesize that students' motivational efforts will correlate with their final class scores, and that increased motivation leads to higher grades and academic success.

Materials and Methods

Students (n = 276) enrolled in human anatomy and physiology I (A&P I) during the Fall 2021 semester at the University of Mississippi were recruited to participate in this study. BISC 206 is the first semester course of a two-semester sequence and focuses on the structure and function of cells, tissues, and the integumentary, skeletal, muscular, and nervous systems within the human body. Human Anatomy and Physiology Society Learning Outcome Modules A through H (Body Plans through Nervous System; HAPS 2019) were used in course design and assessment selection. There was one lecture section that met three times a week for 50 minutes per session plus 10 to 13 laboratory sections that met once a week for two hours (additional background information on the course structure can be found in Britson 2022). All lecture and laboratory sessions in the Fall 2021 semester were held in-person. This protocol was approved as exempt under 45 CFR 46.101(b) (#2) by the University of Mississippi Institutional Review Board (Protocol #21x-262).

Three optional surveys were administered to students enrolled in A&P I at intervals throughout the semester. Each survey was conducted during the students' laboratory session and took 10-15 minutes to complete. Each student who completed a survey was required to sign a consent form to grant access to survey responses and de-identified final course scores. Survey questions asked participants to respond to each statement on a Likert scale (Fowler 2009) from "strongly disagree" to "strongly agree." Specific dates to administer the surveys were chosen to assess motivational thoughts and efforts at the beginning of the semester, mid-semester, and end of the semester.

The first survey was administered during the second week of the semester. Survey 1 contained optional demographic questions, (e.g., age, sex, year in school, GPA, cultural background, and major) in addition to questions specific to A&P I (Table 1) and students' thoughts and goals for their academic performance throughout the upcoming semester (i.e., future tense was used in the questions). The second survey (Table 2) was administered during 28-30 September 2021, which was just before the week of the first lab practical and the middle of the semester. Survey 2 was a standardized survey with questions adapted from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al. 1990) and used the present tense. The third survey (Table 3) was administered during 16-18 November 2021, the week before the Thanksgiving holidays and three weeks before final examinations that would mark the end of the semester. Survey 3 included questions similar to survey 1 but evaluated students' thoughts towards their course performance after having almost completed the course (i.e., past tense was used in questions).

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Survey Question	strongly disagree (1)	disagree (2)	neutral (3)	agree (4)	strongly agree (5)	N	mean score ± SD	Source of Motivation
I think I will make a good grade in this class.	0	1	48	122	43	214	3.98 ± 0.67	
I will work hard to do well even if I do not enjoy the material being taught.	0	0	1	64	148	213	4.69 ± 0.47	EM identified
I will try my hardest to attend every lecture.	0	0	1	40	171	212	4.80 ± 0.41	
I am only taking this course because it is required for my major/post-college career.	11	42	55	60	45	213	3.41 ± 1.17	EM external
I will spend as much time as it takes to understand the material being taught.	0	0	7	96	111	214	4.49 ± 0.56	IM accomplishments
I will work hard to get a good grade even if I do not enjoy the material being taught.	0	0	1	58	147	206	4.71 ± 0.46	EM external
I will complete practice questions and review assignments to study for exams.	0	0	3	74	129	206	4.62 ± 0.52	EM identified
It is important to me that I learn and understand the material I am being taught in class.	0	0	1	46	159	206	4.77 ± 0.43	IM know
I will be an active learner and ask questions when I need to.	0	1	19	76	112	208	4.44 ± 0.68	IM know
I am taking this class for the pleasure that I experience in broadening my knowledge about subjects which appeal to me.	1	15	76	70	40	202	3.66 ± 0.89	IM know

Table 1. *Frequency, mean, and standard deviation of human anatomy and physiology I student responses to survey 1. Categorization to source of motivation is listed for relevant survey questions (EM = extrinsic motivation, IM = intrinsic motivation).*

