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Full Length Research Paper

The Impact of Instructor-Provided Study Guides on Student Academic Performance in Introductory Anatomy and Physiology

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Abstract: Background: Research indicates a strong correlation between success in undergraduate gateway courses and overall student retention. These lower division courses serve as prerequisites to upper-level coursework and are often associated with high failure rates. Anatomy and Physiology-I, a key gateway course for health science majors, exemplifies theses challenges. **Methods:** This retrospective quasi-experimental study assessed the impact of instructor-provided study guides on student performance in 16 course sections (N = 502) across four semesters at Florida Gulf Coast university. Eight sections used study guides (Study guide group) and eight did not (Control Group). Independent *t*-tests and the Friedman test compared exam scores, final grades, and pass rates. **Results:** The Study Guide group had a notably lower failure rate (10.89% compared to 34.70%) and significantly higher exam scores and final grades. Furthermore, no significant instructor variability was found, suggesting that standardized resources may reduce discrepancies in teaching effectiveness. **Conclusion:** These findings highlight the value of structured learning resources in improving outcomes in complex course. Implementing such resources may promote student success in foundational courses essential for careers in health sciences. **Limitations:** Quasi-experimental design, lack of randomization, potential confounding variables, and single-institution scope may restrict causal inference and generalizability.

Keywords: Study guides; anatomy and physiology; academic performance; gateway courses; pass rates; student engagement, guided notes; cognitive load.

1. Introduction

Student engagement and active participation are widely recognized as essential to academic success in secondary and postsecondary education. Contemporary pedagogical strategies including, active learning, scaffolding, and guided inquiry, have shifted the instructional focus from rote memorization to conceptual understanding, aiming to help students apply content knowledge in meaningful ways [1, 2]. Despite these advances, many incoming college students continue to struggle with developing effective studying strategies, making content retention a persistent challenge for educators, especially in high-demand introductory courses where dense content delivery is the norm. Anatomy and Physiology-I (A&P-I), a pivotal gateway course for health science majors, exemplifies these challenges. These content-heavy courses are typically lecture-driven and rely on passive information delivery, which may hinder students from fully engaging with and internalizing the material. In these environments, students are typically expected to process, organize, and simultaneously take notes – a cognitive demanding process that often leads to gaps in comprehension and long-term retention [3, 4].

To mitigate this cognitive overload, scholars have increasingly focused on note-taking strategies to enhance student learning [3-5]. Research in cognitive

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psychology demonstrates that successful learning relies not only on exposure to content but also on the learner's ability to connect new information to prior knowledge and encode it meaningfully into long-term memory [3]. Figure 1 illustrates the interplay between sensory memory, working memory, and long-term memory during note-taking. Without establishing these conceptual connections, information is more likely to remain in short-term memory and be quickly forgotten. Thus, the effectiveness of note-taking on learning is influenced by the student's ability to transfer information from sensory input into working memory.

The process of note-taking can become increasingly difficult as students experience attentional fatigue during extended lectures, making it increasingly difficult for students to take high-quality notes that support academic success. As focus diminishes, notes tend to lack the conceptual detail necessary for meaningful learning, resulting in information that remains in short-term memory and is easily forgotten [3]. While note-taking can help capture information, it primarily supports the read/write learning preference and does not adequately reflect other learning modalities such as visual, auditory, or kinesthetic learning [6]. Notably, research by Peverly et al. emphasized the critical impact of note quality, identifying it as the strongest predictor of learning outcomes [7].

In response to these challenges, a broad body of literature reveals a consensus on the importance of practical note-taking strategies and the effectiveness of guided notes in enhancing student learning outcomes [8-13]. Instructional techniques such as concept maps, outlines, and guided notes have been shown to improve the depth and clarity of note quality, in turn, student performance. Research by Ponce found that providing complete or partially completed course notes prior to class encourages deeper engagement during lecture [9]. With access to structured materials beforehand, students are more likely to immerse themselves in the content during lectures, engage more fully in class activities, and focus their efforts on supplementing the materials with personalized notes—such as writing down key terms, instructor elaborations, or reflections based on their own knowledge gaps [12].

Structured course notes help reduce the cognitive load associated with listening and transcription simultaneously, enabling students to concentrate more effectively on understanding key concepts. By minimizing the documentation burden, this approach promotes deeper engagement with lecture content, encouraging learners to focus on central ideas, pose questions, and form meaningful connections that enhance comprehension, learning, and retention. Biggers [8] affirmed the positive impact of guided notes in supporting student learning outcomes, while Gharravi et al. [13] expanded on this by examining the effect of instructor-provided notes in a medical education context. Their study conducted within an organ system-based curriculum, directly compared students who received pre-prepared notes with those who did not, revealing significant improvements in academic performance among the former group. A post-course questionnaire further highlighted high levels of student satisfaction with the provided notes. Gharravi et al. concluded that instructor-provided notes not reduce documentation-related demands but also support deeper cognitive learning [13]. However, they highlighted the need for further research to explore the generalizability of this approach across different academic disciplines.

