

The Predictability of Anatomical Self-Efficacy Perception Levels of Associate Degree Students in Academic Performance

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Abstract:

Objective: Anatomy education is a fundamental component of health education and professional competence. Anatomical self-efficacy is defined as the belief in one's ability to successfully complete anatomy instruction. This study aimed to examine the difference in anatomical self-efficacy perception score over a semester and assess its impact on predicting the academic performance of associate degree students enrolled in gross anatomy courses.

Methods: The demographic data of the students were collected. The “Self-efficacy Perception Scale for the Human Anatomy Course” was administered twice before the mid-term and final exams during the semester. As an academic performance, the mid-term and final exam grades were retrieved from the e-campus information system. Differences in exam grades and anatomical self-efficacy perception were analyzed using a t-test, while the effect of anatomical self-efficacy perception on exam grades was assessed through simple linear regression analysis.

Results: The mid-term ($P<0.001$) and final exam grades ($P<0.001$), and anatomical self-efficacy perception increased significantly ($P<0.001$). A simple linear regression analysis showed that both midterm ($P<0.001$) and final exam grades ($P<0.001$) were predicted by anatomical self-efficacy perception, suggesting that higher self-efficacy perception is associated with better academic performance.

Conclusion: To enhance academic performance, lecturers should organize training activities designed to increase anatomical self-efficacy.

Keywords: Academic Performance, Anatomy Education, Associate Degree, Exam Grade, Self-Efficacy

The main goal of university departments dedicated to health sciences education is to promote and enhance the overall health of populations[1]. In this context, anatomy education constitutes one of the fundamental subjects within departments dedicated to health sciences education, serving as a foundational component for the

development of professional competencies across all domains of health sciences. It is essential for associate degree students in healthcare-related fields to receive comprehensive anatomy education and to be capable of applying this knowledge in practice through the development of professional skills and competencies.

According to Bandura's social cognitive theory,

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self-efficacy - defined as the confidence to perform the actions necessary to achieve desired goals - plays a crucial role in influencing performance outcomes through its dynamic interaction with environmental and behavioral determinants [2, 3]. Furthermore, self-efficacy is defined as an individual's belief in their ability to succeed at a task and has been demonstrated to influence students' motivation and academic behavior. Anatomical self-efficacy refers to an individual's belief in their ability to perform tasks successfully related to the anatomy curriculum, which encompasses both the learning of anatomical concepts and the application of anatomical knowledge in clinical contexts [4].

Studies assessing anatomical self-efficacy perception, particularly through the description or comparison of self-efficacy perception levels across various health fields, have the potential to enhance our understanding of students' course selections, measure their level of effort concerning the course, and inform instructional practices [5-7]. Additionally, health lecturers are becoming increasingly interested in their students' course motivation. In particular, there is a growing interest in how students' self-efficacy perception relates to learning and development during education, and how this can be promoted [3, 7-9].

In addition to descriptive studies that focus on the concept of anatomical self-efficacy perception, investigations are examining the relationship between anatomical self-efficacy perception and various factors such as students' place of residence [5], test anxiety, and willingness to choose a field of study [6]. However, there is a notable scarcity of research that explores the predictability of anatomical self-efficacy perception related to academic performance [4]. Specifically, to the best of our knowledge, no studies have assessed the anatomical self-efficacy perception of associate degree students in health-related fields or examined its relationship with academic performance.

This study aims to examine the differences in anatomical self-efficacy perception and academic performance among associate degree students in healthcare-related fields over a semester and assess the predictability of their anatomical self-efficacy perception on their academic performance. The study hypothesizes that: (1) students' anatomical self-efficacy perceptions increase from the middle to the end of the semester, and (2) perceptions of anatomical

self-efficacy predict health students' academic performance in anatomy exams.

METHODS

Ethical approval for the study was obtained from the Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (approval number 2023/11). The principles of the Declaration of Helsinki were followed throughout the research. Before the study, all participants were comprehensively informed about the research, and written informed consent was obtained from each individual.

Participants

The pre-test-post-test quasi-experimental study was conducted at Afyonkarahisar Health Sciences University. Participants were included in the study through the convenience sampling method. The study population comprised students aged 18 to 25 enrolled in the Oral and Dental Health, Patient Care, Elderly Care, Physiotherapy, Dialysis, Electroneurophysiology (ENF), First Aid and Emergency, Prosthetics and Orthotics, Medical Laboratory Techniques, and Medical Imaging Techniques programs at the Atatürk Health Services Vocational School, who were taking the Gross Anatomy course in 2024. No incentives were provided for participation in the study. The inclusion criteria were as follows: enrollment in the Gross Anatomy course, no prior participation in any anatomy course (whether in high school or at the same or another university), and aged between 18 and 25 years.

