



ORIGINAL ARTICLE

The effect of using peer-teaching in teaching physiology course on the learning of medical students and their

اثر استخدام تعلیم الأقران في تدريس مقرر علم وظائف الأعضاء على تعلم طلاب الطب ورضاهم

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Background: Education through peer-teachers is one of the teaching-learning methods that is being increasingly used in various studies. The purpose of this study was to investigate the use of peer-teachers in teaching physiology on learning and satisfaction of medical students.

Method: This semi-experimental study was conducted on medical students of the basic sciences in Mashhad Medical School in 2021-2022. Students were divided into two groups: conventional and Peer teaching methods. The average score of the quizzes at the beginning and end of each session, final exam score, and rate of information retention were compared between the two groups. A survey was also conducted among students to assess their satisfaction.

Results: The mean scores of the quizzes in the peer-teaching group were significantly higher than the control group ($p < 0.05$), but there was no significant difference between the two groups in the final exam score. In the PT group, the greatest improvement in grades was in students with GPA above 17 compared to students with GPA between 14 and 17 and GPA less than 14, but in the control group, there was no significant difference between students with different GPAs. Examining the rate of data retention showed that the students in the peer-teaching group had a higher score than the control group. 83% of students were highly satisfied with this teaching method.

Conclusion: The use of peer-teaching method improved motivation among medical students and increase their learning process, in addition to creating satisfaction among them.

Key words: Education, Peer-teaching, Learning, Physiology

الخلفية: يعد التعليم من خلال المعلمين الأقران إحدى طرق التدريس والتعلم التي يتم استخدامها بشكل متزايد في الدراسات المختلفة. كان الغرض من هذه الدراسة هو التحقق من استخدام المعلمين الأقران في تدريس علم وظائف الأعضاء في التعلم ورضا طلاب الطب.

الطريقة: أجريت هذه الدراسة شبه التجريبية على طلاب الطب للعلوم الأساسية في كلية الطب بمشهد في العام ٢٠٢١-٢٠٢٢. تم تقسيم الطلاب إلى مجموعتين: طرق التدريس التقليدية وطرق التدريس من خلال الأقران. وتمت مقارنة متوسط درجات الاختبارات في بداية ونهاية كل جلسة، ودرجة الاختبار النهائي، ومعدل الاحتفاظ بالمعلومات بين المجموعتين. كما تم إجراء استبيان بين الطلاب لتقييم مدى رضاهم.

النتائج: كان متوسط درجات الاختبارات في مجموعة تدريس الأقران أعلى بكثير من المجموعة الضابطة ($P < 0.05$)، ولكن لم يكن هناك فرق كبير بين المجموعتين في درجة الامتحان النهائي. في مجموعة PT، كان التحسن الأكبر في الدرجات لدى الطلاب الذين لديهم معدل تراكمي أعلى من ١٧ مقارنة بالطلاب الذين لديهم معدل تراكمي بين ١٤ و ١٧ ومعدل تراكمي أقل من ١٤، ولكن في المجموعة الضابطة، لم يكن هناك فرق كبير بين الطلاب ذوي المعدل التراكمي المختلف. أظهر فحص معدل الاحتفاظ بالبيانات أن الطلاب في مجموعة تدريس الأقران حصلوا على درجات أعلى من المجموعة الضابطة. ٨٣% من الطلاب كانوا راضين للغاية عن طريقة التدريس هذه.

الاستنتاج: إن استخدام أسلوب تعليم الأقران أدى إلى تحسين الدافعية لدى طلاب الطب وزيادة عملية التعلم لديهم. بالإضافة إلى خلق الرضا بينهم.

الكلمات المفتاحية: التعليم، تعليم الأقران، التعلم، علم وظائف الأعضاء

اثر استفاده از آموزش همتا در تدريس فيزيولوجي بر ميزان يادگيري و رضايتمندی دانشجویان پزشکی

طبی طلباء کے سیکھنے اور ان کے اطمینان پر فزیالوجی کورس کی تدريس میں ہم مرتبہ تدريس کے استعمال کا اثر

زمينه و هدف: آموزش از طریق معلم يارها یا همتا يان آموزشی، یکی از شیوه های یاددهی- یادگیری است که در مطالعات مختلف مورد استفاده قرار گرفته و هدف این مطالعه، بررسی استفاده از معلم يارها در تدريس درس فيزيولوجی بر ميزان یادگیری و رضايتمندی دانشجویان پزشکی می باشد.

