

## The Effects of Clay Modeling and Plastic Model Dressing Techniques on Veterinary Anatomy Training [1]

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### Abstract

In addition to classical anatomy applications, particularly in medicine education, the contribution of different methods (3D modeling, body painting and clay modeling) has been investigated for the purpose of anatomy training. In recent years, clay modeling which is the one of these methods is frequently used. The aim of the present study was to determine the contribution of clay modeling and plastic model dressing methods to veterinary anatomy training. The ruminant forelimb's bones, joints, muscles and nerves were chosen as the topic of this study. Clay material was used for bone models, coloured play dough were used for joints, and Colored Eva Sponges were used for muscles and nerves. Students were divided into two groups as new method group and classical method group. The students were given exams and the results of exams were evaluated at the end of each application. It was detected that the student success rate increased when clay modelling and plastic model dressing methods were employed ( $P<0.05$ ). There was no significant difference for the lesson success rate between male and female students ( $P>0.05$ ). With this study, the clay modeling and plastic model dressing methods applied for the first time in veterinary anatomy training was found to increase student achievement and motivation significantly. Furthermore, we believe that organ models prepared by this method will contribute to education.

**Keywords:** Clay modelling, Plastic model dressing, Veterinary anatomy education

## Kıl Modelleme ve Plastik Model Giydirmeye Tekniğinin Veteriner Anatomi Eğitimine Etkisi

### Öz

Anatomı eğitiminde, özellikle tıp fakültelerinde klasik anatomı uygulamaların yanında farklı yöntemlerinde (3D modelleme, vücut boyama, vb) eğitime katkısı araştırılmaktadır. Son yıllarda bu yöntemlerden kil modelleme yöntemi sık kullanılmaktadır. Bu çalışma ile kil modelleme ve plastik giydirmeye yöntemlerinin veteriner anatomı eğitimine katkısının belirlenmesi amaçlandı. Konu olarak ruminant ön bacak kemikleri, eklemeleri, kasları ve sinirleri seçildi. Kemik modellemeleri için kil materyal, eklem için renkli oyun hamurları, kas ve sinir için ise renkli eva süngerleri kullanıldı. Öğrenciler yeni yöntem grubu ve klasik yöntem grubu olarak ikiye ayrıldı. Her uygulama sonu sınav yapıldı ve sonuçları değerlendirildi. Başarının, kil ve plastik model giydirmeye yöntemi ile arttığı saptandı ( $P<0.05$ ). Erkek ve kız öğrencilerin ders başarıları arasında fark gözlenmedi ( $P>0.05$ ). Veteriner anatomı eğitiminde ilk kez uygulanan ve eğitime katkısının araştırıldığı bu çalışmanın öğrenci başarısını ve motivasyonunu oldukça artttığı saptandı. Ayrıca bu yöntem ile hazırlanacak olan organ modellerinin de eğitime katkısının olacağını düşünmekteyiz.

**Anahtar sözcükler:** Kil modelleme, Plastik model giydirmeye, Veteriner anatomı eğitimi

## INTRODUCTION

Current research reveals that learning should be considered

as a mental activity. Those who use the left hemisphere of the human brain learn by reading, and those who use the right hemisphere actively learn by observation and



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experience [1]. In general, the primary goal of veterinary anatomy training is to ensure that the learner obtains the necessary knowledge in the most effective way and practices it efficiently. For this, different teaching methods have been used in which the information is given in various ways [2-8]. In anatomy learning, in the teaching-learning process, visual methods are more effective than auditory and other methods [5,9,10]. The foundation of anatomy education is based on the cadaver studies [7,11]. In addition, methods such as book, atlas, model, visualization and simulation are also used in anatomy education [3,5,6,11-13]. In anatomy training, as an addition or alternative to these methods, lectures using new methods have been gaining an increasing importance [2,4,14-17]. Furthermore, the efficiency of the methods used in anatomy education has also been studied [10,14,18,19].