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Survey Question	strongly disagree (1)	disagree (2)	neutral (3)	agree (4)	strongly agree (5)	N	mean score ± SD	Source of Motivation
I have made good grades in this class thus far.	2	30	73	83	13	201	3.38 ± 0.85	
I do not really enjoy the material being taught, but I am still studying hard in order to do well in the class.	10	77	62	44	9	202	2.82 ± 0.97	EM identified
I have attended lecture and paid attention.	2	3	25	92	79	201	4.21 ± 0.79	
I have given myself enough time to prepare for the exam, so that I don't have to cram.	6	23	68	78	27	202	3.49 ± 0.96	EM identified
I am spending as much time as needed in order to learn and understand the material.	2	19	56	93	32	202	3.66 ± 0.89	IM know
This material is too difficult. I do not feel motivated to study if I cannot understand.	13	100	55	30	6	204	2.59 ± 0.92	Amotivation
I have utilized my resources (practice questions, reading the textbook, reviewing quizzes, office hours) to learn the information being taught.	1	7	37	116	31	192	3.88 ± 0.73	IM know
I am learning and understanding the material, not just memorizing it.	0	18	61	103	10	192	3.55 ± 0.73	IM know
I am an active learner and ask questions when I need to.	5	37	74	67	11	194	3.21 ± 0.90	IM know
I am glad I am taking this class.	5	14	65	80	28	192	3.59 ± 0.92	

Table 2. *Frequency, mean, and standard deviation of human anatomy and physiology I student responses to survey 2. Categorization to source of motivation is listed for relevant survey questions (EM = extrinsic motivation, IM = intrinsic motivation).*

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Survey Question	strongly disagree (1)	disagree (2)	neutral (3)	agree (4)	strongly agree (5)	N	mean score ± SD	Source of Motivation
I am going to make a good grade in this class.	7	24	61	61	17	170	3.33 ± 0.98	
I worked as hard as I could to understand the material being taught.	0	8	36	80	45	169	3.95 ± 0.83	IM accomplishments
I attended lectures and paid attention throughout.	1	10	31	88	39	169	3.92 ± 0.84	IM know
I wish that I had put more effort into this course.	4	30	50	64	22	170	3.42 ± 1.00	EM identified
I spent as much time as needed to understand the material.	3	19	70	60	18	170	3.42 ± 0.89	IM know
I worked as hard as I could to get a good grade in the course.	0	9	50	66	41	166	3.83 ± 0.86	EM external
I completed practice questions, read the textbook, reviewed quizzes, and attended office hours to better learn the material.	2	19	50	64	31	166	3.62 ± 0.95	IM know
I enjoyed learning about A&P and feel confident in my knowledge of it.	4	22	70	48	22	166	3.37 ± 0.95	IM accomplishments
I would recommend this course to other students.	12	32	68	36	18	166	3.10 ± 1.06	
I am glad I took this course.	9	17	61	46	32	165	3.46 ± 1.08	

Table 3. *Frequency, mean, and standard deviation of human anatomy and physiology I student responses to survey 3. Categorization to source of motivation is listed for relevant survey questions (EM = extrinsic motivation, IM = intrinsic motivation).*

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Survey responses were given numerical values on a scale of 1-5 for the corresponding responses of Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree respectively. Where relevant, survey questions were categorized to source of motivation [Internal Motivation (IM), Amotivation (AM), or External Motivation (EM), Tables 1-3; Sturges et al. 2016]. Summed motivation scores for each student were then analyzed via Pearson correlation tests for each pair wise comparison of motivation scores, exam scores, lab practical scores, and course average. The level of significance was set at alpha = 0.01. Post-hoc, power analysis using G*Power Statistical Software (Faul et al. 2007) for correlation analyses at this level of significance yielded a power of 0.99 or greater for sample sizes of at least 85. Effect sizes of significant correlations were categorized at small (0.1 to 0.3), medium (0.3 to 0.5), or large (0.5 or greater; Cohen 1988). Frequency data and descriptive statistics were calculated for all survey questions. All statistical tests were conducted using SPSSV27 software licensed to the University of Mississippi.

Results

Demographic information was requested on survey 1, and students were given the option to share their age, sex, year in school, GPA, cultural background, and major. Of those, 159 shared their gender, with 85.5% female and 14.5% male. 165 students shared their year in school, with 3.6% in first year, 52.1% in second year, 30.9% in third year, 12.1% in fourth year, and 1.2% in fifth year or doing post-undergraduate studies. 14 students were first-generation college students. 28 students identified as ethnic majorities while 12 students identified as ethnic minorities and 6 students were gender minorities. 125 students provided their college majors, with the most common majors including exercise science, allied health studies, and dietetics and nutrition (Fig. 1). Mean, raw exam scores and earned course scores for students who participated in the surveys are shown in Table 4. Raw scores for exam and lab practical scores were normalized to an average of 75 using a z-score transformation (Winter, 2002) due to particularly low scores prior to calculating the student's earned score for the course. The earned course score incorporates 2 lab practical scores, online homework, in-lab assessments, and extra credit points.