روش: این مطالعه نیمه تجربی بر روی دانشجویان پزشکی مقطع علوم پایه در دانشکده پزشکی مشهد انجام شد. دانشجویان به دو گروه تدريس به شیوه معمول (کنترل) و گروه معلم يار تقسیم شدند. میانگین نمره کوئیزها در ابتدای و انتهای هر جلسه، نمره پایان ترم، و ماندگاری یا Retention اطلاعات در دو گروه مورد مقایسه قرار گرفت. نمره رضایتمندی نیز از دانشجویان انجام شد.

یافته ها: میانگین نمرات کوئیزها در گروه معلم يار نسبت به گروه کنترل به طور معنی داری بالاتر بود ($p < 0.05$) اما در نمره امتحان پایان ترم تفاوت معناداری بین دو گروه وجود نداشت. در گروه معلم يار، بیشترین اثر بهبود در نمره، در دانشجویان با معدل بالاتر از ١٧ در مقایسه با دانشجویان با معدل بین ١٤ تا ١٧ و کمتر از ١٤ بود ولی در گروه کنترل تفاوت معنی داری بین دانشجویان با معدل های مختلف وجود نداشت. بررسی ماندگاری داده ها نشان داد دانشجویان در گروه معلم يار نمره بالاتری نسبت به گروه کنترل کسب نموده بودند. ٨٣ درصد دانشجویان رضایت بالا از این شیوه آموزش داشتند.

نتیجه گیری: استفاده از معلم يار و شیوه آموزش همتا می تواند علاوه بر ایجاد رضایت مندی، سبب بهبود انگیزه و یادگیری بهتر و بیشتر در دانشجویان پزشکی گردد.

واژه های کلیدی: آموزش، معلم يار، یادگیری، فيزيولوجی

پس منظر: هم مرتبه اساتذہ کے ذریعے تعلیم ایک پڑھائی سیکھنے کے طریقوں میں سے ایک ہے جسے مختلف مطالعات میں تیزی سے استعمال کیا جا رہا ہے۔ اس مطالعہ کا مقصد طبی طلباء کے سیکھنے اور اطمینان پر فزیالوجی کی تعلیم میں ہم مرتبه اساتذہ کے استعمال کی تحقیقات کرنا تھا۔

طریقہ: یہ نیم تجرباتی مطالعہ ٢٠٢١-٢٠٢٢ میں مشہد میڈیکل اسکول میں بنیادی علوم کے طبی طلباء پر کیا گیا تھا۔ طلباء کو دو گروہوں میں تقسیم کیا گیا تھا: روایتی اور ہم مرتبه تدريس کے طریقے۔ ہر سیشن کے آغاز اور اختتام پر کوئز کے اوسط سکور، امتحان کے آخری سکور، اور معلومات کو برقرار رکھنے کی شرح کا دونوں گروہوں کے درمیان موازنہ کیا گیا۔ طلبہ کے اطمینان کا اندازہ لگانے کے لیے ان کے درمیان ایک سروے بھی کیا گیا۔

نتائج: ہم مرتبه ٹیچنگ گروپ میں کوئز کے اوسط اسکور کنٹرول گروپ ($p < 0.05$) سے نمایاں طور پر زیادہ تھے، لیکن آخری امتحان کے اسکور میں دونوں گروہوں کے درمیان کوئی خاص فرق نہیں تھا۔ PT گروپ میں، گریڈز میں سب سے زیادہ بہتری ١٧ سے اوپر کے GPA والے طلباء کے مقابلے میں ١٤ اور ١٧ کے درمیان GPA اور ١٤ سے کم GPA والے طلباء میں تھی، لیکن کنٹرول گروپ میں، مختلف GPA والے طلباء کے درمیان کوئی خاص فرق نہیں تھا۔ ڈیٹا برقرار رکھنے کی شرح کا جائزہ لینے سے معلوم ہوا کہ ہم مرتبه تدريسی گروپ میں طلباء کا اسکور کنٹرول گروپ سے زیادہ تھا۔ ٨٣% طلباء اس طریقہ تدريس سے بہت مطمئن تھے۔

