

# Opinions of Physiotherapy Students on the Effect of Anatomy Education in Clinical Practice Course: A Preliminary Study

## Fizyoterapi Öğrencilerinin Klinik Uygulama Dersinde Anatomi Eğitiminin Etkisine İlişkin Görüşleri: Bir Ön Çalışma

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### ABSTRACT

**Background:** The aim of this study was to describe the dynamic connections between physiotherapy students' anatomy and 4<sup>th</sup> grade clinical practice courses through student perceptions.

**Materials and Methods:** In this cross-sectional study, a three-part questionnaire was applied to 141 fourth-year physiotherapy students. The first part included the descriptive information of the students, the second part, the perceptions of the students on anatomy knowledge during the clinical practice course using a 5-point Likert scale, and the third part, the perceptions of the students on the subjects of systematic anatomy. Descriptive statistics and the explanatory factor analysis methods was used in data analysis.

**Results:** According to factor analysis, a total of 21 items (Cronbach  $\alpha=0.88$ ) revealed 3 factors explaining 50.24% of the variance ( $p<0.001$ ): (1) Compliance in clinical practice and anatomy courses, (2) Anatomy learning qualifications in clinical practice and (3) Importance of anatomy in clinical practice. The factors were significantly correlated with each other ( $p<0.05$ ). Students who passed the anatomy course in one attempt and students who had experience working as a health professional showed high scores in factor 1 ( $p<0.05$ ).

**Conclusion:** Findings limited to student responses provides guiding ideas to anatomists and educational physiotherapists about the effectiveness and importance of anatomy education in clinical practice course.

**Keywords:** Anatomy, clinical practice, education, physical therapists

### ÖZ

**Amaç:** Bu çalışmanın amacı, fizyoterapi öğrencilerinin anatomi ve 4. sınıf klinik uygulama dersleri arasındaki dinamik bağlantıları öğrenci algıları üzerinden tanımlamaktır.

**Gereç ve Yöntemler:** Bu kesitsel çalışmada, dördüncü sınıftaki 141 fizyoterapi öğrencisine, üç bölümden oluşan bir anket uygulandı. Birinci bölümde öğrencilerin tanımlayıcı bilgileri, ikinci bölümde 5'li Likert ölçeği kullanılarak öğrencilerin anatomi bilgilerini klinik uygulama dersi sırasındaki algılama durumları ve üçüncü bölümde öğrencilerin sistematik anatomi konularına yönelik algıları yer aldı. Veri analizinde tanımlayıcı istatistikler ve açıklayıcı faktör analizi yöntemi kullanıldı.

**Bulgular:** Faktör analizine göre toplam 21 ifade, (Cronbach  $\alpha=0,88$ ) varyansın %50,24'ünü açıklayan 3 faktör ortaya koymuştur ( $p<0,001$ ): (1) Klinik uygulama ve anatomi derslerindeki uyum, (2) Klinik uygulamalarda anatomi öğrenim yeterlilikleri ve (3) Klinik uygulamalarda anatominin önemi. Faktörler birbirleri ile anlamlı düzeyde ilişkiliydi ( $p<0,05$ ). Anatomi dersini tekrar etmeksizin geçen öğrenciler ile bir sağlık profesyoneli olarak çalışma deneyimine sahip öğrenciler faktör 1'de yüksek puanlar gösterdi ( $p<0,05$ ).

**Sonuç:** Elde edilen öğrenci yanıtlarıyla sınırlı bulgular, anatomi eğitiminin klinik uygulama dersindeki etkinliği ve önemi hakkında anatomistlere ve eğitici fizyoterapistlere yön gösterici fikirler vermektedir.

**Anahtar Kelimeler:** Anatomi, klinik uygulama, eğitim, fizyoterapist



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## Introduction

Anatomical knowledge and understanding are essential components of physiotherapy education and practice (1) and a path to success in further applications (2). It is also necessary to equip students with safe and effective clinical skills (3). For this reason, anatomy courses, which have tremendous impact in clinical courses and postgraduate professional practice, are an integral part of the physiotherapy education curriculum (4,5,6). In the National Core Training Program for Physiotherapy Departments in Türkiye, the importance of functional and applied/specialized anatomy knowledge focused on health or disease associated with physiotherapy practices is emphasized (7).

In the 4-year undergraduate physiotherapy education, anatomy is taught to students in their first year of university. In fact, this curriculum model is based on the assumption that further learning in later years builds on the knowledge gained in the early stages of the program (1,2). On the other hand, it has been shown that physiotherapy students cannot retain their anatomy knowledge gained in the first years in the following years (1). In the physiotherapy curriculum, applications on a real patient are only possible toward the end of undergraduate education and the clinical reasoning skills of the students develop from novice to professionalism (8). Therefore, it is necessary to clarify the effects of anatomical knowledge learned early in undergraduate education on clinical reasoning skills learned and experienced in senior clinical practice courses. In order for students to collect and interpret information from the patient, and to plan and apply treatment, they should have knowledge of the normal functions of an anatomical structures and should be able to detect possible disorders in terms of movement and participation. This model in clinical reasoning is also recommended in World Health Organization's International Classification of Functions (9,10).