An educational method which has been started to be used in medical anatomy training in the world is clay modeling [4,20,21]. In veterinary anatomy training, no study on clay modeling or plastic model dressing methods has been reported. With this study, clay and plastic models are included in the dressing training process. Thus, it is aimed that students learn and become activate by doing-living. The study has aimed to determine the effects of these methods on learning and to reveal the results obtained from the exams and questionnaires by using statistical analysis and to determine the contribution towards education.

## MATERIAL and METHODS

### Preparation of Anatomical Materials

In this study, bone, joint, muscle, nerve cadaver and models prepared routinely for anatomy lesson were used. Also bone models of the ruminant forelimb (*Scapula*, *skeleton brachii*, *skeleton antebrachii*, *skeleton manus*) were created using clay by a selected group of students who were taking the course. Colored Play Dough was distributed to the same group in order for them to create joint models [*articulatio (art.) humeri*, *art. cubiti*, *art. manus*] on plastic models by using the dressing method. Colored Eva Sponges were used to create muscle [*musculus(m.) infraspinatus*, *m. deltoideus*, *m. supraspinatus*, *m. deltoideus*, *m. teres minor*, *m. teres major*, *m. subscapularis*, *m. brachialis*,

*m. biceps brachii*, *m. triceps brachii*, *m. tensor fascie antebrachii*, *m. extensor carpi radialis*, *m. extensor digitorum lateralis*, *m. extensor carpi ulnaris*, *m. adductor digiti I longus*, *m. flexor carpi ulnaris*, *m. flexor carpi radialis*, *m. flexor digitorum superficialis*, *m. flexor digitorum profundus*] and nerve [*nervus (n.) suprascapularis*, *n. musculocutaneus*, *nn. subscapulares*, *n. axillaris*, *Nn. pectorales craniales*, *n. thoracicus longus*, *n. thoracodorsalis*, *n. thoracicus lateralis*, *Nn. pectorales caudales*, *n. radialis*, *n. ulnaris*, *n. medianus*] in models.

### Application of the Course

This study was approved by Ondokuz Mayıs University, Social Sciences and Humanities Research and Publication Ethics Committee (Number: 2018/72-108). It was applied to the students (n:105) who were recently enrolled in the anatomy course. The students did not have anatomical knowledge. Firstly, all students were taught the theoretical courses including ruminant forelimb bones, joints, muscles and nerves for first, second, third and fourth weeks, respectively (Table 1). At the end of each theoretical course of the week, the students took a written exam.

For practical course, the students (n:105) were divided into two groups (Group 1: 56 students; Group 2: 49 students) by regarding their preferences. The students of the Group 1 performed the classical method including re-expression of the subjects described in the theoretical lecture on the cadaver in the laboratory. The students of the Group 2 performed practical courses in accordance with the new method including the clay and plastic materials in a different hall. The theoretical knowledge was repeated in the practical course at each stage. In the new method, students used clay materials during the first two weeks and they studied on the plastic material in the following two weeks. Coloured eva sponges were used for dressing on these plastic materials to explain the structures of muscles and nerves. The plastic materials were 3D plastic models which were previously sculpted by us using real bone model. To 3D models, we injected to silicon molds the liquid casting materials consisting of polyester, calcite (marble powder-0,5per), cobalt and mekperoxide mixture (Table 1). In Group 1 and Group 2, practical courses were carried out interactively. At the end of the courses, both groups took the same written examination every week.