نتیجہ: ہم مرتبه تدريس کے طریقہ کار کے استعمال نے میڈیکل کے طلباء میں حوصلہ افزائی کی اور ان کے سیکھنے کے عمل کو بڑھایا، اس کے علاوہ ان میں اطمینان پیدا کیا۔

کلیدی الفاظ: تعلیم، ہم مرتبه کی تعلیم، سیکھنا، فزیالوجی

INTRODUCTION

The most important goal in teaching medical sciences and the use of different learning and teaching methods is to enhance and improve the learning process and theoretical and practical skills of students and train useful, efficient and effective human resources to meet the health needs of the country (1, 2). Different methods for learning and teaching have been introduced and used so far, and learning and teaching through peer teachers is one of the teaching-learning methods that has been and is being increasingly used in various studies, as an effective method of education in medical sciences (2). The use of peer education, in contrast to the conventional methods of education in which the main professional training of students is performed by professors, tries to integrate students in the education process and plays a very important role in improving and upgrading the learning environment (3, 4). It is believed that since the peers have already gone through the same stages of education and were at the level of the current students, they are familiar with the educational needs of the students of lower levels and can better help them learn while understanding their educational problems. (5-7)

In the peer education method, students are from the same group with the same characteristics and receive training from and with each other (8). One of the advantages mentioned in peer-to-peer education is that in addition to students helping each other in the learning process, they will feel more comfortable with their peers, and this will deepen learning in students (4). On the other hand, it has been shown that peer-to-peer training is also valuable for the peers, because it increases their educational ability and experience (2, 9).

Review of previous studies regarding the use of peer education in students shows that this method has been carried out in some courses, mainly practical fields such as nursing, dentistry and anesthesiology in the form of holding short-term classes or workshops, but based on the present researchers' knowledges, so far, no study has been conducted regarding the use of this method in teaching basic-science courses for medical students in Iran. On this basis and considering the importance of using new and diverse teaching methods, the purpose of this study is to investigate the effect of using peer-education in teaching physiology to medical students on their learning rate compared to current teaching methods.

METHODS

The present study is a semi-experimental study which was conducted on medical students at the basic-sciences levels in Mashhad Medical School (on average 180 students per semester). The inclusion criteria were medical students who had chosen the endocrine physiology course in the third semester, and the exclusion criteria were the unwillingness of the students to be in this teaching method and to be in this group. The initial idea of this was formed at the beginning of the year 1400 Shamsi (2021 A.D.) and interested students who were at the end of the clinical preparation course (physiopathology) or higher, were invited to participate in this study as peer-teachers through a call-out by the office of

Vice president of general medicine, Student scientific associations, the Exceptional talents committee, etc. After receiving the application of a number of interested students and conducting the initial interview and initial explanations regarding the goals and expectations, 5 medical students who were at the end of the clinical preparation course and currently engaged in the externship course were selected and the executive details of the work were carefully reviewed in numerous sessions. After finalizing the details, this study started from the beginning of the first semester of 1400-1401 and continued for three semesters until the end of the first semester of 2021-2022.

In Mashhad University of Medical Sciences, medical students are randomly divided into two groups at each entrance, based on the division that is done through the Education Office of the medical school. One group was selected as the Peer Teaching or PT group and the other group was selected as the control group. In the control group, according to the procedure of the previous years, the subject teacher taught the subject mainly in the form of a lecture, but in the PT group, the main part of the teaching and the way of teaching was in the hands of the peer-teachers, although the subject teacher was present in the class in all the sessions in the PT group; however, except for special cases, he did not interfere in the teaching process. The subject taught was Physiology of Endocrine Glands and Reproductive Systems. In the teaching method in the PT group, the teaching assistants used different methods such as using educational videos, game softwares, etc. All students in both groups had access to the video files prepared by the professor, and a lot of coordination and emphasis was done with the peers so that the content of the educational materials presented to the two groups were the same and completely in accordance with the valid references provided by the Ministry of Health, Treatment and Medical education for the comprehensive examination of basic-sciences. In the PT group, at the beginning of the first session, explanations were given to students about this teaching method and its expectations and goals in the class. At the beginning of each session in both groups, quizzes were taken virtually through the e-sanjesh website by students' mobile phones, and at the end of the session, the same quiz was answered by the students again, and finally the average score of the quizzes was compared between two groups. At the end of the semester, the final grades obtained by the students of both groups were compared. Also, the average score of quizzes among students based on their previous semester's GPA and dividing the students into three groups with GPA below 14, GPA 14 to 17, and GPA 17 and above were also examined in both groups. Also, in order to check the retention of information, after about 3-4 weeks from the last quiz, two quizzes were taken from students in both groups without prior notice and the results were compared. At the end of the study, the overall satisfaction of the students was assessed by asking the question, "How satisfied are you with teaching using PT?" using a 1 to 10 scoring scale. An interview with a number of students was also conducted to check the quality of this teaching method.