Despite growing support for structured note-taking, a notable gap exists in the literature as no studies have yet examined the impact of instructor-provided notes specifically in undergraduate introductory anatomy and physiology-I (A&P-I) courses. This oversight is significant, given the persistent challenges and high attrition rates commonly associated with foundational science courses such as A&P-I. Although evidence from related fields suggests potential benefits, the effectiveness of structured notes within this particular context remains largely untested [13, 14]. This gap holds added significance considering the role A&P-I as a gateway course for upper-level programs in exercise science, nursing, and most health science disciplines. Gateway courses— lower-division, credit-bearing, foundational courses, and prerequisite to majors—are known for their high rates of unsuccessful outcomes (letter grades of D, F, and W) [15]. Research consistently links success in gateway courses to degree persistence and program completion, highlighting the urgency of exploring targeted interventions such as structured note-taking to improve academic outcomes in A&P-I [16,17].

In light of this gap and the potential benefits of structured support, the present study aims to examine the impact of instructor-provided study guides on student academic performance in A&P-I, as measured by exam scores and course pass rates (percentage of students receiving letter grades of A, B, and C). The primary research question investigates whether a significant difference exists in academic performance between students who received instructor-provided study guides and those who did not. The corresponding null hypothesis posits no statistically significant difference between exam scores of students receiving instructor-provided study guides and students who did not receive instructor-provided study guides. A secondary research question examines whether instructor-level variation influences outcomes when using standardized course notes, with a null hypothesis suggesting no statistical difference among instructors. Finally, student outcomes from three new faculty members teaching A&P-I lecture in 2024 utilizing the same study guides were compared to the 2020-2023 faculty group, with the research null hypothesis anticipating no significant difference between the two instructional groups.

2. Materials and Methods

2.1. Study Design

This retrospective non-equivalent quasi-experimental design examines the effect of instructor-provided study guides on student academic performance [18]. Data was obtained from sixteen sections of the same A&P-I during the spring semester of 2020, 2021, 2022, and 2023 from

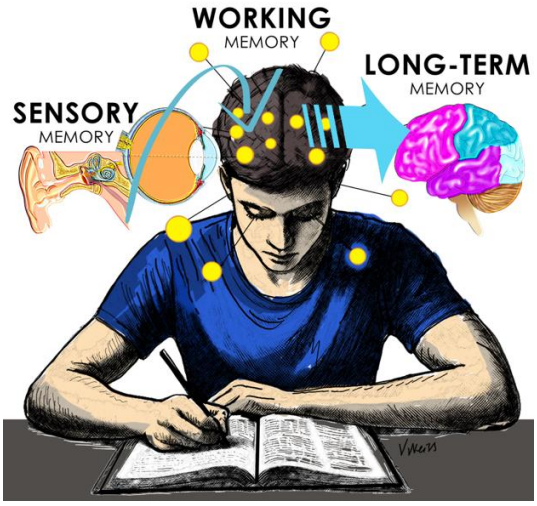


Figure 1. From sensory input to long-term memory.

students at Florida Gulf Coast University (FGCU) (Fort Myers, FL, USA). Additionally, data from 2024 was obtained to identify the ongoing benefit of using study guides by different instructors (Figure 2).

The FGCU's IRB approved this study as a "*not human subjects' research determination"* since the study used archived data. Student information was archived and de-identified data, and there were no direct interactions or interventions with human subject participants. Ethical considerations for this study included maintaining confidentiality of participants' information and data. For that reason, data from study subjects was coded for analysis. These procedures are grounded in the ethical principle of autonomy and respect for subjects. The research data storage from participants' files was kept in a secure, dually locked computer accessible only to the researchers, thereby ensuring subjects' rights to confidentiality and autonomy.

2.2. Participants

Sixteen sections of the same Anatomy and Physiology-I course were analyzed during the spring semesters of the academic years 2020- 2023. The sixteen A&P-I sections were divided into two different groups. Students self-registered for the A&P-I course based on schedule needs. Typically, A&P-I students are a mix of primarily freshman and sophomore students pursuing a health-related major. No prerequisite is required to take A&P-I. One group consisted of eight A&P-I sections (two sections from each academic year in 2020-2023), who were provided a study guide throughout the semester by their course instructor and labeled "Study Guide" group (SG). Four different course instructors taught these courses (Table 1). The other eight course sections (two sections from each academic year 2020-2023) were labeled the "Control" group (CG) was taught by three different instructors and did not receive study guides during the semester (Table 1).