**Table 1.** Theoretical and practical course content according to the weeks

Week	Theoretical Course Lesson Subjects/ Attending Number of Students Participating	Practical Course Lesson Materials/Attending Number of Students Participating	
		Classical Method (Group 1)	New Method (Group 2)
1	Ruminant forelimb bones/85	Ruminant forelimb bones cadaver/41	Clay materials/47
2	Ruminant forelimb joints/91	Ruminant forelimb joints cadaver/35	Clay materials and colored play dough/31
3	Ruminant forelimb muscles/85	Ruminant forelimb muscles cadaver/36	Plastic ruminant forelimb bones and coloured eva sponges/29
4	Ruminant forelimb nerves/83	Ruminant forelimb nerves cadaver/37	Plastic ruminant forelimb bones and coloured eva sponges/31

**Table 2.** Evaluation feedback questionnaire form of after practice course for new method group

Questions	Points*
Schematic drawing and clay modeling practices facilitated my comprehension of the subject	
My interest in the subject gradually increased during the practical course	
Complicated topics got clarity during the practical course	
I performed the applications without any distraction	
My interest and attention were distracted during this practice	
This application brought me in nothing	
Comments	

\* 1: Strongly disagree, 2: Rather disagree, 3: No idea, 4: Rather agree, 5: Strongly agree

Finally, a feedback form was carried out on students in Group 2 (*Table 2*-lowest score 1 and highest score 5).

### Statistical Evaluation

In this study, the data obtained from the exam and feedback forms that were given to the students were recorded using SPSS for Windows (Version 21.0; SPSS Inc., Chicago, IL, USA) software. Independent Samples T test was used for statistical analysis. Comparisons of means were made by converting success rates (number of successful students/total number of students) of subjects to proportional variables based on their frequencies and analyzed with Chi-square ratio test at  $P<0.05$  level and comparison of differences of groups [22] were done with ODDS Ratio (OR).

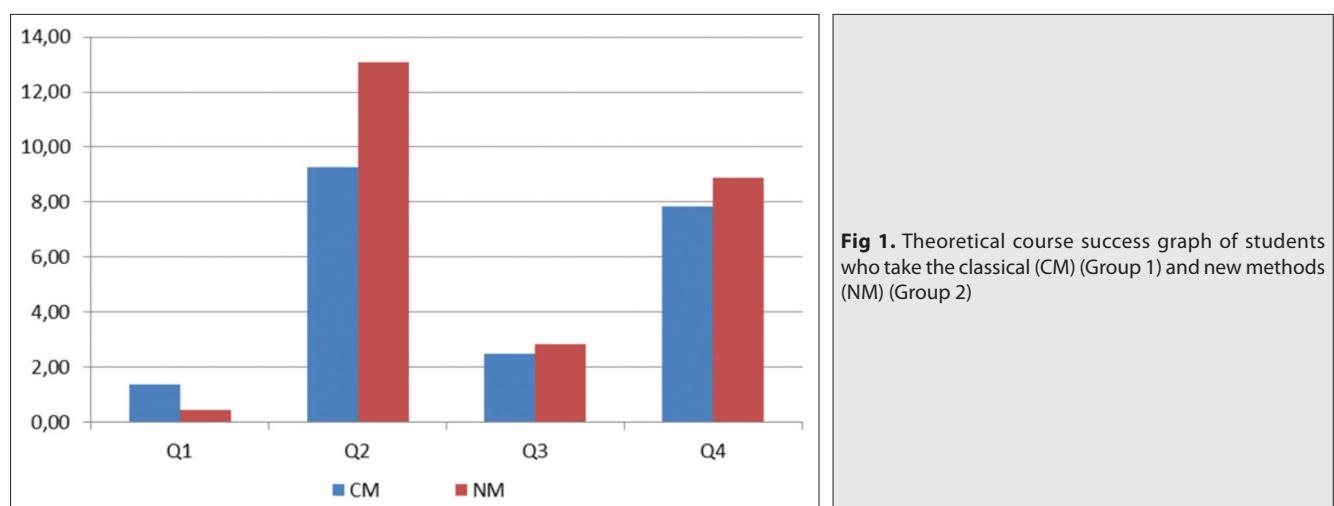
## RESULTS

The structures consisting of the ruminant forelimb such as bones (3 lesson hours=135 min), joints (3 lesson hours=135 min), muscles (3 lesson hours=135 min), nerves (3 lesson hours=135 min) were taught theoretically. At the end of each theoretical course, students were given written exams prepared in advance. Exams were graded out of 100. The means of student remarks from first week to fourth weeks were obtained as:  $0.86\pm0.38$ ;  $11.09\pm1.25$ ;  $2.65\pm0.79$ ;  $8.36\pm1.85$ , respectively. *Fig.1* shows the variance

of theoretical course success graph of students.