Data Collection Tools

Data were collected on two occasions (before the mid-term and final exams) within the period from November 2023 to January 2024, in the classroom under the supervision of the researchers, using a self-report survey. Between the two survey assessments, students were instructed in the Gross Anatomy course. The Gross Anatomy course encompasses basic anatomical knowledge for each program and is delivered through theoretical instruction over 14 weeks, with 2 hours of instruction per week.

The demographic data of the students, including age, gender, student matriculation number, program of study, and whether they had previously completed an

anatomy course, were collected. Participants completed the "Self-Efficacy Perception Scale for the Human Anatomy Course" to assess their anatomical self-efficacy perceptions. [10, 11]. The survey was administered twice: once before the mid-term exam and again before the final exam.

As part of the anatomy course, students were assessed through mid-term and final exams consisting of multiple-choice questions. The mid-term and final exam grades of the participants were used as indicators of academic performance. The mid-term and final exam grades for each student were retrieved from the e-campus information system.

Bahçeci [10] developed the "Self-Efficacy Perception Scale for the Human Anatomy Course," which consists of 26 questions, each featuring items rated on a five-point Likert-type scale. The valid and reliable scale assessed participants' commitment to the anatomy course, positive and negative behaviors related to the course, preconceptions about the anatomy course, and beliefs regarding the necessity of the anatomy course. The scale consists of 3 sub-dimensions (the Cronbach's alpha is 0.75). The sub-dimensions are as follows: sub-dimension 1 reveals the feeling of confidence in the knowledge of anatomy; sub-dimension 2, the awareness of practical skills in anatomy; and sub-dimension 3, the ability to transform theoretical knowledge in anatomy into real-life skills. The scale allows for a score ranging from 26 to 160 [10].

Statistical Analysis

The IBM SPSS Statistics 26.0 software was

employed for the data analysis. The suitability of the variables for normal distribution was considered through the skewness and kurtosis values. Skewness and kurtosis values between +2 and -2 suggested that the variables conform to a normal distribution [12]. Descriptive statistics, which were illustrated in tables and graphs, were reported for continuous variables as means and standard deviations, while categorical data were reported as frequency counts and percentage distributions. The differences between sub-dimension and total scores of the Self-Efficacy Perception Scale for the Human Anatomy Course, and the differences between mid-term and final grades were analyzed using a dependent samples t-test. The predictability of the independent variable, anatomical self-efficacy perception, on the dependent variable, exam grade, was assessed using simple linear regression analysis. Autocorrelation was evaluated using the Durbin-Watson statistic (ranging from 1.5 to 2.5), and no autocorrelation was detected during the regression analyses. During the regression analysis assessing the predictive validity of self-efficacy before the final exam on final grades, three outlier data points were removed from the analysis, and the regression analysis was subsequently completed. No outliers were detected in the other variables. In all analyses, a $P < 0.05$ was considered statistically significant. [13].

RESULTS

A total of 588 students were invited to participate in the study, and 407 students consented to participate.

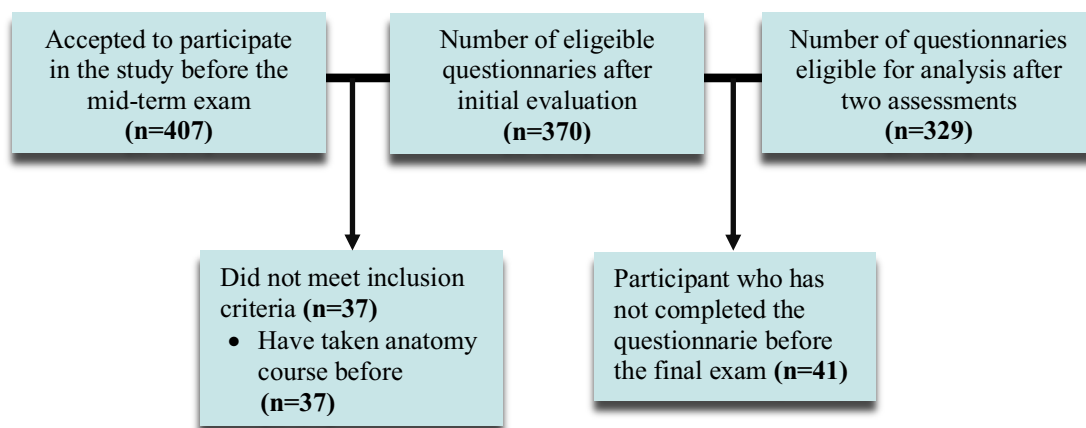


FIGURE 1. Flow chart of the study.