Two questionnaires were used in this process. These

questionnaires were made by researchers and were used to survey students regarding this teaching method at the beginning and end of the study. Its information and questions were summarized from different articles and evaluated based on the Likert scale from 1 to 5 (I strongly disagree, I disagree, I have no opinion, I agree, and I strongly agree). To determine the validity and reliability of these questionnaires, the questionnaires were given to eight medical education specialists and thirty medical students, and their corrective comments were applied. Test-retest method was used to determine the reliability of the questionnaires. These questionnaires had Cronbach's alpha coefficient of 0.80 and validity of about 0.73.

The data was analyzed using SPSS 20 software. Data were checked for randomness using Kolmogorov-Smirnov test and reported as mean and standard deviation. T-test was used to compare the questionnaire data between two groups and paired t-test was used to compare the data before and after the process. P less than 0.05 was considered significant.

RESULTS

Findings obtained from the survey questionnaire of students regarding the use of PT

On average, 57 students participated in the survey in each semester (table 1). The results of the average response percentage of students before and after the implementation of this method are presented in table 1. About 90% of students agree or very agree with the use of peer-teachers in the teaching process, and about 80% of students believed that teaching with this method is better than common teaching methods, and the learning would be deeper.

At the end of the study (the last session of the class), another questionnaire was distributed among the students, the results of which are presented in table 2. About 80% of the students suggested the use of peers to teach physiology in future semesters, and about 65% of the students

recommended the use of peer teaching methods for other basic-science courses. Also, 75% of the students believed that their motivation to learn basic-science courses has increased.

Comparison of student scores

The average scores of the quizzes before starting the class and at the end of each session of the class in two groups are shown in Figure 1, part A. The average scores of the quizzes in both groups at the end of the sessions were higher than at the beginning of the sessions, but in the PT group, the scores of the quizzes at the end of the sessions were significantly higher than the control group ($p < 0.05$). Examining students' end-of-semester exam scores showed that there was no significant difference between the end-of-semester scores of the two groups (Figure 1, Part B). Analyzing the quiz questions in terms of difficulty at the beginning and end of the class in two groups showed that the percentage of difficult questions in the PT group has decreased more than the control group, and on the contrary, the percentage of easy questions has increased in this group (Figure 1 Part C and D). Analyzing the scores of the end-of-class quizzes in two groups based on students' GPA showed that in the PT group, the greatest improvement in the grades was in students with a GPA above 17 compared to students with a GPA between 14 and 17 and GPA less than 14 (Figure 2 Part A), while in the control group, there was no significant difference between students with different GPAs (Figure Two, Part B).

Checking the durability of data in two groups is shown in figure 2, part C. As can be seen, although students in the PT group scored higher than the control group, there was no significant difference between the two groups.

Student satisfaction survey

The survey regarding the overall satisfaction of students with this teaching method based on a scale of 0 to 10 showed that about 61% of students have high satisfaction (score 8 to 10), 22% are relatively satisfied (score 5 to 7) and about 7% were not satisfied (score of less than 5).