Exam 1	60.8
Exam 2	52.3
Exam 3	53.4
Exam 4	49.7
Exam 5	44.2
Earned course score	77.0

Table 4. *Mean exam scores (%) and earned course score (%) of participating students in human anatomy and physiology 1.*

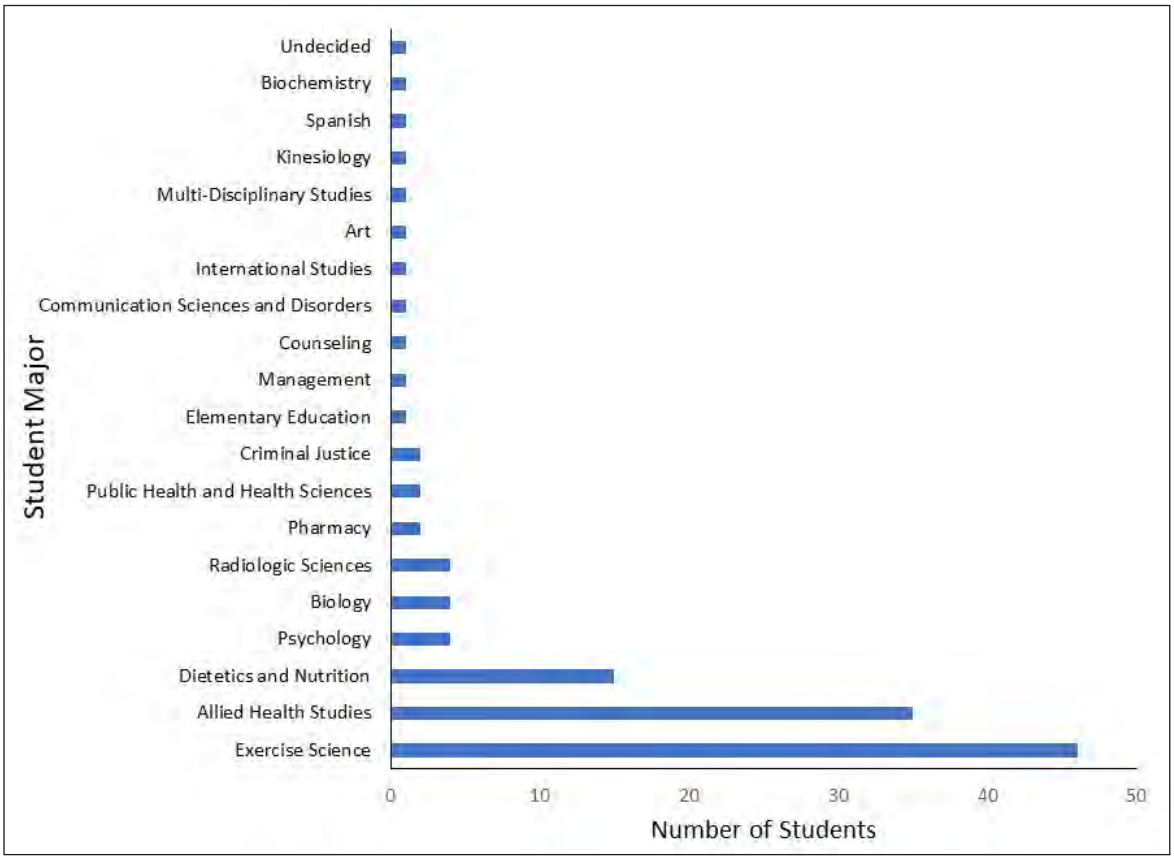

Figure 1. *Program majors of students enrolled in BISC 206 in fall of 2021.*

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Survey 1 consisted of 10 questions that aimed to evaluate student motivation at the start of the course and before the first exam using a Likert scale. When the total extrinsic (Table 5) and intrinsic motivation scores (Table 6) from survey 1 were analyzed for correlations with performance on the lecture exams, lab practical exams, earned course score, and self-reported GPA, no significant relationships were identified.