Undergraduate physiotherapy students develop hypothetical-deductive reasoning skills by comparing and reflecting on different reasoning approaches (11,12). Over time, students learn to synthesize these different approaches into their individual approaches (11). Therefore, anatomy needs to be dynamically understood and evaluated in clinical contexts (12). Physiotherapists and physiotherapy students consider it extremely important to use their knowledge of anatomy to solve clinical problems and develop practical skills (4,13).

More research is needed to develop clinical reasoning skills and explore the best strategies (14). In the development of the physiotherapy profession, which has

become very popular in the world in recent years, and in the education curriculum of the students, importance is given to the development of anatomy education (5,6). For this reason, in previous studies, it was tried to determine the needs of the student group by taking student feedback (4,6,15). However, to the best of our knowledge, no feedback has been received regarding the empirical impact of knowledge of anatomy on the clinical practice knowledge and experience of senior physiotherapy students. In fact, a study in this direction may contribute to the understanding of the holistic relationship between the clinical practice course, where professional skills are experienced for the last time before specialization, and anatomy education, which is one of the cornerstones of the undergraduate curriculum.

Final training of senior physiotherapy students before starting the profession as a professional physiotherapist includes clinical skills learned in 4<sup>th</sup> year clinical practice. The aim of this study is to provide a preliminary assessment of the dynamic link between clinical practice skills and anatomy learning of 4<sup>th</sup> year physiotherapy students. Emphasis on strengths or weaknesses in anatomy knowledge in clinical reasoning processes by students who experience and develop their clinical practice on patients can contribute to an improved understanding when planning anatomy and physiotherapy curriculum.

## Material and Methods

### Study Design, Sampling and Ethical Considerations

In this study, a cross-sectional research design was preferred using quantitative methods. The research was carried out in accordance with the Declaration of Helsinki. After the approval of Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (decision dated 05.11.2021 and numbered 2021/492), 180 students who were potential participants of the study and who were successful in the clinical practice course after the completion of the 2021 fall semester were contacted. These students were senior students enrolled in a four-year physiotherapy and rehabilitation department at Afyonkarahisar in Türkiye. Participation in the study was voluntary and all participants read and approved the informed consent form. Those who did not want to participate in the study (n=18), those who had deficiencies in their descriptive information or missing data in their answers (n=11), and those who were found to have given contradictory answers to the control question asked during the analysis (n=10) were excluded in the study (Figure 1). For the calculation of sample size we used formula  $[n=Nt2pq/d2(N-1)+t2pq]$ . The sample size for the universe of 180 physiotherapy students was determined

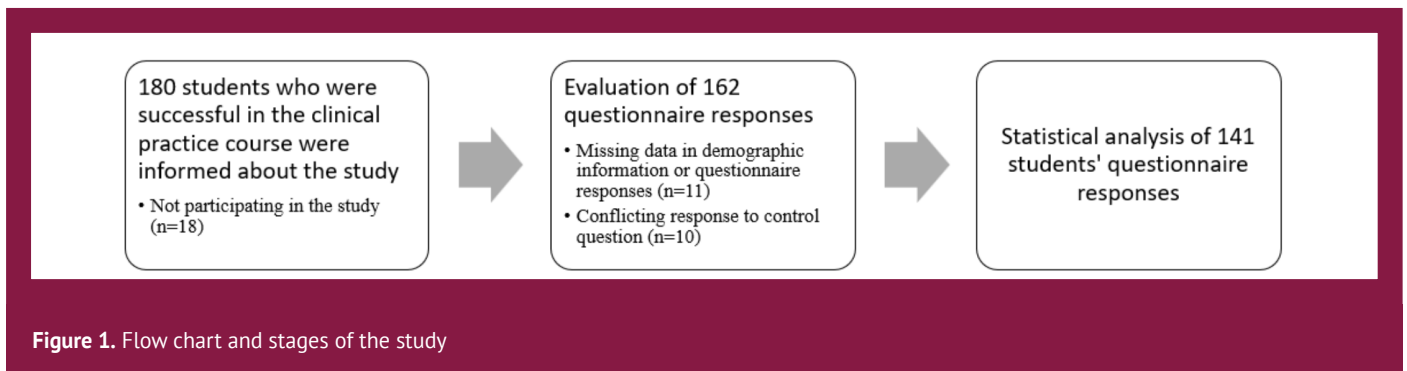


Figure 1. Flow chart and stages of the study

as 123 students (confidence level: 95% and a confidence interval: 5%). The data collection process was completed on January 10, 2021 by reaching 141 students with simple random sampling method.