The practice course (4 lesson hours=180 min) was taken by both groups following the theoretical course every week. Group 1 took practical courses in accordance with the classical method. Group 2 used clay and plastic materials according to the new method (*Fig. 2, 3*). At the end of the courses, both groups took the same written exam which was prepared in advance. According to the exam marks of these two groups, the success rate was demonstrated in *Fig. 4*. Quizzes after theoretical course and practical course were compared and it was determined that both the classical application method used in anatomy and the new method used in this study increased success after application ( $P<0.01$ ). However, when these two methods of applications were compared with one another, it was determined that the success rate increased more with the use of the new method (*Table 3, Fig. 5*). The success rates from the first week to the fourth week were 105.15%, 96.23%, 168.87%, 16.74%, respectively. For both groups, the results of the last week's test were statistically unreliable. It was thought that this was caused by the fact that the students were in the period of intensive final exams.

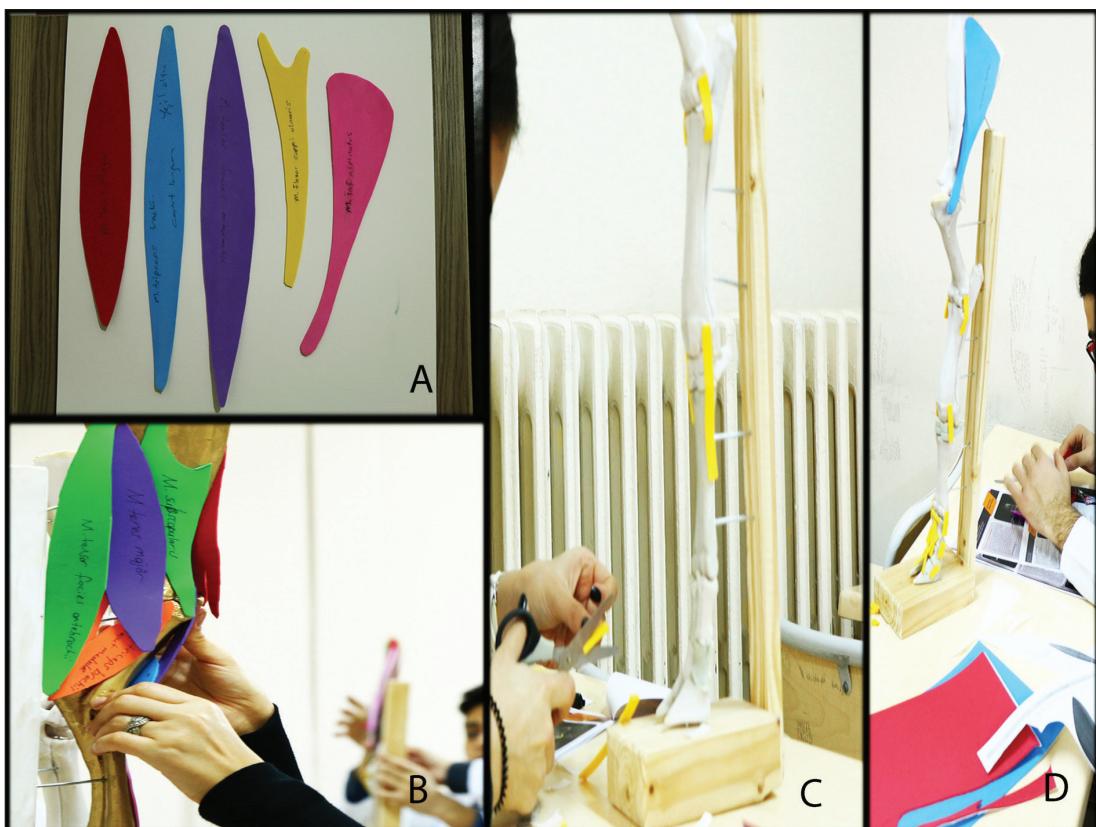
At the end of this study, the successes of male and female students were compared in order to determine