		Earned course score	Exam 1 score, raw	Exam 2 score, raw	Exam 3 score, raw	Exam 4 score, raw	Exam 5 score, raw	Lab practical 1 score, raw	Lab practical 2 score, raw	GPA	Survey 1, total extrinsic motivation score	Survey 2, total extrinsic motivation score	Survey 3, total extrinsic motivation score
GPA	Pearson Correlation	*0.49*	*0.385*	*0.344*	*0.362*	*0.359*	*0.375*	*0.225*	*0.324*				
	Sig. (2-tailed)	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.025*	*0.001*				
	N	*99*	*99*	*99*	*99*	*99*	*99*	*99*	*99*				
Amotivation total	Pearson Correlation	*-0.291*	*-0.267*	*-0.237*	*-0.265*	*-0.291*	*-0.211*	*-0.275*	*-0.223*	0.041			
	Sig. (2-tailed)	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	*0.002*	*0.000*	*0.001*	0.697			
	N	*204*	*204*	*204*	*203*	*203*	*204*	*204*	*203*	92			
Survey 1, total extrinsic motivation score	Pearson Correlation	-0.045	-0.005	-0.063	-0.006	0.042	-0.015	-0.028	-0.015	0.056			
	Sig. (2-tailed)	0.515	0.939	0.367	0.931	0.550	0.829	0.692	0.827	0.593			
	N	208	208	208	207	207	207	208	207	92			
Survey 2, total extrinsic motivation score	Pearson Correlation	-0.028	-0.083	-0.083	-0.128	-0.037	-0.021	-0.108	-0.021	0.000	*0.217*		
	Sig. (2-tailed)	0.695	0.237	0.236	0.069	0.603	0.768	0.123	0.762	0.999	*0.003*		
	N	204	204	204	203	203	204	204	203	92	*192*		
Survey 3, total extrinsic motivation score	Pearson Correlation	-0.114	-0.048	-0.116	-0.098	-0.087	-0.129	-0.079	-0.138	0.079	0.091	-0.041	
	Sig. (2-tailed)	0.142	0.535	0.135	0.208	0.266	0.097	0.307	0.075	0.503	0.251	0.608	
	N	167	167	167	167	167	167	167	167	75	160	157	
Extrinsic motivation total	Pearson Correlation	-0.056	-0.034	-0.134	-0.105	-0.047	-0.054	-0.152	-0.107	-0.024	**0.791**	**0.641**	**0.42**
	Sig. (2-tailed)	0.498	0.682	0.103	0.199	0.568	0.513	0.063	0.193	0.843	**0.000**	**0.000**	**0.000**
	N	150	150	150	150	150	150	150	150	68	**150**	**150**	**150**

Table 5. *Pearson correlation coefficients (r) for external motivation scores, amotivation scores, and course performance for students enrolled in human anatomy and physiology I. Correlation coefficients that exceed ± 0.5 (a large effect size) for a significant (p<0.01) correlation are in bold, and correlation coefficients that are between ± 0.3 to 0.5 (a medium effect size) or ± 0.1 to 0.3 (a small effect size) for a significant (p<0.01) correlation are in italics. Correlations on the diagonal are not depicted.*

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		Earned course score	Exam 1 score, raw	Exam 2 score, raw	Exam 3 score, raw	Exam 4 score, raw	Exam 5 score, raw	Lab practical 1 score, raw	Lab practical 2 score, raw	GPA	Survey 1, total intrinsic motivation score	Survey 2, total intrinsic motivation score	Survey 3, total intrinsic motivation score
GPA	Pearson Correlation	*0.49*	*0.385*	*0.344*	*0.362*	*0.359*	*0.375*	*0.225*	*0.324*				
	Sig. (2-tailed)	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.025*	*0.001*				
	N	*99*	*99*	*99*	*99*	*99*	*99*	*99*	*99*				
Survey 1, total intrinsic motivation score	Pearson Correlation	0.091	0.105	0.141	0.108	0.056	0.040	0.137	0.127	0.133			
	Sig. (2-tailed)	0.196	0.135	0.045	0.125	0.427	0.575	0.050	0.072	0.212			
	N	203	203	203	203	203	202	203	203	90			
Survey 2, total intrinsic motivation score	Pearson Correlation	*0.272*	*0.224*	0.154	0.173	*0.203*	0.178	0.151	0.151	-0.010	**0.321**		
	Sig. (2-tailed)	*0.000*	*0.002*	0.032	0.016	*0.005*	0.013	0.035	0.036	0.925	**0.000**		
	N	*195*	*195*	195	194	*194*	195	195	194	87	**178**		
Survey 3, total intrinsic motivation score	Pearson Correlation	**0.308****	*0.202*	*0.256*	*0.203*	**0.334****	*0.257*	*0.21*	*0.22*	0.187	**0.349**	**0.381**	
	Sig. (2-tailed)	**0.000**	*0.009*	*0.001*	*0.008*	**0.000**	*0.001*	*0.007*	*0.004*	0.107	**0.000**	**0.000**	
	N	**167**	*167*	*167*	*167*	**167**	*167*	*167*	*167*	*75*	**155**	**150**	
intrinsic motivation total	Pearson Correlation	*0.26*	*0.22*	0.193	0.203	*0.289*	0.206	0.174	0.21	0.129	**0.688**	**0.778**	**0.799**
	Sig. (2-tailed)	*0.002*	*0.009*	0.023	0.016	*0.001*	0.015	0.040	0.013	0.321	**0.000**	**0.000**	**0.000**
	N	*139*	*139*	139	139	*139*	139	139	139	61	**139**	**139**	**139**