### Curriculum

At the university where the study was carried out, the anatomy teaching of the students who are subject to the 4-year physiotherapy undergraduate curriculum is mainly carried out in the first years of education. Anatomy teaching is offered in three different terms and with three different courses (Anatomy I and Anatomy II courses, 1<sup>st</sup> grade; Neuroanatomy course, 2<sup>nd</sup> grade). Students who successfully complete the basic sciences and physiotherapy vocational courses in the first three years take the clinical practice I and II courses in the 4<sup>th</sup> year under the supervision of physiotherapist supervisors in order to experience what they have learned in these courses in clinical settings. The information about the curriculum of the students and the purpose of the relevant courses is presented in Table 1.

### Data Collection and Study Procedure

Students were motivated by the knowledge that this research would contribute significantly to the development of teaching methods. It is stated that they can stop filling out the questionnaire at any time. In this study, a questionnaire consisting of three parts and prepared within the scope of the literature (2,6,16) was used as a data collection tool. Sections in the survey form are as follows: (1) Demographic information, (2) A 5-point Likert-type, 35-question questionnaire on the relationship between anatomy education and clinical practice course and (3) 3 multiple-choice questions about participants' attitudes toward systematic anatomy issues.

**Demographic information:** This section included questions about participants' age, gender, employment status in a health institution, school enrollment types, clinical practice rotations, and success in anatomy courses.

Table 1. Anatomy and clinical practice training in the physiotherapy curriculum

Course and bologna knowledge	Aim of the course
<b>Anatomy I</b> 1 <sup>st</sup> year fall semester 2 theoretical course hours per week 2 laboratory course hours per week Term ECTS: 5	Learning the anatomy of locomotor, respiratory, circulatory, digestive, urogenital, endocrine and nervous systems as well as general anatomical concepts
<b>Anatomy II</b> 1 <sup>st</sup> year spring semester 3 theoretical course hours per week 2 laboratory course hours per week Term ECTS: 5	To understand the shape and structure of the human body in detail, to understand the structures and organs that make-up the body, to understand their functions, to understand the relationship with each other and to apply all the knowledge to the clinic.
<b>Neuroanatomy</b> 2 <sup>nd</sup> year fall semester 2 theoretical course hours per week 2 laboratory course hours per week Term ECTS: 4	To give basic and clinical information about the structures and organs that make up the central nervous system at undergraduate level, to enable students to recognize the structures of the central nervous system theoretically and practically, and to teach the relations of these structures both within themselves and with other systems.
<b>Clinical practice I</b> 4 <sup>th</sup> year fall semester 35 practice course hours per week Term ECTS: 30	To provide students with the opportunity to apply their treatment theoretical knowledge and skills in various clinical settings (Neurological and pediatric rehabilitation or general FTR and Orthopedic rehabilitation) under the supervision of a supervisor.

ECTS: European credit transfer and accumulation system

**Survey structure:** Study participants were asked whether they agreed with each item and how strongly they agreed, using a point rating scale. In this study, each item in the questionnaire was measured using a 5-point Likert scale based on positively expressed inferences (strongly disagree, 1; disagree, 2; undecided, 3; agree, 4; strongly agree, 5). Relevant survey responses for each item were

collected, and the mean and standard deviations (SD) of the responses for each item were calculated over the total scores of the respondents.

**Questionnaire for the relationship between anatomy education and clinical practice course:** This section was used to measure the participants' perceptions, awareness and suggestions about the information they learned in Anatomy I, Anatomy II, and Neuroanatomy courses and the experiences they gained in the clinical practice course. While preparing the questionnaire, 22 questions in the literature were included in the first stage. Sample questions were as follows: (i) "Success in anatomy theory courses is effective in success in clinical practice course." (ii) "Anatomy courses should be given again after the 1<sup>st</sup> and 2<sup>nd</sup> grades together with the vocational courses." (iii) "What I learned in the anatomy course increases my curiosity about the clinic." Afterwards, 12 more statements were added regarding the purpose and course outputs of the relevant courses, by interviewing the responsible lecturers of the anatomy and clinical practice courses. A few of these questions were: (i) "What I learned in the anatomy course allows me to be successful in clinical practice." (ii) "During clinical practice, I found that I had deficiencies in anatomy." (iii) "The knowledge achieved in anatomy lessons helps in exercise practice." In order to measure whether the students gave sincere answers when filling out the form, a statement was added to the form by the researchers as a control question and determined as an exclusion criterion. In the final form of the questionnaire, there were a total of 35 questions. In the analysis phase, the compatibility between the control questions (3<sup>rd</sup> and 27<sup>th</sup> items) was evaluated separately in each form. The forms of those with a total of 8, 9, or 10 responses to both statements were not included in the analyzes by the researchers. In addition, those with 10% or less missing data in their answers were accepted as random missing data and the mean score of the missing variable was entered instead of missing values. The flow chart of the study and at which stages and how many data losses occurred are presented in Figure 1.

