

A Student-as-Teacher Program: A Pathway to the Accountability of Medical Education Systems

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Abstract

Background: Teaching is identified as a necessary role and responsibility for junior faculty members in their future careers.

Objectives: The present study aimed to test the hypothesis that a student-as-teacher (SaT) program can effectively prepare the students for their future roles as teachers and educators.

Methods: In this quasi-experimental study, the participants included 143 postgraduate students of 12 doctorate and master's degree programs at Shahid Sadoughi University of Medical Sciences, who were selected by census method. Nine learning objectives were classified in four competency domains: (1) adult learning principles; (2) instructional design; (3) teaching and learning processes; and (4) learner's assessment. The educational methods were based on an active learning approach.

Results: The mean score of learners in the practical assessment was 12.5 ± 3.6 out of 15, and their mean score in the modified essay test was 8.5 ± 1.5 out of 10 after the educational intervention. The results showed that the scores of the learners' attitude about cooperative learning were significantly different before (2.38 ± 0.31) and after (4.15 ± 0.65) the intervention ($P=0.0001$). Also, the scores of learners' capabilities in teaching were significantly different before (2.5 ± 0.61) and after (3.80 ± 0.34) the intervention ($P=0.0001$). The learners considered their teaching capabilities to be at the level of "familiarity without mastery" and "implementation mastery" before and after the intervention, respectively ($P=0.0001$).

Conclusion: It is recommended to develop and implement SaT programs to improve the teaching capabilities of students using innovative teaching methods and prepare them for their future roles as instructors and teachers.

Keywords: Teaching, Competency, Educational Capability, Postgraduate Program

Background

Over the past decades, the preparation of learners for fulfilling multiple roles in their future careers has become a major responsibility of educational systems. Teaching has been described as a role of junior faculty members in professional health programs (1). These faculty members should be able to educate their colleagues, learners of other disciplines, and recipients of services. The student-as-teacher (SaT) and resident-as-teacher (RaT) programs in clinical disciplines have been introduced as important components of professional health education (2-4).

Recently, the preparation of learners as teachers for fulfilling different roles, especially at postgraduate levels,

has been emphasized (1, 5, 6). In postgraduate programs, such as doctorate and master of sciences (MSc) degrees, the development of research skills and evidence-based practice has been highlighted, besides the development of teaching capabilities. The implementation of teaching and learning methods, such as problem-based learning, small group learning, active learning methods, and self-directed learning skills, has also been underlined in various studies (1, 5, 7-9). Besides, the ability to facilitate the learning process in different environments, use role models and apply practice-based learning skills, and communicate with learners has been introduced as an essential skill of students (10, 11).

In postgraduate programs, the learners' use of teaching skills for different audiences in a variety of environments has been described as a major competency. Postgraduate and graduate programs generally define the main context for preparing the students to play a teaching role. Different roles and skills have been described for a teacher in medical education systems (12). The National Framework for Professional Standards for Teaching in the United Kingdom reported that the competencies of an efficient teacher include acquisition of basic knowledge and commitment to professional values and doing activities (12). Besides, in the Three-Circle Model, three components are defined as the competencies of an excellent teacher: "Doing the right thing" (planning, facilitating, learning, and evaluating), "doing the thing right" (mental/emotional intelligence and analytical/creative intelligence), and "the right person doing it" (professionalism) (12, 13).

Molenaar et al. described a framework of teaching competencies across the medical education continuum. This framework defined teaching at a micro level and divided it into development, organization, coaching, and evaluation domains (14). Overall, it is important to provide educational opportunities for learners to achieve these competencies. In this regard, a systematic review of peer teaching programs among healthcare professionals showed that the implemented programs included the foundations of education theories, teaching methods and techniques, and feedback. In a previous study, the needs of healthcare providers, including students, graduates, and experienced workers, were highlighted to improve the teaching skills of future teachers. However, future studies are needed to evaluate the objective methods of evaluation in the programs (15).

Furthermore, Mann et al. and Freret et al. suggested twelve instructions to develop RaT or SaT programs (6, 7). Freret et al. divided the instructions into three domains, including pre-implementation, implementation, and post-implementation (6). Another study reported that the SaT curriculum consisted of feedback, teaching and clinical perceptions, small-group teaching, case-based teaching, and professionalism (5). Besides, the results of a study by Muir et al. revealed that providing teaching situations for several months led to the participants' preparedness for their teaching responsibilities in their working life (16).

One of the main goals of postgraduate programs in health sciences is to enable the learner to participate in the teaching process (1). Despite the significant teaching role of graduate and postgraduate learners, many of them receive no formal education on how to teach effectively (17). Doctoral and master's degree graduates are hired by universities as teachers, without any formal training about teaching skills. In previous studies, the need assessment of doctoral students at the schools of medicine and public health showed that these students assessed their capabilities to be at the level of "familiarity without mastery". The lowest level of capabilities was determined in the assessment domain, and the most important educational need was related to the methods of increasing

motivation among learners (18, 19).

