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Virtual Reality in Anatomy Instruction: a Preliminary Study

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Modern practical and theoretical instruction sessions need to be up-to-date, and nested with creativity and technology. Virtual reality (VR) is a state-of-the-art user interface interacting with multiple sensory channels and creating real-time simulations. In this study, we examined the effect of VR on the learning of the anatomy of the head and neck region. Seventeen students from 12 different medical schools in Turkey participated in this study. After one hour of theoretical training, the students were trained on cadavers for five hours. Then, a pre-test examination was given. After the pre-test, all students were given one-to-one virtual reality training and then a post-test. A statistically significant increase in the achievement of the students was found between the mean pre- and post-VR test scores (p=0.003). VR is considered as a rising trend in medicine when the skills and competencies of the generation Z on digital technologies are taken into consideration.

Key words: Medical education, virtual dissection, digital anatomy, virtual reality

Introduction

In 2018, the majority of students who are studying medicine are involved in the Generation Z. 'Generation Z' term describes the people born between 1995 and 2012 [4, 19], who were born and grown in advanced digital conditions. This makes them more susceptible to digital knowledge and skills without the need for extra training, unlike previous generations [16, 17]. The Generation Z is much more interested in technology; thus, expects practical and theoretical instruction media to be up-to-date, and lectures to be nested with creativity and technology [4, 18]. Therefore, traditional learning methods and environments do not appeal to the Generation Z.

Traditional techniques are well-established and have proven efficacy; however, up-to-date methods for differentiating and enriching education should be used to

attract the attention of these students [2]. The use of new technologies in medical education and practice requires special importance and priority. Virtual reality (VR), which is frequently used in flight and warfare simulators, architecture, engineering and industrial design, has also taken a remarkable place in medical education in recent years [9]. Parallel to the increase in the number of sensory organs involved in learning process, the learning becomes more permanent [5]. VR is a state-of-the-art user interface interacting with multiple sensory channels and creating real-time simulations. In VR, instead of the real world, a virtual world created by the computer is perceived [3]. VR has been used in the teaching of complex structures such as larynx [10] and temporal bone [6], in the experience of risky interventions such as endoscopic skull-base surgery [20] and kidney transplantation [14], in preoperative surgery planning of the congenital heart diseases [12], etc. All of these studies emphasized that VR is an effective tool for learning and practical applications. In this context, we conducted a preliminary study to test whether VR training is useful or not as an additional tool to classical anatomy instruction. The objective of this study was not to introduce a new method of instruction; however, we aimed to provide a statistical evidence to support the efficiency of a VR education tool.

Materials and Methods

Thirty students participated in the dissection course, organized by TOBB ETU Faculty of Medicine Students Scientific Research Association. Among these students, 17 volunteers were involved in the study. Informed consent was obtained from all participants. The content of this dissection course was “Head and Neck Region”. Traditionally, students were given 1 hour of theoretical training and 5 hours of dissection. In addition to theoretical and dissection training, this course also included VR training. The seventeen students participating in this study, were 2nd and 3rd year medical students from 12 different medical schools in Turkey. The age range of the students was 19-21. After one hour of theoretical training, the students were trained in applied dissection on cadavers, in groups of five for five hours (**Fig. 1**). Following dissection, a pre-test examination was given to all students with 5 questions consisting of true-false questions, multiple choice questions and questions on anatomical models.

Fig. 1. Dissection set up of the study.

After the pre-test, students were given one-to-one virtual reality training using Vived Anatomy software (VIVED Inc., Coralville, IA, USA) on zSpace Desktop VR systems (zSpace Inc., Sunnyvale, CA, USA) for 15 minutes (**Fig. 2**). After the virtual reality training, all students were given post-test, which covered similar content with pre-test. Pre- and post-test scores were evaluated on 5 points and the results were recorded. Statistical analyzes were made using IBM SPSS Statistics 28 software.

Fig. 2. Virtual reality set up of the study.

Results and Discussion

The pre-VR and post-VR test scores of the 17 volunteers which involved in the study is presented in **Table 1**. The average pre-VR test score was 2.7059±1.22382 while the average post-VR test score was 3.5647±1.1418. A statistically significant increase in the achievement of the students was noted when the averages of the pre- and post-VR test scores were compared (p=0.003).

Traditionally, textbooks and lecture presentations for theoretical education, cadavers and anatomical models for practical training, are used in anatomy lessons. One of the best methods for learning anatomy is observing cadavers, which provides better understanding of structure of the body, organs and limbs. Cadavers have been essential for students to have a thorough understanding of the human morphology, and have played a crucial role in medical education [2]. On the other hand, during the last decade cadaver supply got into a critical shortage level in Turkey. The developing technology and increasing expectations of students, led to numerous innovations in education. In recent years preliminary experiences have been carried out using simulations of diagnostic and treatment modalities, surgical operations, especially in faculties providing health education. Virtual classes, laboratories and operating rooms are being successfully tested by some universities and educational institutions [10, 13, 15]. VR offers possibilities to perform experiments in virtual environments where it is difficult to experience in live models, to see their results and to get their output. Although computer-based trainings could not compare with conventional anatomy teaching methods [8], they provide significant contributions to the anatomy education [11]. Some regions of the human body are much more complicated from anatomical point of view and have a difficult structure to learn. Liu et al. in their study on the larynx, which is a complex anatomic region, have transformed 2D images obtained from the database into 3D VR models. Then they used this model in the anatomy lessons of the students and received positive feedback [10]. Aebersold et al. showed that students who trained with VR for nasogastric tube implementation, were significantly more successful in this application than control

group [1]. Ha et al. obtained VR images from cadavers and they made measurements on these data. They indicated that VR can accurately simulate anatomical features, thus it could be used for planning of individual surgeries [7]. In our study, we provided a statistical evidence that VR training was effective in better understanding of the complex anatomy of head and neck.

Table 1. The pre-VR and post-VR test scores

Participant No	Pre-VR Test Score	Post-VR Test Score
1	3.50	5.00
2	3.50	4.50
3	2.00	3.00
4	2.00	2.00
5	3.50	3.50
6	3.00	3.80
7	1.00	3.00
8	3.00	3.80
9	1.50	1.50
10	4.50	4.50
11	2.00	4.50
12	1.00	1.00
13	2.00	3.50
14	3.50	4.00
15	1.00	4.00
16	4.50	4.50
17	4.50	4.50

Conclusion

In conclusion, VR should be considered as a rising trend in medical education, when the results of all the above studies, as well as the skills and competencies of the Generation Z on digital technologies, are taken into consideration.

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