Table 6. *Pearson correlation coefficients (r) for internal motivation scores and course performance for students enrolled in human anatomy and physiology I. Correlation coefficients that exceed ± 0.5 (a large effect size) for a significant (p<0.01) correlation are in bold, and correlation coefficients that are between ± 0.3 to 0.5 (a medium effect size) or ± 0.1 to 0.3 (a small effect size) for a significant (p<0.01) correlation are in italics. Correlations on the diagonal are not depicted.*

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Survey 2 consisted of 10 questions that were standard to the Motivated Strategies for Learning Questionnaire (Pintrich et al. 1990). It was administered in between exam 2 and the first lab practical. Amotivation scores from question 6 (Table 2) were negatively correlated with all course performance variables but not self-reported GPA. Total extrinsic motivation scores from survey 2 were not correlated with any performance variable (Table 5), while total intrinsic motivation scores were positively correlated with exam 1 and exam 4 performance as well as earned course score (Table 6).

Survey 3 was administered to students one week after taking exam 4 and consisted of 10 questions that were similar to the questions asked in survey 1. Total extrinsic motivation scores from survey 3 were not correlated with any performance variable (Table 5), while total intrinsic motivation scores were positively correlated with all performance variables excluding self-reported GPA. The total extrinsic motivation scores from surveys 1, 2, and 3 combined were not significantly correlated with any performance variable (Table 5). The total intrinsic motivation scores from surveys 1, 2, and 3 combined were significantly correlated with exam 1 and exam 4 performance as well as earned course score (Table 6).

Across all three surveys, the mean response per question often declined from survey 1 to survey 3 for identical questions. For example, question 1 of each survey gauged the student's confidence in their grade throughout the course. 3.98 was the mean response to this question for survey 1, 3.38 for survey 2, and 3.33 for survey 3 where 2 correlates to a response of "disagree", 3 correlates to "neutral", and 4 correlates to "agree" (Fig. 2). Question 2 across all surveys gauged the student's motivations to work hard in the course. 4.69 was the mean response for survey 1, 2.82 for survey 2, and 3.95 for survey 3. Question 3 across all surveys asked if students were attending lecture and paying attention. 4.81 was the mean response for survey 1, 4.21 for survey 2, and 3.92 for survey 3.