Table 1. Results obtained from the questionnaire about students' opinion pertaining to the use of peer-teachers in teaching physiology, before the beginning of the study (before) and after at the end of study (after)

	I strongly agree (%)		I agree (%)		I have no opinion (%)		I disagree (%)	
	Before	After	Before	After	Before	After	Before	After
1 I agree with the participation of peer-teachers in the process of teaching and learning of physiology	2.17	29.5	54.35	60.5	30.44	4.22	10.87	4.22
2 With the help of peer-teachers, I can receive more practical and useful knowledge.	0	22.5	43.48	59.15	50	9.85	4.35	5.63
3 Peer-teachers help me to learn the lessons more deeply.	4.35	19.71	34.78	54.92	50	19.71	6.52	5.63
4 The educational atmosphere of the class gets better with the presence of peer-teachers	4.35	26.76	39.13	60.35	50	9.85	4.35	2.81
5 By using peer-teachers I learn more about the applications of physiology in medicine.	2.17	32.39	45.65	56.33	45.65	4.22	6.52	5.63
6 In total, I find it fruitful to use peer-teachers in all courses.	4.35	23.94	47.83	53.52	28.26	9.85	17.39	12.67
7 Teaching by this method is better than current prevalent methods and the learning process is deeper.	4.35	22.53	43.48	57.74	43.48	9.85	6.52	7.04

Table 2. Results obtained from the questionnaire about students' general opinion on the use of peer-teachers at the end of the study

		I strongly agree (%)	I agree(%)	I have no opinion(%)	I disagree (%)	I strongly disagree(%)
1	I recommend using peer-teachers for teaching physiology in the coming semesters	35.18	44.44	14.81	3.70	1.85
2	I recommend using peer-teachers for other courses of basic-sciences	31.48	33.33	24.07	5.55	5.55
3	I am more enthused to learn basic-sciences.	24.07	51.85	20.37	0	1.85
4	I have achieved a better concept about the future of my medical practice and my duties as a doctor.	27.77	57.40	5.55	1.85	5.55
5	The atmosphere of the class was in such way that I got encouraged to participate in the teaching process.	37.03	46.29	5.55	7.40	1.85
6	The presentation of the course was in such way that encouraged me to be an active learner and increased my self-confidences.	24.07	50	12.96	7.40	1.85
7	The importance of physiology in my future medical practice has become much more.	37.03	44.44	12.96	1.85	1.85
8	The presentation of the course was in such way that the students could have active participation.	12.96	48.14	22.22	12.96	3.70
9	Learning goals of this course were completely clear to me.	18.51	66.66	9.26	3.70	1.85
10	Peer-teachers had sufficient information about the materials of the course.	27.77	57.40	11.11	1.85	1.85