**Multiple choice questions about participants' attitudes towards systematic anatomy topics:** This section has been prepared as multiple choice in clinical practice courses to explore the requirements of systematic anatomy knowledge. Students were asked to choose at most three among the subjects of movement (bone, joint, muscle), circulation, respiratory, urinary, digestive, genital, nervous, endocrine systems and sensory organs, according to the specified questions: (1) Most interesting to me, (2) the one I am most successful at, and (3) the most challenging for me.

## Statistical Analysis

Statistical analysis was performed by using the IBM Statistics SPSS v25.0. (IBM Corp. Armonk, NY, USA). The frequency and percentage distribution of the obtained data is described. The homogeneity of the data was evaluated using the Shapiro-Wilk test, but according to the results of the parametric assumption test, the data could not meet the normality assumption. Therefore, non-parametric procedures were used for data analysis. Exploratory factor analysis was performed to investigate whether there were different structures in the data for the questionnaire items and to investigate the construct validity of the questionnaire. The number of factors to be removed by the researchers was determined by fixing it at three. The rotation method used was Varimax with Kaiser normalization. To verify that the factor analysis was appropriate for the data, the Kaiser-Meyer-Olkin sampling adequacy measure and Bartlett's test of sphericity was calculated. The mean scores of the factors were calculated for each student group variable, and the differences between the two groups were evaluated using the Mann-Whitney U test. Results were presented as means with  $\pm$  SD or medians with interquartile range. Spearman correlation analysis was performed to determine the relationship between subfactors. In statistical analyzes, significance test and confidence intervals were evaluated at  $p < 0.05$  significance level.

## Results

### Demographic and Survey Completion Rate

A total of 162 (90% participation rate) students responded to the questionnaire. The study was completed with 141 (78% inclusion rate) participants after exclusion criteria. 72.3% (n=102) of the participants were female, 27.7% (n=39) were male. The mean age of the participants was  $23.01 \pm 3.43$ . The rate of those working in any health institution before or during undergraduate education was 19.9% (n=28). The rate of those who were enrolled in the department with the post-secondary university entrance exam was 92.2% (n=130). The rate of those who received neurological and pediatric rehabilitation practices during the clinical practice course was 41.8% (n=59). The rate of those who failed any of the Anatomy I, Anatomy II and Neuroanatomy courses in the previous years and who took the course again was 37.9% (n=52) (Table 2).

### Determining the Importance of Anatomy Education in Clinical Practice Courses

The statement of "Explaining the anatomy and physiotherapy clinic associating them increases the success in clinical applications. was the statement with the



**Table 2. Demographic characteristics of the participants**

Demographic characteristics	n	%
<b>Gender</b>		
Females	102	72,3
Males	39	27,7
<b>Type of school registration of students</b>		
With university entrance exam	130	92,2
With external transfer exam	11	7,8
<b>Working status as a healthcare professional of students</b>		
Yes	28	19,9
No	113	80,1
<b>Clinical practice course of students</b>		
Completed general PTR and orthopedic rehabilitation practices	68	48,2
Completed pediatric and neurological rehabilitation practices	59	41,8
Completed both practices	14	9,9
<b>Status of retaking the anatomy lesson</b>		
None	89	63,1
Re-takers at least once	52	36,9
<b>Age (years), mean ± SD</b>	23,01±3,43	

N: Number of participants, %: Percentage of participants, PTR: Physiotherapy and rehabilitation, SD: Standard deviation

highest mean (mean ± SD, 4.65±0.52), the statement of “I’m considering postgraduate education in anatomy” was the statement with the lowest mean (mean ± SD, 3.51±1.17). In Table 3, mean value, SD, frequency and percentage values are given for the answers to 35 questions.

The Cronbach  $\alpha$  is a statistic widely cited by the authors to demonstrate the relevance of tests and scales created or adopted for research projects (17). Thirty-four statements in this study achieved a reliability coefficient of 0.88 and had high internal consistency. A limited exploratory factor analysis was performed on 3 factors to facilitate understanding and interpretation of the relationships among the questionnaire statements. A total of 21 statements (Cronbach  $\alpha$ =0.88) diverged in 3 factors after removing the items that did not meet the sufficient threshold to enter any factor. The first factor explained 28.7% of the variance, the second 13.3% and the third 8.3%. Therefore, 50.24% of the variance was explained by these three factors. Factor 1: Students’ perceptions of compliance in clinical practice and anatomy courses (10 items and Cronbach  $\alpha$ =0.86). Factor 2: Students’ perceptions of anatomy learning competencies in clinical practice (5 items and Cronbach  $\alpha$ =0.78). Factor 3: Students’ perceptions of the importance of anatomy in clinical practice (6 items and Cronbach  $\alpha$ =0.78) (Table 4). The three factors were statistically significantly correlated among themselves ( $p<0.05$ ) (Table 5).