Although different instructors taught the course sections, all sixteen sections used the same syllabus, assignments, textbook, PowerPoints, Canvas platform, and resources. No other course materials were provided by the instructors. All four instructors utilized traditional didactic in-person lecture delivery, using PowerPoints. Additionally, all course sections utilized the same tests, test settings, and grading policies, which allowed for effective comparison of exam scores and course performance. It should be noted that during the spring semester of 2020, all sections of A&P-I transitioned to “live-online” due to the COVID pandemic. Thus, the last five lectures for all four sections in spring 2020 were conducted via Zoom and the SG group continued to receive their SG online. Exam-2 and the final exam were given online and proctored through Lockdown Browser.

Given the nature of this retrospective study design, data on other confounding variables such as preparedness, prior academic performance, student motivation, and the use of supplemental instruction was not collected. Lastly, data from three-course sections in 2024, using the study guides taught by different instructors, were used in the analysis compared to the 2020-2023.

2.3. Materials

A completed study guide designed by one of the instructors was provided to all students in the SG group for each lecture topic of the A&P-I course throughout the semester. The 14 study guides covered the following topic: medical terminology and introduction to A&P, the cell, tissue, skin and body membranes, bone tissue, axial and appendicular skeleton, joints, muscle tissue, muscles of the face and trunk, muscles of the extremities, nervous tissue, central nervous system, peripheral nervous

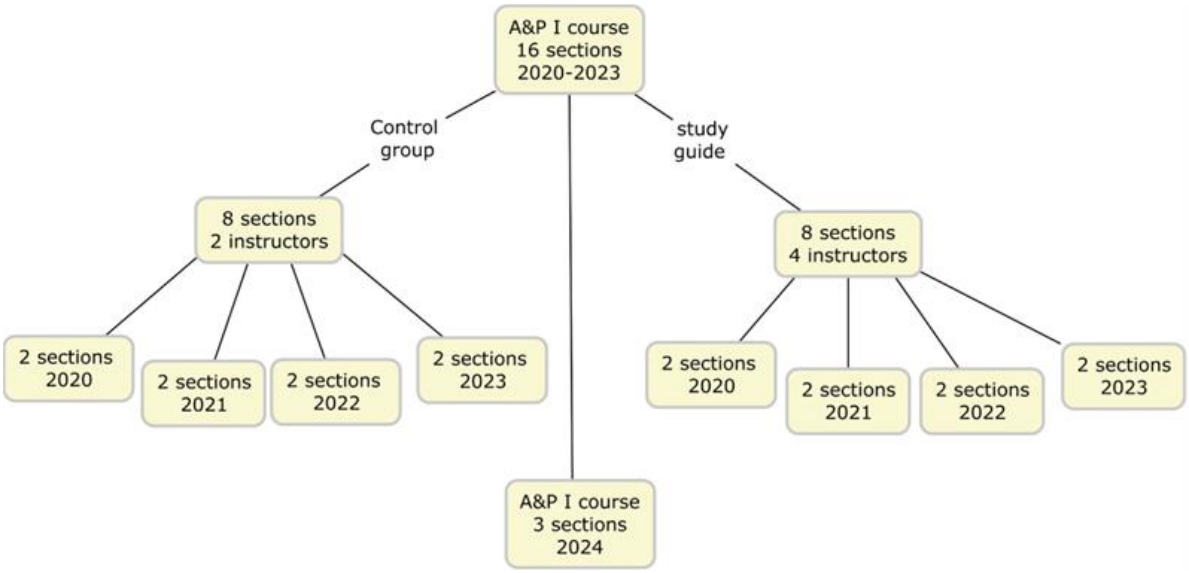


Figure 2. Study Flow chart.

Table 1. Number of A&P I sections over 2020-2023 and what each of the three instructors taught.

