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Design, implementation and evaluation of surface anatomy educational software for students of university of medical sciences

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Abstract
The application of films, photos and animations along with educational texts leads to a balance in audio and visual learning and increases the learners' interest in learning. Educational software provides the opportunity to enhance learning and motivate due to its diversity and attractiveness. The purpose of this study was to design and implement a surface anatomy educational software for undergraduate radiology students. This study was conducted on 27 undergraduate students in radiology. Following the student's content need assessment, the educational content was developed and turned into educational software. Then the first group was trained in the usual way without software and the second group was trained with software. The degree of academic achievement, satisfaction, and motivation of students were measured using a standard questionnaire. The mean anatomical scores of the trunk surface anatomy were 18.66 ± 2.82 and the mean scores of this course without software was 12.12 ± 10.84. Statistical analysis shows that a significant difference is found between the academic achievement of the two groups of students ($p = 0.01$). 50% of the students who studied anatomy with the software, were moderately scored, 30% high and 20% very high motivated by the software. Similar results have been obtained for anatomy with this software. 100% of students responded yes to the question of whether they were satisfied with the anatomy software and made it useful for anatomy course. 90% of the students offered software to teach other courses. The study results showed that the level of academic achievement, motivation and satisfaction of students in the presentation of anatomy course was increased using surface anatomy education software.

Keywords: anatomy, education, surface anatomy, educational software, radiology students

1. Introduction
The purpose of designing curricula in the education process is to provide learning opportunities for students so that they can maximize the benefits of participating in learning activities and achieve the highest levels of learning possible [1, 2]. The learning process is, in fact, the creation of appropriate learning opportunities for all students to learn in all fields of educational objectives and the student's comprehensive development [1]. In the process of teaching, direct and indirect teaching patterns and methods has been proposed. Self-centered learning is a direct teaching method in educational patterns, which is a learning process with or without the help of others [1, 3]. From the perspective of medical education professionals, the skill of this strategy is one of the requirements for the ability of lifelong learning as well as the element of achieving higher levels of learning [1, 4]. The use of films, photos and animations along with educational texts leads to a balance in audio and visual learning and increases the interest in learning of learners. Educational software provides rich resources that can provide an opportunity for students to learn and create significant educational interaction. The use of films, photos and animations along with educational texts leads to an interaction between audio and visual learning and increases the interest in learning of learners [5, 6].
The national studies conducted on the effect of software on training have been largely related to school education. Mahmouei *et al*. reported a positive effect of software "Viky and Niky" on the academic achievement of the mathematical lessons of elementary school students in the 5th grade in Birjand [7]. Heidari *et al*. also used the English language education software to motivate students in secondary education in Sari [8]. Rezaei Rad also found similar results in academic achievement and motivation after using the educational CD in the Arabic lesson [9]. In academic research, Khatooni *et al*. designed software for practical principles and techniques, and introduced software as a training policy, in addition to promote cognitive levels, to improve psycho-motor function [6]. Esfehani *et al*. also used the educational software to introduce the principles of cardiopulmonary resuscitation and improve the knowledge and psycho-motor skills of nursing students [10].
A review of international studies shows that they have mostly been conducted on 3D software. There are some studies that have documented the effect of the 3D software on teaching students' anatomy course [11, 12, 13]. Educational software provides the opportunity to enhance learning and motivate due to its diversity and attractiveness. Hence, the purpose of this study was to design and implement a surface anatomy educational software for undergraduate radiology students.

2. Materials and methods
This semi-experimental study was conducted on 27 undergraduate students in diagnostic radiology from the second semester in 2019. The sample size was considered

by census method. The main intervention was the traditional teaching with software. The main measurable consequences were the students' grades, the degree of motivation and satisfaction of the students.

At the first stage, the students' content need assessment was done. At this stage, a list of items required for the trunk anatomy is provided and categorized. Then, the content of the text was generated and classified. At the next stage, educational content became educational software (Figure 1). At the implementation stage, a group of students were trained in the usual way with trunk anatomy topics (the first experimental group) and a group of students were trained with educational software (the second experimental group). The study was one-way blind and students were blind. The test time for the two groups was the same after the usual presentation of the session or presentation of the software. Then, the level of academic achievement, satisfaction and motivation of students was studied using a standard questionnaire. In order to assess the academic achievement, the students' scores of the course were used. Satisfaction and motivation questionnaire was scored based on 5-option Likert scale (very high, high, medium, low and very low). There were also 2 open questions, if the participants suggestions about the weaknesses or the strength of the proposed software, they noted.

In this study, software SPSS and t-test were used for data analysis. Descriptive statistics were used to show mean, standard deviation and percentage of students' satisfaction and motivation.

Fig 1: Surface anatomy educational software for undergraduate radiology students

3. Results

27 undergraduate radiology students in the second half of 2019 entered the study. The mean anatomical scores of the trunk surface anatomy were 18.66 ± 2.82 and the mean scores of this course without software was 12.12 ± 10.84. Statistical analysis shows that a significant difference is found between the academic achievement of the two groups of students ($p = 0.01$).