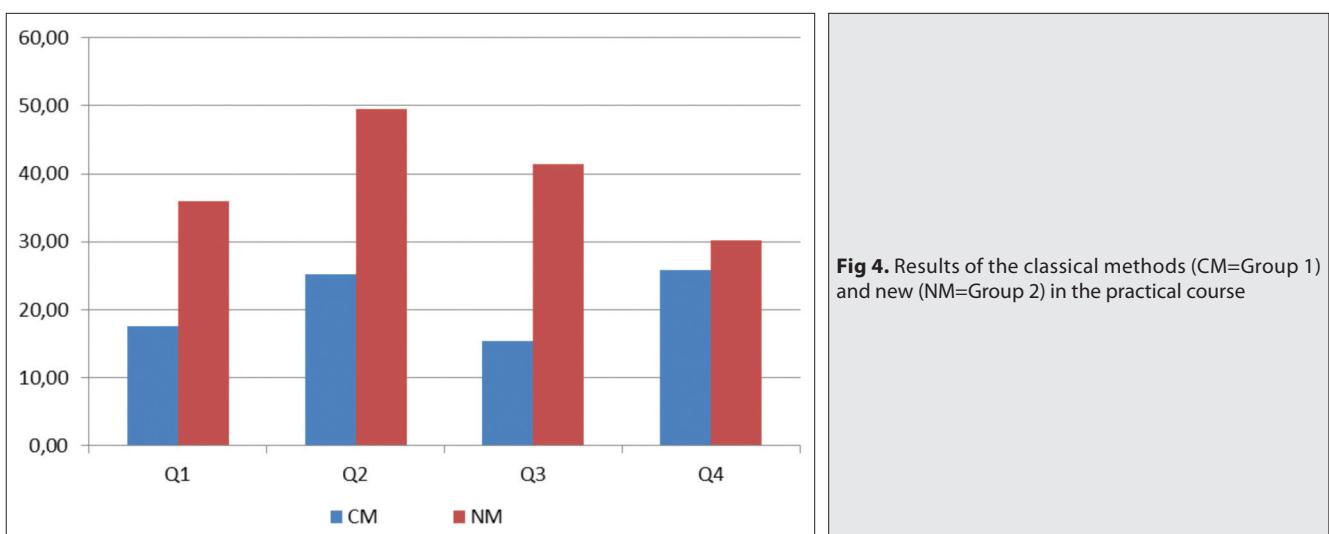
**Fig 2.** Student applications of clay modelling method

A: Operational clay material, B-C-D-E-F: Sculpting steps of the clay models were designed by students