**Table 3. The questionnaire items and students’ responses about anatomy knowledge and clinical applications in physiotherapy**

Items	Mean ± SD	Frequency (%)				
		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Success in anatomy theory courses is effective in success in clinical practice course.	4.41±0.8	1 (0.7)	5 (3.5)	7 (5)	50 (35.5)	78 (55.3)
Success in anatomy practice courses is effective in success in clinical practice course.	4.53±0.72	2 (1.42)	1 (0.71)	4 (2.84)	47 (33.33)	87 (61.7)
Anatomy I, Anatomy II and neuroanatomy courses increase my professional skills.	4.5±0.65	1 (0.71)	0 (0)	6 (4.26)	54 (38.3)	80 (56.74)
The knowledge gained in anatomy classes is helpful in electrotherapy applications.	4.22±0.83	1 (0.71)	6 (4.26)	12 (8.51)	64 (45.39)	58 (41.13)
The knowledge achieved in anatomy lessons helps in exercise practice.	4.55±0.57	0 (0)	1 (0.71)	2 (1.42)	56 (39.72)	82 (58.16)
The knowledge gained in anatomy classes helps me during assessment and evaluation practices in physiotherapy.	4.57±0.59	0 (0)	1 (0.71)	4 (2.84)	50 (35.46)	86 (60.99)
During clinical practice, I can relate musculoskeletal structures to orthopaedic assessment and treatment practices.	4.42±0.62	0 (0)	1 (0.71)	7 (4.96)	65 (46.1)	68 (48.23)



Table 3. Continued						
Items	Mean ± SD	Frequency (%)				
		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
During clinical practice, I can relate neuroanatomical structures to neurological assessment and treatment practices.	4.21±0.68	0 (0)	2 (1.42)	15 (10.64)	76 (53.9)	48 (34.04)
What I learn in anatomy classes motivates me for my career.	4.25±0.84	2 (1.42)	2 (1.42)	18 (12.77)	56 (39.72)	63 (44.68)
Anatomy courses are an important topic for clinical applications in physical therapy.	4.62±0.54	0 (0)	0 (0)	4 (2.84)	46 (32.62)	91 (64.54)
Explaining the anatomy and physiotherapy clinic associated with it increases the success in clinical applications.	4.65±0.52	0 (0)	0 (0)	3 (2.13)	44 (31.21)	94 (66.67)
The anatomy course is important in choosing the appropriate treatment for the patient and pathology.	4.52±0.54	0 (0)	0 (0)	3 (2.13)	61 (43.26)	77 (54.61)
There is a relationship between the anatomy education given in the curriculum and clinical practice.	4.19±0.83	0 (0)	7 (4.96)	16 (11.35)	61 (43.26)	57 (40.43)
Before clinical applications, I need to repeat the anatomy.	4.42±0.69	0 (0)	3 (2.13)	7 (4.96)	59 (41.84)	72 (51.06)
In the exams of clinical practice courses, there are questions that question my knowledge of anatomy.	4.39±0.7	0 (0)	3 (2.13)	9 (6.38)	60 (42.55)	69 (48.94)
I watched at least one video on anatomy during clinical practice.	3.83±1.21	8 (5.67)	17 (12.06)	18 (12.77)	47 (33.33)	51 (36.17)
During clinical practice, I found that I had deficiencies in anatomy.	4.04±0.92	2 (1.42)	8 (5.67)	20 (14.18)	63 (44.68)	48 (34.04)
I reviewed my previous anatomy lecture notes during clinical practice.	4.13±0.95	4 (2.84)	7 (4.96)	12 (8.51)	64 (45.39)	54 (38.3)
Before the clinical practice course, there should be an accelerated anatomy review course.	4.09±0.95	3 (2.13)	5 (3.55)	26 (18.44)	51 (36.17)	56 (39.72)
Anatomy courses should be given again after the 1 <sup>st</sup> and 2 <sup>nd</sup> grades together with the vocational courses.	3.89±1.04	4 (2.84)	9 (6.38)	34 (24.11)	46 (32.62)	48 (34.04)
What I learn in anatomy, which I associate my knowledge of anatomy with clinical applications, becomes more permanent.	4.21±0.95	2 (1.42)	7 (4.96)	18 (12.77)	47 (33.33)	67 (47.52)
Increasing the theoretical course hours of Anatomy I, Anatomy II and Neuroanatomy courses improves clinical practice skills.	3.62±1.05	6 (4.26)	12 (8.51)	41 (29.08)	52 (36.88)	30 (21.28)