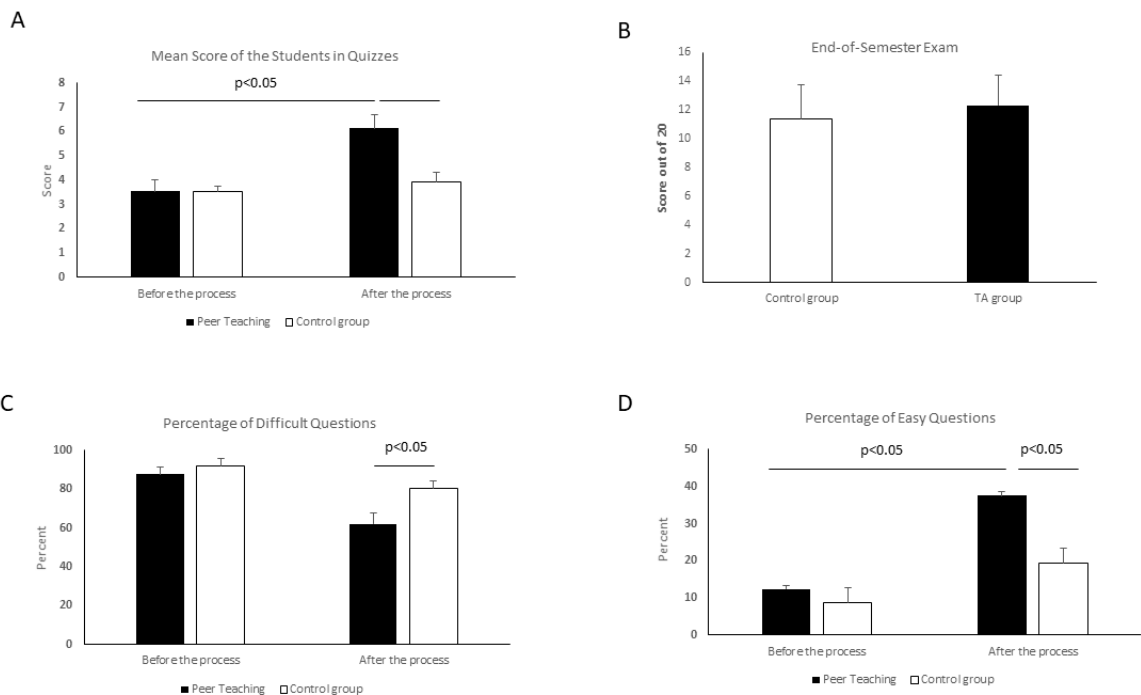


Figure 1. Mean Score of Quizzes and end of semester exam and percent of easy and difficult questions in control and peer-teaching groups

Conducting interviews and qualitative assessment of the study

During and at the end of this study, the students were asked to express their opinions, criticism and suggestions regarding this educational method in written or orally. Also, a meeting with the presence of a number of students was

held in this regard after the end-of-the-semester exam and after the registration of grades. A large number of students expressed overall satisfaction with this teaching method. Some ideas that the students expressed in this regard are mentioned: "I think the idea of using a peer-teacher was interesting and useful. Its strength was that I got to know

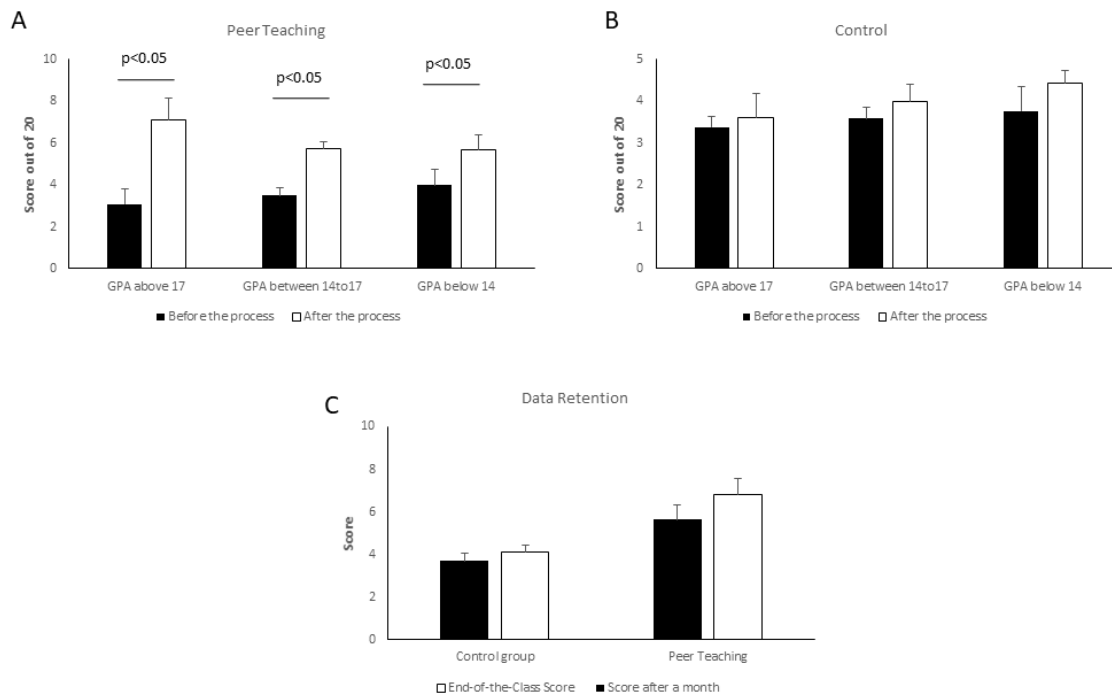


Figure 2. Quizzes score of different grades and comparison of data retention in control and peer-teaching groups.

more about the future of our profession, because the peer-teachers spoke about their own experiences in hospitals and wards, and the main teaching process was also good in my opinion and there was no shortage in this regard, but maybe because the professor himself does not teach, some of the material is not taken as seriously as if the professor himself was teaching the subject. Otherwise, from a scientific point of view, it was good". "An advantage of using peer-teachers was that the peers would explain more about the topics that they knew were probably more difficult for students to understand, and it was easier to communicate with them". "In the case of professors who teach very sympathetically, conscientiously, thoroughly, and are up-to-date, there may be no need to use a peer-teacher, but in the class of professors who may be less willing to spend time or do not teach very well and are not up-to-date, using peers would be more beneficiary".