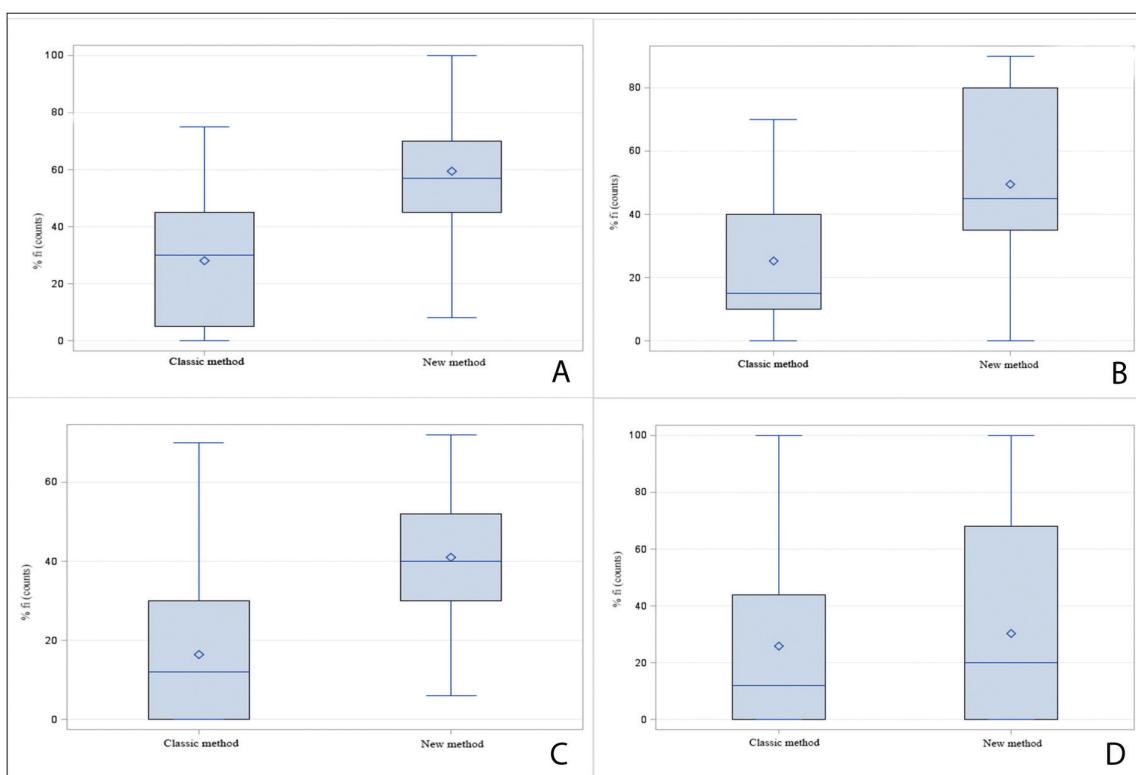
**Fig 3.** Students applications of plastic model dressing method

A: Preparing of muscle templates using with Colored Eva Sponge, B-C-D: Dressing of muscle and ligament templates on plastic model

**Table 3.** After practical courses, examination results\* of the new and classical methods

Methods	Classical (Group 1)		New (Group 2)	
	Mean	Std. Error	Mean	Std. Error
Q <sub>1</sub>	17.55 <sup>b</sup>	2.88	36.00 <sup>a</sup>	3.95
Q <sub>2</sub>	25.20 <sup>b</sup>	3.88	49.45 <sup>a</sup>	4.47
Q <sub>3</sub>	15.42 <sup>b</sup>	3.18	41.46 <sup>a</sup>	2.73
Q <sub>4</sub>	25.86 <sup>a</sup>	5.38	30.19 <sup>a</sup>	6.24

<sup>a,b</sup> Same letters in same rows is not significant at level  $\alpha=0.05$ , \* Exam was graded out of 100, Q<sub>i</sub>: from Quiz1 to Quiz4



**Table 4.** Attending number of students participating in theoretical and practical course n=105

Course Methods	TC1	PC1	TC2	PC 2	TC3	PC 3	TC4	PC 4
Classical Method	38 (18M/20F)	41 (24M/17F)	47 (27M/20F)	35 (22M/13F)	45 (26M/19F)	36 (18M/18F)	42 (24M/18F)	37 (19M/18F)
New Method	47 (23M/24F)	47 (23M/24F)	44 (22M/22F)	31 (12M/19F)	40 (19M/21F)	29 (10M/19F)	41 (20M/21F)	31 (11M/20F)

F: Number of female students, M: Number of male students, TC: Number of students participating in theoretical course, PC: Number of students participating in practical course

whether the success of students with the new method of application varied based on gender. It was found that the new method contributed to the success of both genders at similar rates. Moreover, there was no difference in participation rate between the new method groups and the classical method groups according to gender (*Table 4*). Apart from these, the participation rates of classical method and new method were compared. The success of new method was found to be more than 2 times (ODDS ratio = 2.435) higher compared with the classical method ( $P<0.01$ ) in all application periods.