**Table 3. Continued**

Items	Mean ± SD	Frequency (%)				
		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Increasing the practical hours of Anatomy I, Anatomy II and Neuroanatomy courses improves clinical practice skills.	4.18±0.88	2 (1.42)	4 (2.84)	20 (14.18)	56 (39.72)	59 (41.84)
Seeing anatomical structures through cadavers improves my clinical practice skills.	4.28±0.86	2 (1.42)	3 (2.13)	17 (12.06)	52 (36.88)	67 (47.52)
Anatomy I, Anatomy II and Neuroanatomy course topics should be changed to be more compatible with physiotherapy clinical practice.	4.25±0.86	2 (1.42)	3 (2.13)	18 (12.77)	54 (38.3)	64 (45.39)
Topics such as radiological anatomy, cross-sectional anatomy and clinical anatomy should be added to the anatomy course content.	4.06±0.94	1 (0.71)	5 (3.55)	36 (25.53)	41 (29.08)	58 (41.13)
*Anatomy I, Anatomy II and neuroanatomy courses increase my professional skills.	1.48±0.67	86 (60.99)	45 (31.91)	8 (5.67)	2 (1.42)	0 (0)
Anatomy I, Anatomy II and neuroanatomy courses give an idea about what I can encounter in the clinic.	4.18±0.75	0 (0)	3 (2.13)	21 (14.89)	67 (47.52)	50 (35.46)
In the physiotherapy curriculum, I would like to have elective courses related to anatomy (such as anatomical palpation and anatomy of pain).	4.35±0.71	0 (0)	0 (0)	19 (13.48)	54 (38.3)	68 (48.23)
In my professional life, I would like to attend courses and training related to anatomy.	3.87±0.99	3 (2.13)	9 (6.38)	34 (24.11)	53 (37.59)	42 (29.79)
I am considering postgraduate education in anatomy.	3.51±1.17	9 (6.38)	16 (11.35)	45 (31.91)	35 (24.82)	36 (25.53)
What I learned in the anatomy course allows me to be successful in clinical practice.	4.36±0.67	1 (0.71)	0 (0)	9 (6.38)	69 (48.94)	62 (43.97)
What I learned in the anatomy course increases my curiosity about the clinic.	4.24±0.72	0 (0)	3 (2.13)	15 (10.64)	69 (48.94)	54 (38.3)
I think that anatomy is important in courses related to my profession (taping, pilates, bobath, etc.).	4.5±0.64	0 (0)	2 (1.42)	5 (3.55)	54 (38.3)	80 (56.74)
Anatomy I, Anatomy II and neuroanatomy courses give an idea about what I can encounter in the clinic.	3.53±1.26	12 (8.51)	16 (11.35)	39 (27.66)	33 (23.4)	41 (29.08)

\*Duplicate control question, SD: Standard deviation



**Table 4. Exploratory factor analysis results of questionnaire items**

Items	Factor loadings	Cronbach alpha
Anatomy I, Anatomy II and neuroanatomy courses increase my professional skills.	0.74	0.86
Success in anatomy practice courses is effective in success in clinical practice course.	0.72	
The knowledge achieved in anatomy lessons helps in exercise practice.	0.70	
There is a relationship between the anatomy education given in the curriculum and clinical practice.	0.68	
Anatomy courses are an important topic for clinical applications in physical therapy.	0.63	
Success in anatomy theory courses is effective in success in clinical practice course.	0.61	
Explaining the anatomy and physiotherapy clinic associated with it increases the success in clinical applications.	0.61	
The anatomy course is important in choosing the appropriate treatment for the patient and pathology.	0.59	
What I learn in anatomy classes motivates me for my career.	0.58	
The knowledge gained in anatomy classes helps me during assessment and evaluation practices in physiotherapy.	0.56	
What I learned in the anatomy course increases my curiosity about the clinic.	0.71	0.78
In my professional life, I would like to attend courses and training related to anatomy.	0.66	
What I learned in the anatomy course allows me to be successful in clinical practice.	0.66	
In the physiotherapy curriculum, I would like to have elective courses related to anatomy (such as anatomical palpation and anatomy of pain).	0.66	
I think that anatomy is important in courses related to my profession (taping, pilates, bobath, etc.).	0.62	
Anatomy I, Anatomy II and neuroanatomy courses give an idea about what I can encounter in the clinic.	0.62	0.78
Before the clinical practice course, there should be an accelerated anatomy review course.	0.79	
I reviewed my previous anatomy lecture notes during clinical practice.	0.75	
Anatomy courses should be given again after the 1 <sup>st</sup> and 2 <sup>nd</sup> grades together with the vocational courses.	0.73	
During clinical practice, I found that I had deficiencies in anatomy.	0.70	
Before clinical applications, I need to repeat the anatomy.	0.60	

Kaiser-Meyer-Olkin: 0.825; Bartlett's test approx. chi-square: 1096.26, df: 210, p<0.001