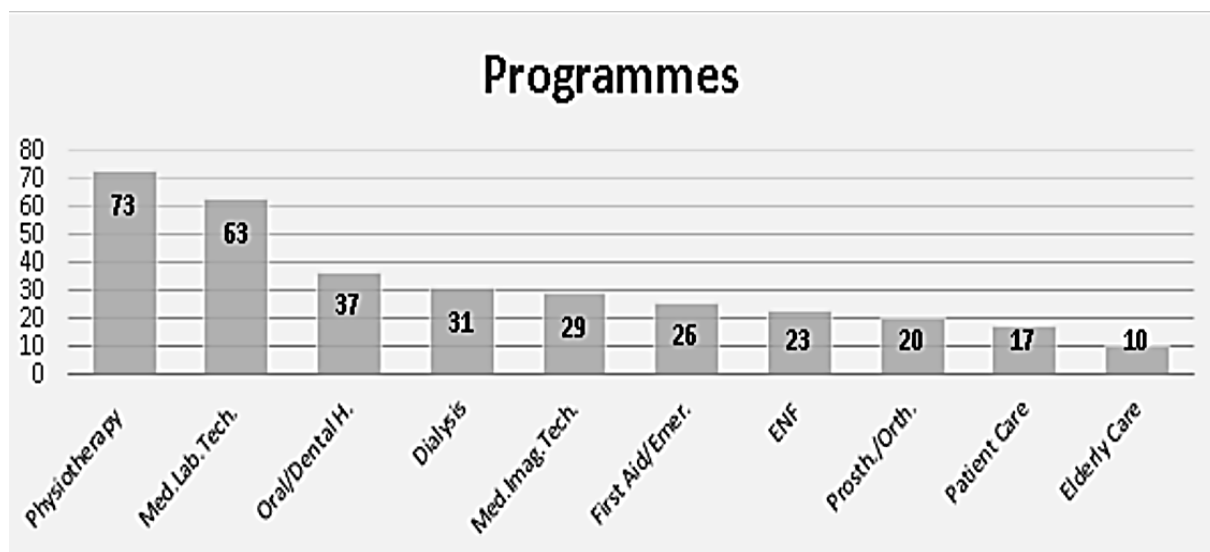


FIGURE 2. The number of students participating in the study from each program.

Thirty-seven students were excluded from the analysis because they had previously completed anatomy courses. Additionally, 41 students were excluded from the study because they did not complete the second survey administered before the final exam. Thus, data from 329 participants, aged 19.05±1.19 years (female, n=257, 78%), were analyzed, resulting in a relative response rate of 80.84% and an absolute response rate of 55.95% (Figure 1).

The majority of participants were students in the physiotherapy program (n=73, 22.2%) (Figure 2).

Before the mid-term exam, the total score, the sub-

dimension 1 score, the sub-dimension 2 score, and the sub-dimension 3 score of the Self-Efficacy Perception Scale for the Human Anatomy Course were 79.58±13.45, 35.47±6.21, 21.24±4.49, and 22.87±4.62, respectively. Before the final exam, the total score, the sub-dimension 1 score, the sub-dimension 2 score, and the sub-dimension 3 score of the Self-Efficacy Perception Scale for the Human Anatomy Course were 82.47±14.41, 36.51±6.34, 21.83±4.79, and 24.12±5.80, respectively. There were significant differences between the total score (P<0.001), the sub-dimension 1 score (P=0.03), the sub-dimension 2 score

TABLE 1. The Mean Scores of the Sub-Dimensions and the Total Scores of the Self-Efficacy Perception Scale for the Human Anatomy Course and the Mean of the Mid-Term and Final Exam Grades

Self-efficacy perception scale for the human anatomy course	Before mid-term exam (mean±SD)	Before final exam (mean±SD)	Paired differences Δ mean±SD	P-value
Sub-dimension 1	35.47±6.21	36.51±6.34	-1.05±6.32	0.003
Sub-dimension 2	21.24±4.49	21.83±4.79	-.59±4.17	0.011
Sub-dimension 3	22.87±4.62	24.12±5.80	-1.26±5.79	<0.001
Total score	79.58±13.45	82.47±14.41	-2.89±12.48	<0.001
Exam grade	Mid-term	Final	Paired differences Δ mean±SD	P-value
	57.85±15.54	75.96±16.35	-18.11±18.63	<0.001

SD, standart deviation. Statistically significant P-values are shown in bold.