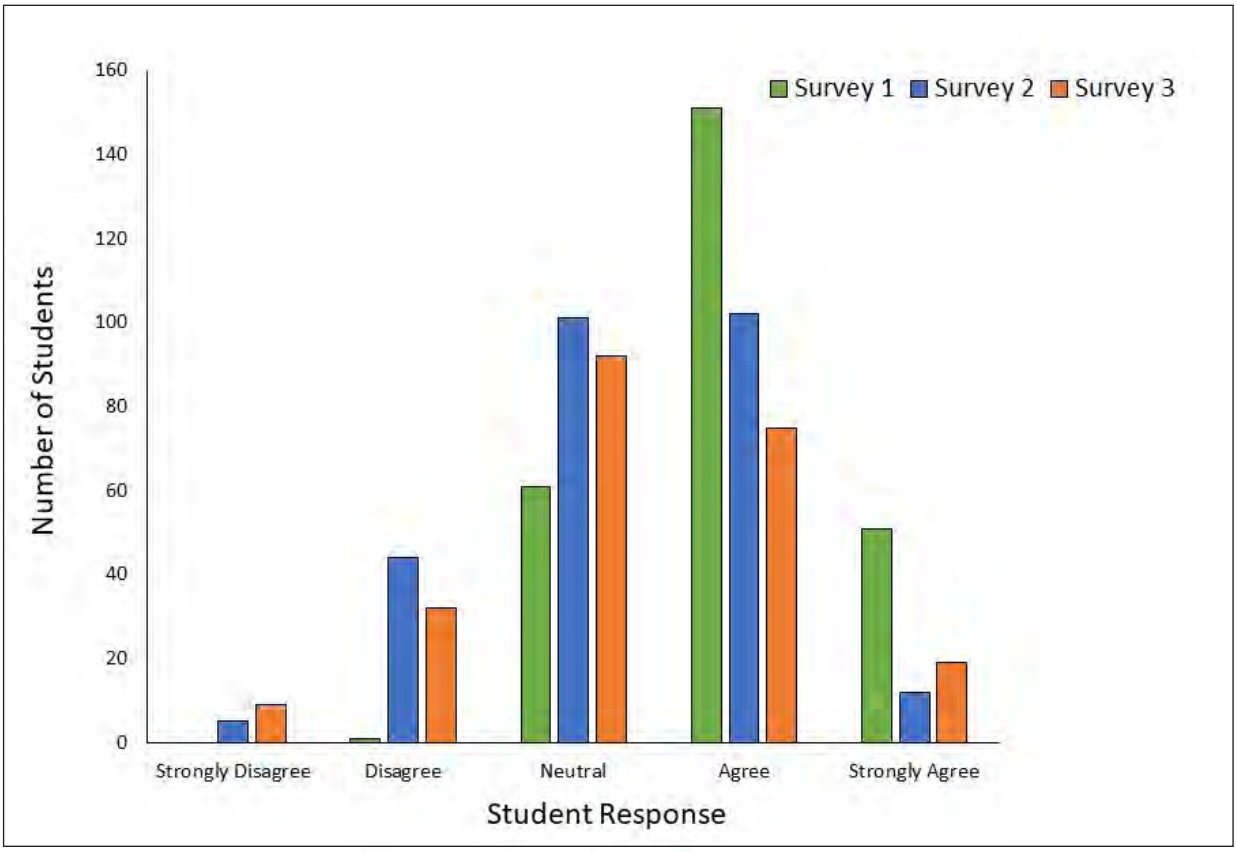

Figure 2. *Student responses to question 1 on surveys 1-3. Survey 1:" I think I will make a good grade in this class." Survey 2: "I have made good grades in this class thus far." Survey 3: "I am going to make a good grade in this class."*

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Discussion

In a 2021 study on academic performance and motivation in undergraduate students enrolled in general chemistry, organic chemistry, and A&P, Botnaru and colleagues found that students in lower-level STEM courses reported relatively high levels of motivation that remained stable over time. Direct observation of students in A&P, however, suggests that motivation levels are not consistent throughout a course. The goal of this study was to examine levels of motivation across a semester and identify significant correlations of different types of motivation to student success. By identifying when, if at all, motivation levels change, we and other A&P instructors would be more enabled to identify and support motivations, particularly internal motivations, in our students, with the ultimate goal of helping students succeed in human anatomy and physiology.

Two general themes emerged from the survey results. First, internal motivation rather than external motivation was highly correlated with student success in the course. Second, scores for both internal and external motivation decreased over the course of the semester. Amotivation was only measured on the second survey and while negatively correlated with assessment performance, changes in amotivation could not be assessed over time. Results for amotivation are included in the present study because questions on the second survey were taken directly from the standard MSLQ (Pintrich et al. 1990) and may be useful in comparison studies.

The first survey was administered during the second week of the semester to assess motivation levels before the first major assessment, exam 1. Average student response to question 10, "I am taking this class for the pleasure that I experience in broadening my knowledge about subjects which appeal to me" was higher than the mean response to question 4, "I am only taking this course because it is required for my major/post-college career." This suggests that students *felt* more intrinsically motivated at the beginning of the semester, wanting to succeed in the course for the enjoyment and not the reward. However, neither the total internal nor external motivation scores from the first survey were correlated with exam 1 performance.