**Table 5. Spearman correlation analysis results of sub-factors**

Sub-factors	1	2	3
<b>Factor 1.</b> Students' perceptions of compliance in clinical practice and anatomy courses (3-2-5-13-10-1-11-12-9-6)	1	0.199*	0.464**
<b>Factor 2.</b> Students' perceptions of anatomy learning competencies in clinical practice (33-30-32-29-34-28)		1	0.370**
<b>Factor 3.</b> Students' perceptions of the importance of anatomy in clinical practice (19-18-20-17-14)			1

\*p<0.05, \*\*p<0.01

Difference analyzes of the sub-factors obtained from the questionnaire according to the independent variables are given in Table 6. It was determined that students who passed the anatomy course at a single time and students who had experience of working as a health professional had higher average scores in the first factor (Table 6) (p<0.05).

### Attitudes Towards Systematic Anatomy Topics

When the students were asked about the anatomy topics that they were successful and most interested in, the answers to these two questions were gathered under the heading of movement system. In addition, when the

**Table 6. The relationship of factor 1 with some participant variables**

Variables	Median ± IQR	Minimum-maximum	q25-q75	p
<b>Working status of the student in the field of health (n=141)</b>				
Yes (n=28)	4.80±0.70	3.40-5.00	4.30-5.00	0.013*
No (n=113)	4.50±0.75	3.30-5.00	4.10-4.85	
<b>Retaking anatomy courses (n=141)</b>				
Yes (n=52)	4.35±0.88	3.30-5.00	4-4.88	0.041*
No (n=89)	4.70±0.70	3.60-5.00	4.2-4.9	

\*p<0.05; Mann-Whitney U test, IQR: Interquartile range



students were asked about the anatomy subjects they had the most difficulty with, the answer was the nervous system.

## Discussion

In this study, senior physiotherapy students who took the clinical practice course stated that the knowledge and understanding they gained in anatomy courses was an important need during clinical practice. As the answers given to the questionnaire questions reached a good level of reliability coefficient, the effect of anatomy learning on clinical reasoning skills was examined in three factors by taking the answers of the students as reference. It was determined that the students who had a professional experience in the field of health and the students who passed the anatomy course in the first semester, perceived the compliance in clinical practice and anatomy courses more positively. Considering that students with professional experience in the field of health work in health units and are familiar with the anatomy course from their previous learning or working experience, the findings were partially predictable. It has been reported in the literature that healthcare professionals see knowledge of anatomy as a basis for understanding neurological or musculoskeletal disorders (18). Therefore, it was not surprising that students with professional experience in the field of health had a high perception of the compatibility of anatomy courses and clinical practice courses. On the other hand, interestingly, the students who passed the anatomy course in the first semester and were successful perceived the compliance between clinical practice and anatomy courses more positively when compared to the students who repeated the course because they were not successful in the anatomy course. In fact, students who repeated the course because they were not successful in the anatomy course also stated the effective role of anatomy in the clinical practice course with a high average score (4.33 on a 5-point Likert scale). Therefore, although students think that anatomy has an active role in clinical practice, failing and retaking the anatomy course seems to pave the way for the connections between these courses to be perceived at different levels. Some researchers reported differences in approach and perspective to study between undergraduate students who did and did not pass anatomy course (19). In this context, the effect of course success on student perceptions in our current study is similar to the results of the previous study.

Due to the difficult nature of the anatomy course, the anatomy knowledge learned in the course can be forgotten in the months and years following the course (1,20). In our study, senior physiotherapy students stated that they benefited from anatomy knowledge in measurement,

evaluation and exercise interventions in physiotherapy, that they repeated the anatomy course, and that the anatomy course should be given with an accelerated curriculum during clinical applications. These results support the need to develop educational strategies that will integrate the anatomy knowledge of the students in the first year into physiotherapy clinical practices. In this way, students' forgetting of anatomy knowledge can be reduced (1), an even anatomy knowledge can develop dynamically until the senior year. In addition, previous studies have revealed some problems in integrating the theoretical knowledge and practical skills acquired by physiotherapy students through preclinical training into the dynamic clinical reasoning process (8,11). As a matter of fact, in a qualitative study investigating the factors affecting clinical reasoning and decision-making among physiotherapists, it was stated that the basic anatomy and physiology knowledge gained in undergraduate physiotherapy studies contributed significantly to physiotherapists in clinical reasoning and solution generation for physiotherapeutic problems (21). Findings from the present study confirmed that a deep knowledge of anatomy contributes to clinical practice course success, development of clinical skills and increasing professional motivation, with the high average of the answers given by the students to the questionnaire questions in this direction.