TABLE 2. The Effect of Anatomical Self-Efficacy Perception Before the Midterm Exam on the Midterm Exam Grade in the Anatomy Course

Independent variable	Unstandardized coefficients		Standardized coefficients	t	P-value	95% Confidence interval
	B	SE	β			
(Constant)	44.647	5.102		8.750	<0.001	34.610-54.685
Self-efficacy perception for anatomy course	0.166	0.063	0.144	2.624	0.009	0.042-0.290

B, unstandardized beta coefficient; β , standardized beta coefficient; SE, standard error. Statistically significant P-values are shown in bold.

Summary of the Model (Analysis): F=6.884; P=0.009; R=0.144; R²=0.021; SEE=15.400; Durbin-Watson=1.707.

(P=0.011), and the sub-dimension 3 score (P<0.001) of the scale before the mid-term and final exams, with the scores before the final exam being significantly higher. The mid-term exam and final exam grades were 57.85±15.54 and 75.96±16.35, respectively. A significant difference was determined between the mid-term exam grades and the final exam grades (P<0.001) (Table 1).

The predictability of participants' anatomical self-efficacy perceptions before the mid-term exam on their mid-term exam grades is presented in Table 2. It was found that anatomical self-efficacy perceptions before the mid-term exam were predictive of the mid-term exam grades (F=6.884, P=0.009). The anatomical self-efficacy perceptions accounted for 2.1% of the variance in the final exam grades. A one-unit increase in anatomical self-efficacy perception was associated with an increase of 0.166 points in the mid-term exam grade (P=0.009).

The predictability of participants' anatomical self-efficacy perceptions before the final exam on their

final exam grades is shown in Table 3. The anatomical self-efficacy perceptions before the final exam were predictive of the final exam grades (F=9.713, P=0.002). The anatomical self-efficacy perceptions accounted for 2.9% of the variance in the final exam grades. A one-unit increase in anatomical self-efficacy perception was associated with an increase of 0.179 points in the final exam grade (P=0.002).

DISCUSSION

This study aimed to investigate the differences in anatomical self-efficacy perceptions of associate degree students throughout the semester, as well as the extent to which these anatomical self-efficacy perceptions predicted their academic performance. As a measure of academic performance, the study also aimed to highlight the differences between mid-term and final exams. The results indicate that both the general anatomical self-efficacy perceptions and exam

TABLE 3. The Effect of Anatomical Self-Efficacy Perception Before the Final Exam on the Final Exam Grade in the Anatomy Course

Independent variable	Unstandardized coefficients		Standardized coefficients	t	P-value	95% Confidence interval
	B	SE	β			
(Constant)	61.814	4.805		12.866	<0.001	52.362- 71.266
Self-efficacy perception for anatomy course	0.179	0.057	0.171	3.117	0.002	0.066-0.292

B, unstandardized beta coefficient; β , standardized beta coefficient; SE, standard error. Statistically significant P-values are shown in bold.

Summary of the Model (Analysis): F= 9.713; P=0.002; R=0.171; R²=0.029; SEE= 14.932; Durbin-Watson=1.515.

grades increased following 14 weeks of gross anatomy course. Consequently, higher anatomical self-efficacy perceptions were found to be a significant predictor of exam grades.

Similar to the present study, a few studies have examined the differences in self-efficacy perceptions throughout the semester concerning anatomy or other courses, but they have yielded different conclusions. Langfield *et al.* reported in their study, conducted in occupational therapy and physiotherapy programs, that the use of online videos had no significant impact on the anatomical self-efficacy perceptions. However, academic performance and anatomical self-efficacy perceptions were improved in a specific subgroup, although this effect was not observed in the entire cohort [14]. Vandenbossche *et al.* examined the extent to which improving anatomical knowledge with echocardiography and videos influences the self-efficacy perceptions of medical students compared to traditional lecture-based teaching. Although a significant difference in self-efficacy perceptions was observed between the two groups in the middle of the intervention, no difference in self-efficacy perception scores was observed at the end of the intervention. They explained that the disappearance of this difference over time could be due to the excessive mental stress in the intervention group [9]. Previous studies have identified numerous factors that can influence self-efficacy in specific domains [4, 15, 16]. Although many factors influence self-efficacy, the observed increase in anatomical self-efficacy perceptions and exam grades in this study suggests that participants completed the anatomy courses.