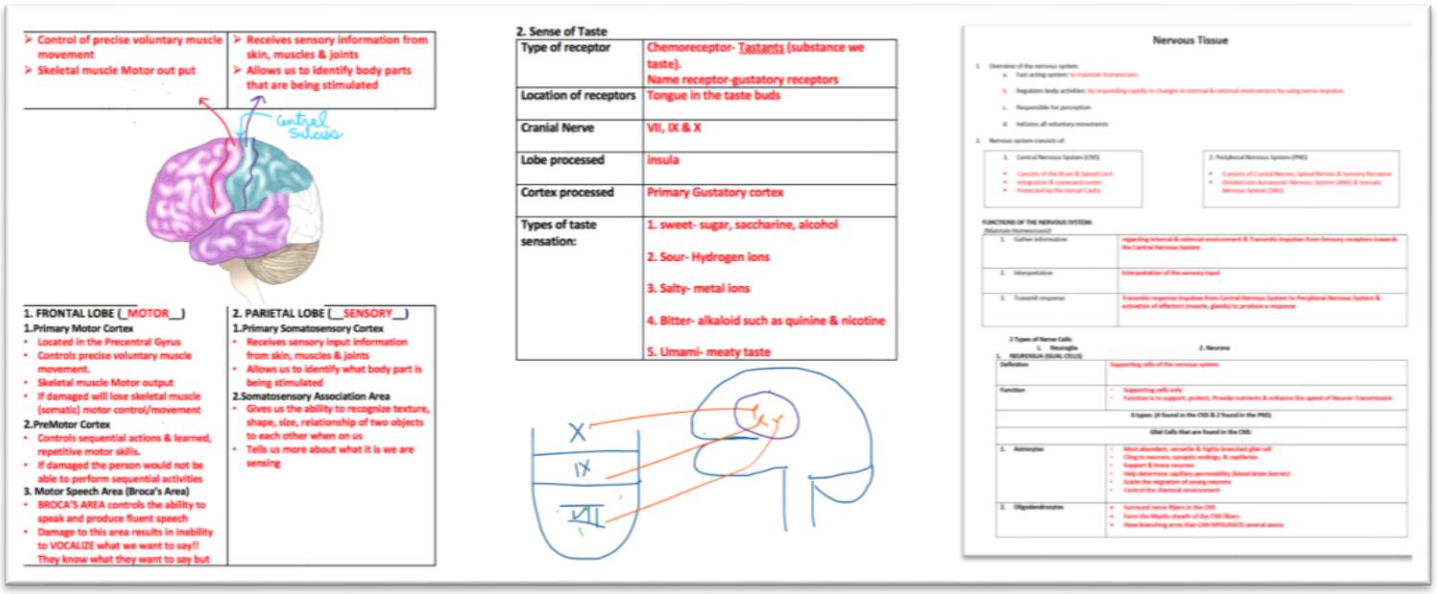
		Study guide group	Control group
Year	Instructor		
2020	1	2 sections	2 sections
2021	1		1 section
	2	2 sections	1 section
2022	1		2 sections
	3	2 sections	
2023	1		2 sections
	3	1 section	
	4	1 section	
Total		8 course sections	8 course sections

system, and general and special senses. Each study guide was an outlined version of the key content for each chapter/topic and ranged from five to 13 pages in length (Figure 3 represents a sample study guide from the nervous system chapter). The study guides incorporated aspects of visual-note-taking by combining icons, sketches and keywords to summarize content while organizing the information in a non-linear structure that included clusters in boxes rather than simple outlines to promote quick identification of key concepts, highlight connections between related topics, and simplify complex ideas [19]. Students in the SG were encouraged, but not mandated, to add notes to the study guides during lecture to facilitate focusing on key concepts covered each week. The use of the study guides by the students was not formally monitored or tracked.

2.4. Statistical Analysis

Statistical analyses were performed using IBM® SPSS® Statistics version 28 with an alpha significance level of 0.05 for all statistical tests. Each student was assigned a unique code to protect the anonymity of the participants. Data analysis included four semesters (Spring 2020, Spring 2021, Spring 2022, and Spring 2023) and sixteen Canvas course sections of A&P-I. Additionally, data from three 2024 course sections were analyzed and compared to the 2020-2023 SG. Descriptive statistics was used to describe the overall study sample. The Shapiro–Wilk test of normality identified that the data was not normally distributed with $p < 0.05$ for five of the nine faculty groups (2020-2023); for that reason, the Wilcoxon signed-rank test was used to determine the difference between both the SG and the C groups and

Figure 3. Example of The Central Nervous System, Peripheral Nervous System and Nervous Tissue Study Guides.



the difference between the group for course instructors separately. The Shapiro-Wilk test of normality identified that exam scores 1, exam score 2, overall score, and fail rate were normally distributed with p>0.05; therefore, parametric statistics were used. The independent *t*-test was used to compare the CG and the SG results. Lastly, the Friedman test was used to compare the student outcome of three new faculty teaching utilizing the study guide in 2024 to those teaching from 2020-2023.

3. Results

The A&P I course sections were divided into two groups: eight sections received instructor-provided study guides, and eight sections did not receive the study guides. This resulted in a sample size of 502 student records (N= 502), of which 249 were in the SG and 253 were in the CG. The SG consisted of 186 (74.70%) females and 63 (25.30%) men. Meanwhile, the gender distribution in the CG was 174 (68.77%) female and 79 (31.23%) men (Table 2).

In addition to gender, the sample of this study included students from different grade levels while taking A&P-1. Among the 249 students in the SG group, 137 (56.85%) were first-year students. Given the purpose of this study, “first-year students” are defined as any student who has completed high school and has commenced their first year of college. It did not include transfer students. In the SG group, 84 (33.73%) were second-year, 10 (4.15%) were third-year students, and 18 (7.47%) were fourth year students. Among the 253 students in the CG, 142 (63.68%) were first-year, 76 (33.63%) were second-year, 17 (7.62%) were third-year, and 18 (8.07%) were fourth-year students. It should be emphasized that A&P-I is a prerequisite course for a variety of health sciences majors; thus, explaining the large percentage of underclassmen enrollment.