Internal motivation scores from survey 2 (administered after the second exam and before the first lab practical) were positively correlated with several assessments (exams 1 and 4 as well as the earned course score) and the internal motivation scores from survey 1. From the third survey, internal motivation scores were positively correlated with performance on all major assessments as well as the earned course score and internal motivation scores from the first and second surveys. Given that no source of motivation was correlated with self-reported GPA, students may have perceived that those rewards previously received via external motivation as routine. External motivation, while easy to provide, did not lead to increased learning and student performance. Further studies are needed to determine if internal motivation is a latent variable that is only identified and accessed by the individual when other sources of motivation are unproductive.

The second survey was administered just prior to mid-term and data showed that students were still motivated to work hard and succeed, but their mean responses were lower than on survey 1. For example, question 3 stated, "I have attended lecture and paid attention", which received a mean score of 4.21, but on the first survey this question received a mean score of 4.80. Self-reported attendance in lecture seemed to decline, and so did students' desire to spend as much time as needed to understand the material. Actual lecture attendance was recorded by the instructor via personal response systems (Britson 2022). Students averaged a low score of 2.82 on the statement, "I do not really enjoy the material being taught, but I am still studying hard in order to do well in the class," and a score of 2.59 on the statement, "This material is too difficult. I do not feel motivated to study if I cannot understand." These results seem to counteract each other, as the first points to students not studying hard in order to do well, and the second statement points to students disagreeing that they do not feel motivated to study.

The third survey was administered three weeks before the end of the semester, and after students had taken 4 exams. From exam 1 to exam 4, average test scores decreased (Table 1) and the mean response scores on the survey also decreased (as compared to responses from surveys 1 and 2). None of the statements on survey 3 received a mean score of 4 or higher. The statement, "I attended lectures and paid attention throughout" received an average score of 3.92, which is lower than the scores on the first two surveys and shows a decrease in self-reported class participation and attendance. Students also were less likely to believe that they would make a good grade in the course, with the average score for this statement being 3.33. At the end of the course students were neutral in their feelings about being glad they took human anatomy and physiology.

These data point to a decrease in motivation throughout the semester, as exam scores also similarly declined. Studies comparable to the present study found similar results. In Young et al. (2018), motivation was surveyed in students across 41 foundational STEM courses at the beginning and end of each semester in an academic year at a small primarily undergraduate university. They found significant pre- to post- semester declines in five measured motivational factors: intrinsic motivation, career motivation, self-determination, self-efficacy, and grade motivation (Young et al. 2018). Zusho et al. (2003) investigated the levels of motivation in 458 students enrolled in introductory college chemistry classes. Overall, they found that students' levels

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of motivation decreased over time, students' judgements of their confidence to do well in the class decreased, and students were less likely to believe that chemistry was important or useful to them (Zusho et al. 2003).

Similarly, coinciding declines in exam and motivation scores in the present study support the statement of Young et al. (2018) that "supporting student motivation…would lead to higher achievement". Offering such support is critical because students' confidence levels decrease if they receive negative feedback in the form of low assessment scores about their course performance (Zusho et al. 2003). It is essential for instructors to communicate to students the importance of maintaining internal motivation to succeed in the course rather than relying on external motivation or avoiding amotivation. Human anatomy and physiology are learnable and positive results are achievable if the student identifies and maintains, with the instructors' guidance and support, their source of internal motivation and puts in the work necessary for success. Zusho et al. 2003 suggested that instructors convey to their students strategies or ways of thinking to better learn the material and encourage students to share with each other how they better learn the material.

A study by Ferland et al. (2022) assessed motivation in a statistics course and also found motivational declines across the semester. In an effort to avoid this decline, they incorporated "statistics in the news" where students brought in articles that could relate to what they were learning. This activity encouraged students to make a connection between the course material and their own lives (Ferland et al. 2022). A similar research project could be beneficial for Human anatomy and physiology courses and instructors. Relating the material to students' lives might help them identify, develop, and maintain their internal motivation for success. Supporting internal motivation may also be one of several outcomes of efforts to promote diversity, equity, and inclusion, particularly a sense of belonging and self-identity as a scientist (Kalender et al. 2019), in the human anatomy and physiology classroom and can promote increases in exam and final course scores for students.

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