Anatomy education is the foundation of clinical skills in health science education for treating a human population (5). Physiotherapists have anatomy books as a bedside resource to help them make decisions in certain clinical processes (22). Decisions made before an intervention are influenced by the physiotherapist's individual characteristics, knowledge, and patient perceptions (21). In a previous study, senior physical therapist undergraduates stated that they think effective clinical reasoning depends on a deep theoretical knowledge and cognitive skills, followed by clinical experience (14). In the current study, senior physiotherapy students answered some statements about anatomy knowledge on clinical practice skills with high scores. The students thought that; (1) they need the knowledge they learned in the anatomy course just before or while taking the senior year clinical practice course, (2) the relationship between anatomy course and physiotherapy clinic will increase clinical practice skills and success, (3) anatomy knowledge helps in clinical measurement, evaluation and exercise applications, (4) anatomy is important in individual treatment selection and (5) it is important in postgraduate courses and trainings. Information from the present study was similar to the literature. Physiotherapy undergraduate students are aware of the importance of anatomy education in physiotherapy education and practice (4).

The clinical reasoning process in physiotherapy students is a complex and systematic process that continues both collaboratively and interactively (10). It is also possible to see different results worldwide depending on the focus of the physiotherapy profession in these countries (5). For this reason, the current study findings were compared with the studies conducted in Türkiye. In a study conducted with 50 physiotherapists, it was reported that clinical and functional anatomy integrated with clinical physiotherapy is a necessity and 94% of physiotherapists have ideas that anatomy education should continue after graduation (13). In our study, 67% of physiotherapist students thought that attending courses and trainings related to anatomy in their professional life, and 98% thought that explaining anatomy and physiotherapy clinic by associating them would increase the success of clinical practice. In another study, physiotherapy students emphasized the importance and necessity of anatomy knowledge during electrotherapy practices (2). In our study, 87% of the students stated that what they learned in anatomy courses was effective in electrotherapy applications. The use of electrotherapy applications as a common therapeutic agent in almost every discipline of physiotherapy and student attitudes towards the need for anatomy knowledge while placing electrodes, as stated in the previous study, have been effective on the current results.

Physiotherapy curriculum generally focuses on musculoskeletal anatomy, and physiotherapists are considered key musculoskeletal-focused practitioners with knowledge of human anatomy (6,23,24). Studies have reported that physiotherapists and physiotherapist students demonstrate more knowledge of the musculoskeletal system than some of their medical colleagues (5). It was stated in a previous study conducted with students that the system that physiotherapy students in Türkiye learn best is the musculoskeletal system (6). In addition, when the effect of anatomy education on different physiotherapy disciplines in Türkiye is evaluated, it has been stated that orthopedic rehabilitation comes to the fore in this field (13). Our findings were similar to studies in the literature. Students stated that they were more successful in musculoskeletal system subjects and showed the most interest in these subjects.

This study is limited to the answers of the students collected in the questionnaire. Although the answers of the participants in the research were confirmed by the control question, it was assumed that all students gave sincere answers. Therefore, generalizability was not an aim of this study. However, the findings obtained in the study can be evaluated in terms of the connections between physiotherapy practice courses and anatomy courses. On

the other hand, although the participants in this study had taken anatomy, neuroanatomy and clinical practices through face-to-face courses, they had to take vocational courses with distance education for one and a half semesters starting from the spring semester of the 2<sup>nd</sup> year due to the pandemic. This suggests that this may have had negative effects on students' professional practice skills.

The positive effects of anatomy education on clinical experience and practices are undoubtedly important for physiotherapists. This study confirms the necessity of a knowledge of anatomy in clinical experience with an actual patient, which is a transitional stage to the professional profession for physiotherapy students. Moreover, unlike previous studies, it shows that repeating anatomy courses and having past experiences in the health field can impact student perceptions.

## Conclusion

This study shows that giving the anatomy course curriculum starting from the first year including the physiotherapy clinic and giving reminder, short and catchy courses about anatomy during vocational courses can contribute to the completion of an effective learning process. In addition, with this study, it was possible to reflect the contribution of anatomy knowledge on the clinical reasoning skills of senior year physiotherapy students by focusing on the interaction between physiotherapy students' anatomy learning and clinical practice courses. In addition, it should not be forgotten that students' attitudes towards anatomy may change. Attitudes and perceptions towards anatomy knowledge may vary depending on an experience in the field of health or taking the course several times. Future studies may develop new recommendations for anatomy and physiotherapy educators by considering the current results on the importance of anatomy education in clinical practice courses and the limitations of the study.

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## Ethics

**Ethics Committee Approval:** The approval of Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (decision dated 05.11.2021 and numbered 2021/492).

**Informed Consent:** Participation in the study was voluntary and all participants read and approved the informed consent form.

**Peer-review:** Internally peer-reviewed.

## Authorship Contributions

Concept: Y.E.K., A.B., Design: Y.E.K., A.B., Data Collection or Processing: A.B., Analysis or Interpretation: Y.E.K., A.B., Literature Search: Y.E.K., Writing: Y.E.K.

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