50% of the students who studied anatomy with the software, were moderately scored, 30% high and 20% very high motivated by the software. Similar results have been obtained for anatomy education with this software (Table 1). 100% of students responded yes to the question of whether they were satisfied with the anatomy software and made it useful for anatomy course. 70% of them reported satisfaction with moderate degree and 30% with high degree (Table 1). 90% of the students offered software to teach other courses (Figure 2).

In the open questions, the cases which seemed to be weaknesses of learning with the software were obscure. The strength of the training with software was also the comprehensiveness and attractiveness of the software, the convenience of using the software and showing the desired details at the time of training. Finally, the students suggested to use more detailed figures in the software.

Table 1: Levels of motivation and satisfaction of students about the use of software in anatomy education

Questions	Very low (%)	Low (%)	Moderate (%)	High (%)	Very high (%)
Was the software a motivation to anatomy learning?	-	-	50%	30%	20%
Do you enjoy with anatomy software?	-	-	60%	20%	20%
Do the software provide better understanding trunk anatomy?	-	-	50%	30%	20%
Was better education with software?	-	-	20%	70%	10%
Software was effective for anatomy education?	-	-	30%	50%	20%
What score do you have for your satisfaction?	-	-	70%	-	30%

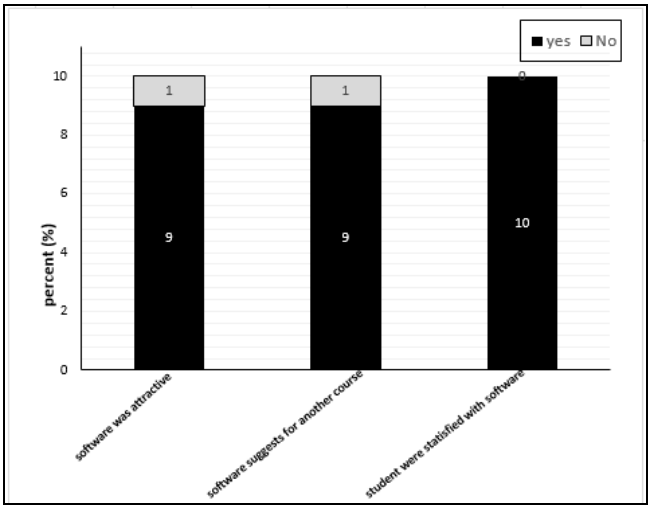

Fig 2: Self-evaluation of students about education with software

4. Discussion

In general, the study results showed that academic achievement in the study of surface anatomy of the group of students with the software has improved significantly. 100% of the students in the group with the software were satisfied with the software, and 90% of them offered software to teach other courses. Mahmouei *et al*. reported a positive effect of software "Viky and Niky" on the academic achievement of the mathematical lessons of elementary school students in the 5th grade in Birjand [7]. Heidari *et al*. also used the English language education software to motivate students in secondary education in Sari [8]. Rezaei Rad also found similar results in academic achievement and motivation after using the educational CD in the Arabic lesson [9].

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In a study by Maldonado *et al*. (2011) on medical assistants in the United States it was reported that the use of clinical skills training software increased the learning motivation in the intervention group and reduced the learning time in this group [14]. Lakdashti *et al*. (2011) conducted a study on technical students in Sari. The results showed that training using simulated software in comparison with traditional method had a positive effect on students' learning. The results of these studies are consistent with the results of the present study [15]. In a study conducted by Kelly *et al*. (2009) in Ireland, it was proposed that training videos should be used for nursing students as complementary [16]. Li *et al*. (2014) showed that the use of educational videos in the intervention group of medical students has been able to improve the level of self-efficacy and improve clinical skills in this regard [17]. A study by Lak *et al*. suggested that the use of arithmetic education simulator software would improve nurses' awareness of arrhythmic interpretation [18]. Also, a study by Harris *et al*. aimed to simulate a method to improve drug prescribing skills for undergraduate nursing students also showed that providing a simulator program with a textual reference could increase students' success [19]. Huihao *et al*. (2014) showed that the use of educational films for clinical examinations of medical students compared with the traditional method has been effective on improving the self-efficacy and clinical and practical skills [20]. Joe *et al*. (2009) reported improved level of knowledge, skills and abilities of patients after training through multimedia software prior to surgery [21]. Dhuvad (2015) showed that smartphone software, like WhatsApp, through facilitating consultation and the relationship between the surgeons can reduce the error and improve the performance of the specialist assistants of facial surgery [21]. The results of these studies are consistent with the results of the present study [22]. Although students were satisfied with the use of the software, the limitations of using the software are the necessity of using a computer, laptop and / or mobile phone.

5. Conclusion

The study results showed that the level of academic achievement, motivation and satisfaction of students in the presentation of anatomy course was increased using surface anatomy education software.

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7. References

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