Table 3 summarizes descriptive analysis for Exam-1 and 2 scores and final grades for the "Study Guide" and "Control" groups. There was an overall trend toward better exam performance and final grades in the "Study Guide" group compared to the "Control" group (Figure 4). The Shapiro-Wilk test revealed seven of the nine different instructor groups were not normally distributed with p<0.05 (Table 4). Therefore, the Friedman test was used to compare the results between the three instructors, and the Wilcoxon signed-rank test was used to determine the difference between the two instructors.

The Wilcoxon signed-rank test was used to compare the overall CG for the 2020-2023 combined course sections to the SG 2020-2023, and there was a significant difference with p<0.01, indicating that the SG groups scored significantly higher (Table 5). An independent *t*-test was performed to compare Exam-1 scores of the difference between the two groups. There was a statistically significance difference in Exam-1 scores between the “Study Guide” group (M = 85.17, SD = 12.22) and the “Control” group (M = 78.50, SD = 14.01); t (464) = 6.59, $p < 0.00001$. The effect size, measured by Cohen’s d, was d = 0.51, indicating a medium effect. Similarly, there was a statistically significant difference in Exam-2 scores between the “Study Guide” group (M = 83.30, SD = 20.45) and the “Control” group (M = 73.80, SD = 21.15); t (464) = -3.81, p = 0.00008. The effect size for Exam-1, measured by Cohen’s d, was d = 0.46, indicating a small effect. Lastly, there was a significant

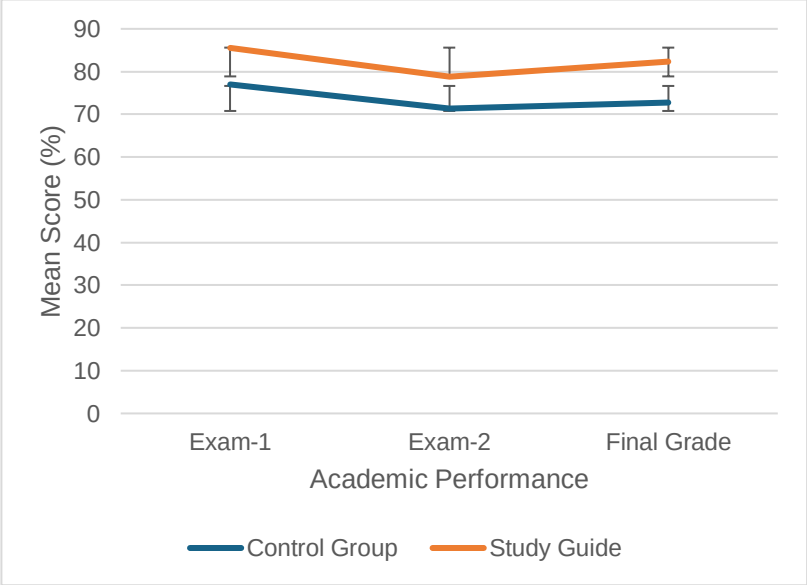
Table 2. Number and Percentage of Male and Female Students Across Groups.

Groups	Male		Female		Subtotal	
	n	%	*n*	%	*n*	%
SG	63	25.30	186	74.70	249	100
CG	79	31.23	174	68.77	253	100
Total	142	22.84	360	77.16	502	100

Table 3. Mean Scores and Standard Deviation for Exam-1, Exam-2, and Final Grades Across Groups.

Groups	Exam-1		Exam-2		Final grades	
	Mean	*Standard*	*M*	*SD*	*M*	*SD*
SG	85.17	12.22	83.30	20.45	89.11	14.65
CG	78.50	14.01	73.80	21.15	65.30	14.56

Figure 4. Graphical display of the Mean Exam Scores and Final Grades (%) Across Groups as reported in table 3.



difference in final grades between the "Study Gide" group (*M* = 89.11, *SD* = 14.65) and the "Control Group" (*M* = 65.30, *SD* = 14.56); t (464) = 6.83, *p* < 0.00001. The effect size for the final exam grades, measured by Cohen's d, was d = 1.62, indicating a large size effect. Based on these results, the research hypothesis that there would be no significant difference between groups was rejected. According to Cohen's conventional bench-

Table 4. Normalcy of data for all instructors.

	Shapiro-Wilk		
	Statistic	df	Sig.
Instructor 1 2020 (CG)	.850	28	<.001
Instructor 1 2021 (CG)	.910	28	.020
Instructor 1 2022 (CG)	.923	28	.041
Instructor 1 2023 (CG)	.948	28	.181
Instructor 2 2021 (CG)	.912	28	.022
Instructor 1 2020 (SG)	.867	28	.002
Instructor 2 2021 (SG)	.803	28	<.001
Instructor 3 2022 (SG)	.952	28	.227
Instructor 3 2023(SG)	.913	28	.023

Table 5. Comparisons and significance testing between instructors, groups, exams, and between instructors in the SG group 2024.