There are studies that demonstrate a positive relationship between self-efficacy and academic performance [8, 17, 18]. Since self-efficacy is recognized to be domain-specific [17], numerous studies have been published on anatomical self-efficacy perceptions and beliefs in various health disciplines. However, the number of studies investigating the relationship between anatomical self-efficacy perceptions and academic performance is limited. In a study conducted by Burgoon *et al.* with medical students similar to the present study, it was found that anatomical self-efficacy predicted exam grades by 5-14% in four different exams during the semester [4]. This indicates that higher anatomical

self-efficacy perception is associated with better academic performance. The finding of a higher prediction percentage than in our study can be attributed to differences in curriculum and examination types across programs. Theoretical and practical hours, curriculum intensity, and other factors for undergraduate students (e.g., medical, dental, and physical therapy students) are fundamentally different from those of associate degree students in healthcare-related programs [6, 19, 20]. The present study may provide a unique perspective on the anatomical self-efficacy perceptions by associate degree students.

In contrast to this study, Reynolds *et al.* [21] found that only cognitive self-efficacy predicted academic performance in the anatomy course by 7% in doctor of physical therapy (DPT) students. They reported that psychomotor and clinical self-efficacy in anatomy and general self-efficacy were not independent predictors [21]. In other studies examining self-efficacy and academic performance in different academic skills, the importance of self-efficacy in predicting academic performance was found to vary [22, 23]. This study revealed that anatomical self-efficacy perception was a predictive factor in academic performance. While self-efficacy is a significant factor in academic performance, it is vital to recognize that it alone is insufficient to guarantee passing an exam, as other factors may also play a crucial role. The variations in results between studies may be attributed to differences in study design, program and curriculum, as well as the methods used to measure academic performance.

Strengths and Limitations

While numerous studies have examined anatomical self-efficacy perceptions in health undergraduate education [4, 7, 9, 14, 19], the present study specifically focused on anatomical self-efficacy perceptions and their predictive value in academic performance within healthcare-related associate degree programs. These associate degree programs prepare technician candidates who play a crucial role in healthcare; consequently, this study provides a unique perspective to the literature.

One limitation of the study was that confounding factors could not be determined. Specifically, one potential confounding factor is the possibility that

participants studied more intensively towards the end of the semester due to anxiety about failing the course, which could have affected the results. This increased study effort could have increased their anatomical self-efficacy and subsequently their exam performance.

Additionally, the influence of other courses in the curriculum on their knowledge of anatomy cannot be overlooked; students might have received varying levels of support or instruction in related subjects, which could impact their overall understanding and performance in anatomy specifically. It is also important to consider that individual differences among students, such as prior knowledge of anatomy, study habits, and test-taking strategies, could further complicate the relationship between self-efficacy and academic performance.

Moreover, methodological limitations, including the use of non-randomized sampling and the fact that the study was conducted at a single center, should be acknowledged. This limits the generalizability of the findings, as results may vary in different educational contexts or among diverse student populations. Future research should aim to address these limitations by employing randomized sampling and multi-center studies to gain a more comprehensive understanding of the factors influencing anatomical self-efficacy and academic performance.

CONCLUSION

In conclusion, this study highlights that anatomical self-efficacy perception is a significant predictor of academic performance. This study also concluded that there was an increase in associate students' knowledge of anatomy and academic performance over the semester. To enhance anatomical self-efficacy and, consequently, the academic performance of students, it is recommended that lecturers regularly evaluate their students' anatomical self-efficacy, increase the number of course hours, and employ diverse teaching strategies that can boost self-efficacy. Students with high self-efficacy perceptions are likely to achieve greater success not only in their courses but also in their professional careers. In light of these findings, future studies could focus on randomized experimental studies that integrate diverse teaching

techniques that could possibly promote anatomical self-efficacy.

Ethics Approval and Consent to Participate

This study was approved by the Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (Decision No: 2023/11; date: 03.11.2023). All procedures were conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all individual participants included in the study.

Data Availability

All data generated or analyzed during this study are included in this published article. The data that support the findings of this study are available on request from the corresponding author, upon reasonable request.

Authors' Contribution

Study Conception: EH; Study Design: EH, GM; Supervision: EH; Funding: EH; Materials: EH, GM; Data Collection and/or Processing: EH, GM; Statistical Analysis and/or Data Interpretation: EH; Literature Review: EH; Manuscript Preparation: EH; and Critical Review: EH, GM.

Conflict of Interest

The author(s) disclosed no conflict of interest during the preparation or publication of this manuscript.

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Generative Artificial Intelligence Statement

The author(s) declare that no artificial intelligence-based tools or applications were used during the preparation process of this manuscript. The all content of the study was produced by the author(s)

in accordance with scientific research methods and academic ethical principles.

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