While this study was being applied, the results of the study were not shared with the students. When the course was completed, a questionnaire was conducted for Group 2. The students who participated to the survey said that the applied lectures were rather satisfactory. ( $P=0.1048$ ).

## DISCUSSION

Veterinary Anatomy education is usually taught by (2D) diagrams, photographs and medical tools. Interactive 3D anatomical models and computer-aided learning packages are being developed for the introduction of new models [3,6]. New approaches are tried to facilitate learning mostly in medical anatomy training. In most of these, efficiency is measured by conducting surveys among students [4,17,21,23]. Because of the difficulty of finding cadavers in medical schools, there are new studies examining the effect of clay modeling on learning [24,25]. Alternative haptic simulators have been developed for cadaver use in student applications in veterinary education and positive feedback has been obtained from students [2]. There have also been studies on case-based learning aimed at learning related to clinical anatomy and basic sciences [16]. In this study, we used clay method and plastic model dressing method to make students more active in education process.

In anatomy training, it is reported that plastisin, clay modeling, drawing and body painting are part of the active learning category and when these methods have been applied as "learning by doing and experiencing", the course topics will not be forgotten [3,23,24,26]. There are studies showing that clay modeling is effective in anatomy training [4,20,21,25]. Motoike et al. [20] found that the clay modeling study, in which students were active, increased the success rate of students' exam results and this method was more effective than the cat dissection in the short term on learning about human muscles. DeHoff

et al. [25] studied clay modeling in muscles, peripheral nerves and blood vessels in human anatomy and reported that this technique could be used independently in anatomy training. Oh et al. [21] investigated the effects of polymer clay on medical students' understanding of cross-sectional anatomy. Cross-sectional surfaces of organ models such as brain, heart, and lungs made with colored clay were compared with corresponding MRI and CT images of the same section and it was reported that students understood the topic easier. It was stated that there was no difference between classical method and clay group when the permanence of knowledge was measured after a certain period of time. However, it was affirmed that the clay method had an important effect on the learning of complex structures. In this study, in which bone modeling with clay was performed, it was observed that student success rate increased in accordance with the literature [4,20,21-25].

There are also other different methods that are used as alternatives in anatomy training. These are digital, non-digital 3D imaging [15,18], Mobile Augmented Reality [17,27] and methods of painting live material [3]. In this study, apart from these methods, plastic model dressing method has been applied. It was found that plastic model dressing method increased the motivation of the students similar to the other methods mentioned above.

Cevik Demirkan et al. [28] have stated that traditional training tools such as bone, skeletal model and cadaver were very effective in learning about veterinary anatomy and that new alternative approaches could not be an alternative to anatomy education but could be used as an adjunct. The findings obtained in this study are different from those reported by Cevik Demirkan et al. [28]. The results of our study showed that the new method increased the success compared to the classical method. It is thought that the effect of all alternative methods on the success of the course cannot be the same.

In literature reviews, among the studies in which the classical and other methods have been compared, there is no study that looked into the link between the success rate in the course and the gender. In this study, the success rates of the male and female students were compared. Clay and plastic model dressing techniques were shown to increase success rates in both genders.

This study was the first one to evaluate the success of students by using clay method and plastic model dressing in veterinary anatomy training. As a result, it has been found

that clay modeling and plastic model dressing techniques increase student motivation and contribute to learning positively. We think that this method can be expanded to cover all the subjects of anatomy in the future.

## CONFLICT TO INTEREST

We have no conflict of interest to declare

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