Comparison	Test	Significance
Instructor 1-CG 2020-2023	Friedman	0.123
Instructor 1, 2, 3 SG 2020-2023	Friedman	0.449
Instructor 1 and 2 SG 2020-2023	Wilcoxon Signed Rank	0.057
Instructor 1 and 2 SG 2020-2023	Wilcoxon Signed Rank	0.367
Instructor 1 and 4 SG 2020-2023	Wilcoxon Signed Rank	0.021
Instructor 2 and 3 SG 2020-2023	Wilcoxon Signed Rank	0.195
Instructor 2 and 4 SG 2020-2023	Wilcoxon Signed Rank	0.086
Instructor 3 and 4 SG 2020-2023	Wilcoxon Signed Rank	0.052
Instructor 1 and 2 CG 2020-20223	Friedman	0.441
Instructor 1-CG and 2-CG	Wilcoxon Signed Rank	0.105
Instructor 1-CG and 1-SG	Wilcoxon Signed Rank	<0.001
Instructor CG and SG	Wilcoxon Signed Rank	<0.001
Instructors SG 2020-2023 and Instructors 2024	Wilcoxon Signed Rank	0.150
Exam 1 CG and SG	Independent *t*-test	<0.001
Exam 2 CG and SG	Independent *t*-test	0.008
instructors 2024	Friedman	0.419

marks, the magnitude of difference in Exam -1 and Final Exam scores between the SG and CG reflects a meaningful educational impact, particularly in the context of a high-demand gateway course such as A&P-I [20]. The observed effect size highlights the practical significance of structured study materials in supporting early academic success.

Non-parametric statistics were used to determine Instructor variability and its effect on outcomes in the CG and SG course sections. The Friedman test was used to compare the results of the 2020, 2021, 2022, and 2023 course sections of Instructor 1. There was no significant difference between 4 years outcomes for instructor 1 with p=0.123. Instructor 2 only taught the CG in 2021. To compare the difference in student performance between instructors 1 and 2, the data for Instructor 1 was combined and compared to that of Instructor 2. No significant difference in scores was identified using the Wilcoxon Signed rank test with p=0.105. It was concluded that there was no "instructor effect" in the CG outcomes (Table 4). Four different instructors delivered instruction for the SG cohorts 2020-2023. The Friedman tests comparing the four instructors was significant, with p=0.010. The Wilcoxon Signed rank test was used to further identify this significant difference. The difference between instructors one and four was significant (p=0.021). There was no significant difference between any of the other instructor combinations. It concluded that there was a possible "instructor effect" of instructor four in the SG outcomes (Table 5). Based on the results, the research hypothesis that there would be no statistical difference between instructors was rejected.

Table 6. Statistics of for both the groups with number of students with that grade, mean, standard deviation, and significance.

	N	Mean	Standard Deviation	Significance
F grade CG	45	45.7	11.2	0.03
F grade SG	12	41.8	15.1	
D grade CG	108	59.5	14.1	<0.01
D grade SG	50	70.7	4.7	

Non-parametric statistics were used to further analyze the impact of the instructor-provided study guides on the number of students earning a “D” or “F” grades. The Wilcoxon Signed Rank Test was employed to compare differences between the control group (CG) and the study group (SG) for students who earned a grade of “D.” A statistically significant difference was observed with p= 0.03, indicating better performance among students in the SG. Similarly, for students who earned a grade of “F,” the test revealed a significant difference with $p < 0.01$, again favoring the SG (Table 6).

The overall course failure rate in the CG was 34.7%, compared to 10.89% in the SG. The mean final score in the CG was 65.30 (out of 100), while the SG students achieved a higher average of 89.11 (out of 100). Additionally, the course withdrawal rate was higher in the CG at 9.6%, compared to just 2.3% in the SG.

The Friedman test was used to compare the three instructors utilizing the study guide in their instruction in 2024. There was no significant difference between the three instructors using the Friedman test with p=0.419. When comparing the overall outcomes of the 2024 instructors to the 2020-2023 study guide group using the Wilcoxon Signed Rank test, there was no significant difference (p=0.150). Based on the results, the research hypothesis that there would be no statistical difference between 2024 instructors and the 2020-2023 instructors was not rejected.