DISCUSSION

The purpose of this study was to compare the teaching method using peer-teachers against the traditional teaching method. The results of the present study showed that the scores of the quizzes in the peer-teachers group were significantly higher than the control group. But regarding the grade of the final exam of the semester, based on the results obtained, although the end-of-the-semester grades were slightly higher in the peer-teachers group than the control group, there was no significant difference between the two groups. The survey of questionnaires and satisfaction survey and interviews with students showed that the general trend of this educational method is approved by the majority of students and a large number of students find this educational

method effective to deepen the learning process, and consider it a better method compared to the common teaching methods that are mainly based on lectures. Similar to our results, in a semi-experimental study conducted on midwifery students at Yasuj University of Medical Sciences, it was shown that the average post-test score in the peer-education group was higher than the lecture group, but the average end-of-semester exam score was not significantly different in the two groups; but it had created more enthusiasm and encouragement for the students to participate in the learning process compared to the lecture method (10). In another study in the country, it has been shown that the professors of basic-sciences and clinical courses agreed very much with the peer-education method and believed that this method leads to the training of capable human resources (11). In a study between 2011 and 2015 at UCLA University in USA, teacher assistants were used in teaching anatomy. The results of the study showed that the students were very satisfied with the presentation of this program in the university and a large number of them were interested in implementing this teaching method for the next courses of the university. The students also expressed their satisfaction with the various teaching methods of the teacher assistants (12). The results of a study in one of the American universities in the state of Michigan also showed that the use of peer-teaching method in teaching emergency medicine courses increased students' interest in learning (13). In a recent study conducted in 2022, three cohort studies were examined and their results showed that peer education has great beneficial effects on skills, teamwork, and lifelong learning (14). Studies on medical students have shown that peer-education has increased grades in physical examination

courses or practical exams such as OSCE and improve critical thinking in students (15, 16). On the other hand, the results of some studies show that peer-to-peer teaching may have beneficial effects on learning some theoretical concepts, but it has less effect on learning practical matters (17) and it has also been reported that some students found the use of teacher-assistant to be less effective and they preferred the professor to teach the lesson (18). Some of the contradictory results obtained in different studies can be related to the difference in the studied groups, theoretical, laboratory or clinical course units, and the type of course in terms of difficulty, especially in the case of courses that require specialized explanations. One of the challenges in this field is that it should be tried to have the same educational content taught in both groups. Therefore, one of the matters for which a lot of time was spent, was to coordinate between the teacher and the peer-teachers in order to be no difference in the content taught to the study groups. The teaching reference was based on the latest references specified by the General Medical Secretariat of the Ministry of Health, Treatment and Medical Education.

Another result obtained from this study is that in the group of peer-teachers, the improvement in learning and grades was higher in students with higher GPA and it seems that the most effect of this teaching method is in students with higher academic level. It has been shown that one of the positive consequences of teaching by teacher-assistants is that it affects the learners and creates this motivation in them that they can take the role of teachers in the future by developing their knowledge and skills (2).

Among the limitations of this study is that this process was only carried out in one of the subjects of the medical physiology course, which is suggested to be used in more areas of the physiology course and even other basic-science courses. One of the consequences of this teaching method is

that teaching by peers can improve teaching skills, increase self-confidence and develop the personal growth of the peers (2), which is suggested to examine the personal growth of peer-teachers.

In addition to creating motivation, enthusiasm and high satisfaction in medical students, the use of teaching assistants in the training of medical students can help them learn better and become more familiar with the practical concepts of basic-sciences.

Ethical Considerations:

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors. The ethics committee of Mashhad University of Medical Sciences approved this research, ethics code IR.MUMS.REC.1401.034.

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