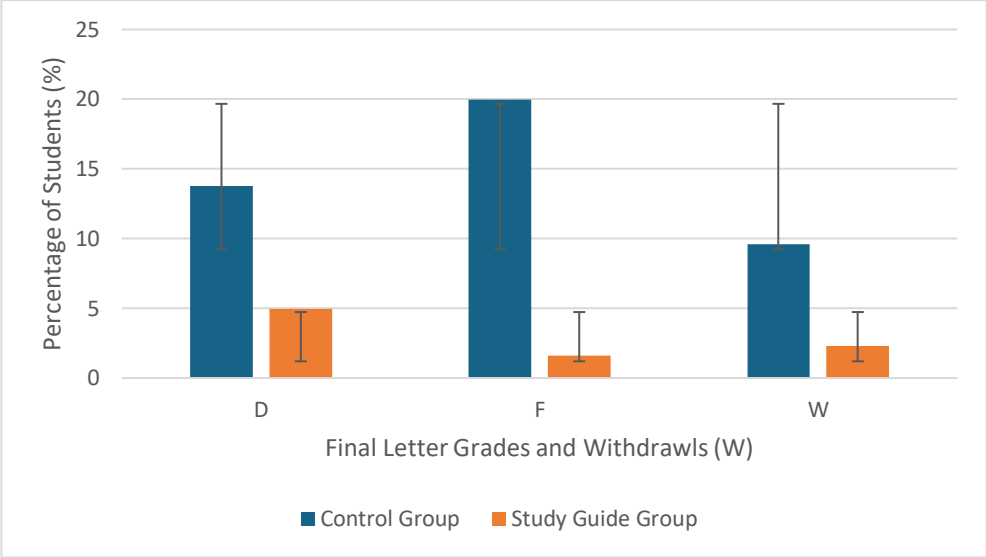
4. Discussion

This retrospective non-equivalent quasi-experimental study evaluated the benefit of faculty-created study guides on A&P-I student course outcomes. The findings of this study provide compelling evidence regarding the positive impact of instructor-provided study guides on student academic performance in undergraduate A&P-I courses. The data collected from 502 students across sixteen A&P I course sections revealed statistically significant differences between the "Study Guide" and the "Control" groups in exam scores, final grades, and course pass rates. These results support the growing evidence that providing students with study guides in foundational gateway courses is beneficial [21]. A&P-I courses provide students with challenging content. The breadth of information can be challenging for first-year college students, and this course is considered high stakes for those students pursuing health-related fields. Our results concur with Peverly et al. [11], who demonstrated the benefit of note-taking on immediate retention, long-term knowledge, and understanding of complex anatomical and physiological processes.

A plausible explanation for the findings of this study could be based on the cognitive load theory, which identifies that overall learning depends on the mental effort required to organize, break down, and process the course material [22-23]. Students often struggle in Anatomy and Physiology I (A&P-I), a challenging gateway course, due to the overwhelming cognitive demands associated with managing large volumes of information within the limited capacity of working memory. This struggle may result in difficulty comprehending content and transferring it into long-term memory, ultimately affecting academic performance and exam outcomes [24, 25].

The study’s findings, that instructor-prepared study guides led to improved student performance, are consistent with prior research suggesting that structured support helps learners better manage the complexity of content. The availability of a study guide helped students navigate course material more effectively, reducing mental fatigue and allowing more focus on understanding key concepts. These findings align with those of Gharravi et al. [14], who reported that instructor-provided notes positively influenced learning and exam outcomes among medical students in a systems-based curriculum. Gharravi and colleagues demonstrated that pre-prepared notes reduced the documentation burden, enabling learners to engage more fully with the material. While similar in purpose, the current study differs in context and population, representing the first known examination of instructor-provided notes within undergraduate A&P I education, a course known for its high attrition rates. This study contributes novel insight by applying this instructional strategy to non-medical, undergraduate students.

Figure 5. Percentage of final D and F grades and Withdraws for both groups.



The course instructor used a mind-mapping framework to organize the study guide, which helped break down content into digestible, structured segments [26]. With this guide in hand, students were relieved of the additional cognitive burden of organizing content on their own and could instead focus on learning the material's core elements. While the structure was provided, students retained autonomy by annotating the guides with personal reflections, clarification points, and key lecture details. This flexible structure enabled a more active and personalized engagement with the content, encouraging deeper learning. Real-time interaction with material in this manner may have further contributed to the positive results observed [27, 28].

Importantly, the study guide offered guiding questions, visual organization, and conceptual cues, allowing students to evaluate their understanding and adjust study strategies accordingly. This reflective engagement supports the development of metacognitive skills, originally described by Flavell [29], which are known to enhance academic success. Overall, the findings of this study suggest that providing structured study guides is a practical, low-cost, and impactful intervention to support student learning, particularly in challenging foundational science courses such as A&P-I.

The secondary research question was to determine if a direct instructor influenced student success. Any time different instructors teach course material, this could lead to variability in the outcome due to confounding factors, such as course schedule, instructor's reputation as a good teacher, and additional instructor course materials. Due to this study's retrospective design, these possible factors were not controlled for. The instructors all used the same textbook and the same study guide for the students, and the students in all course sections received the same quizzes, midterm, and final examinations. Although standardized study guides likely created consistency across course sections, individual teaching styles, lecture pacing, and additional support resources could have affected how effectively students utilized the guides [30]. Despite this likely variability, the results identified not only consistency in the course sections taught by the same instructor in both the SG and the CG groups but also, when comparing the student outcomes for the four instructors, there was not much difference in course results. This finding contrasts with the results from Jackson, who identified that factors such as teaching style, instructor experience, and student-instructor interaction may be crucial in shaping academic outcomes [31]. One rationale for this discrepancy would be that the A&P-I course was a lecture format, which limits the opportunity for active learning activities, leading, in general, to more passive student participation. Future investigations should further evaluate how confounding factors influence teaching pedagogy and the benefit of instructor-prepared course notes.

The instructors in this study had varying years of teaching experience (respectively>15, 10 years, and 1 year). Even though more experienced instructors may have refined their ability to pace content delivery, identify and address common content challenges, and offer students better feedback, our results do not show this significantly impacted student outcomes. This concurs with previous research that less experienced instructors will achieve similar outcomes as the more experienced instructors [32]. In 2024, the course faculty decided that all course sections would use the study guides based on the demonstrated benefit. Three new instructors taught A&P-I course sections in 2024. There was no significant difference in outcomes in 2024. This study proved evidence

that over a five-year time frame, instructor variation does not impact the overall student outcomes when using the same material and study guides. Therefore, the hypothesis that there would be a difference was rejected. To implement study guides across other courses or institutions, instructors should embed them into course design, aligning content with learning objectives and weekly topics. Standardizing the format across sections ensures consistency and equitable support for students. Including features like mind maps, key terms, and guiding questions accommodates various learning styles and reduces cognitive load. Encouraging students to annotate, reflect, and self-test with the guides deepens engagement and builds metacognitive skills. Faculty training and feedback collection can help refine the process and promote adoption. Though initially designed for A&P-I, this approach can be extended to other content-heavy courses across disciplines. Institutional support—through department planning or equity initiatives—can scale the impact of this low-cost, high-return strategy.

Limitations and Future Research

While the findings of this study are promising, it is essential to acknowledge its limitations. First, the retrospective quasi-experimental design inherently limits the ability to establish causal relationships. Without random assignment, the study relied on naturally occurring cohorts across the 19 course sections at a single institution over five academic years. This non-equivalent group structure introduces potential selection bias and restricts internal validity, as group differences may have existed prior to the intervention. Although quasi-experimental designs are valuable in educational settings where randomization is often impractical, they are more susceptible to confounding variables that may influence outcomes. Second, given that the study was conducted at a single institution with seven instructors, the study's generalizability may be limited as findings may not translate to other academic contexts, institutions, or disciplines. Instructor variability—differences in teaching style, experience, and engagement— was not systematically controlled for. Third, confounding variables such as students' baseline academic preparedness, study habits, motivation, and use of supplemental sources were not measured or controlled. These factors could have influenced bot the likelihood of benefiting from study guides and overall academic performance. Additionally, the absence of a prerequisite for A&P-I introduces possible heterogeneity in student level of preparedness. Fourth, the possibility of cross-group contamination— specifically, the sharing of study guides between students in the study guide and the control groups— was not monitored. This uncontrolled variable may have diluted the observed effect of the intervention and reduced the contrast between groups. Fifth, the transition to remote "live-online" instruction during the COVID-19 pandemic in Spring 2020 may have introduced atypical learning conditions that affected student engagement, access to resources, and academic performance. These external disruptions may complicate comparisons across semesters and may have introduced additional variability into the dataset. Finally, the study did not assess actual usage or engagement with the study guides. It remains unclear whether students in the SG group consistently used the materials, how they integrated them into their study routines, or whether they perceived them as helpful. Without this information, it is difficult to determine the mechanism by which the study guides may have influenced learning outcomes.

To address the limitations identified in the current study, future research should adopt a prospective, randomized controlled design to reduce selection bias and establish causality more robustly. Expanding the investigation across multiple institutions and academic disciplines would enhance the generalizability of findings beyond the context of a single A&P-I course. To better account for instructional variation, studies should incorporate standardized teaching protocols or use of multilevel modeling to isolate instructor-level effects. Additionally, collecting data on confounding variables such as baseline academic preparedness, study habit, motivation, and use of supplemental resources would provide a clearer understanding of the factors influencing student performance. Exploring how students interact with and perceive study guides through surveys and qualitative interviews, could provide richer insights into how these resources influence learning outcomes. Finally, longitudinal research could examine the sustained impact of instructor-provided study guides across multiple semesters or into advanced coursework, offering insights into the long-term effectiveness on academic progression and retention.

5. Conclusions

Providing students with instructor-created study guides is an effective strategy for improving academic performance and supports student success in a demanding gateway course such as Anatomy & Physiology-I. Study guides may reduce cognitive load, encourage active student engagement, and lead to metacognition, which improves student outcomes. The results of this retrospective study found a significant improvement in student exam scores, final grades, and course pass rates in those using the instructor-created study guide. The groups provided with the study guide had a significant and consistent reduction in course withdraw, F, and D grades over the four years. Therefore, by prioritizing the development and implementation of structured study resources, institutions can enhance their student's academic success, particularly in foundational gateway courses critical for career advancement in health sciences.

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Abbreviations
The following abbreviations are used in this manuscript:

A&P	Anatomy and Physiology
FGCU	Florida Gulf Coast University
SG	Study guide group
CG	Control group
N	Number of Subjects

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