Generally, the development of the postgraduate students' ability to play teaching roles is one of the most important requirements of healthcare systems (7). The SaT program is incorporated in the curriculum of postgraduate programs at the Public Health school of Shahid Sadoughi University of Medical Sciences. It seems that by developing SaT programs, we can improve the learners' teaching competency (18, 19).

Objectives

The present study aimed to test the hypothesis that SaT programs can effectively prepare the students for their future roles as teachers and educators.

Methods

This quasi-experimental single-group study was conducted in two phases. In the first phase, an educational program, based on an active learning approach, was developed to improve the teaching skills of postgraduate students. In the second phase, the educational program was implemented for the postgraduate students at the Public Health School of Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Twenty-four faculty members of the Health Education and Medical Education Departments participated in the program development process. In the second phase, the postgraduate students of MSc and doctorate programs at the public health school were recruited by census method. Finally, 143 postgraduate students of 12 different PhD and MSc programs participated in the SaT program. First, the educational program was developed. A Delphi technique was used to collect the expert opinions about the main teaching roles of an assistance teacher in the SaT program. In the first round, an open question was asked to gather the opinions of the participants by email. This process was conducted in three rounds, and 77 competencies and skills were extracted. Next, the SaT program was developed by an expert panel, including eight PhD graduates of health education. Nine learning objectives were classified in four competency domains: (1) adult learning principles; (2) instructional design; (3) teaching and learning processes; and (4) learner's assessment.

The educational content of the program included the teacher's role in the medical education system, the design of the program plan and its components, principles of small group learning, active learning methods, and feedback or reflection as an educational tool and assessment method. Small-group learning (snowball groups, group discussion, and buzz groups), role-play, review of videotaped sessions, and case-based learning were determined as the educational methods based on the active learning approach. First, the learners were familiarized with the adult learning principles. Second, they were exposed to the active learning methods in the classroom; this step allowed the person to play different roles, such as facilitator and group member in interactive learning activities. Third, the learners designed and

implemented a classroom as a teacher, based on the active learning approach (real situations in practical teaching). The interventions were implemented in eight sessions (16 hours) over six semesters.

A 16-item self-assessment questionnaire was used to examine the students' educational capabilities and needs. The questionnaire was developed by Farhadian (20) and validated among postgraduate students in a previous study (Cronbach's alpha of educational capabilities, 0.86; Cronbach's alpha of educational needs, 0.95) (18). The scores for each capability ranged from 1 to 4 (1= "non-familiarity" and 4= "mastery"), and the scores of educational needs ranged from 1 to 5 (1= "very low" and 5= "very high"). The questionnaire was completed by the learners before and eight weeks after the educational sessions.

Moreover, the learners' attitude toward the use of cooperative learning was assessed using a 12-item questionnaire, developed by Farzaneh and Nejadansari (21). The validity of this questionnaire and its internal consistency were approved (Cronbach's alpha=0.82) in the present study. Besides, the learners answered ten modified essay questions after six weeks of the educational sessions. The modified essay questions were short scenarios,

followed by questions that assessed cognitive skills, such as organization of knowledge, reasoning, and problem-solving (22).

To assess the learners' teaching performance, each learner designed and delivered an educational session based on the active learning approach in a classroom situation. The teaching performance of the learners was assessed using a 13-item checklist by observing their performance after four weeks of the SaT program. The modified essay questions and the observational checklist were developed by the expert panel and validated by medical education experts (n=10). The frequency and percentage were measured for describing the sample characteristics. Mean, and standard deviation (SD) were also calculated for all instrument scores. The self-assessment results were compared using the student's t-test and ANOVA in SPSS version 16.

Results

Postgraduate students from 12 MSc and doctoral programs, including 74 women (51.74%) and 69 men (48.25%), participated in the SaT program (n=143).

Table 1. The students' attitude toward cooperative learning

Items	Pretest Mean (SD)	Posttest Mean (SD)	P
1) I willingly participate in cooperative learning activities.	2.45(0.30)	4.4(0.40)	0.001
2) When I work with other students, I achieve more than when I work alone.	3.0(0.18)	4.3(0.32)	0.001
3) Cooperative learning can improve my attitude toward work.	2.1(0.42)	4.8(0.9)	0.001
4) Cooperative learning helps me to socialize more.	2.0(0.52)	4.6(0.82)	0.0001
5) Cooperative learning enhances good working relationships among students.	2.5(0.28)	4.3(0.99)	0.0001
6) Cooperative learning enhances class participation.	2.3(0.32)	4.9(0.85)	0.0001
7) Creativity is facilitated in the group setting.	1.79(0.17)	3.7(0.70)	0.01
8) Group activities make the learning experience easier.	2.5(0.57)	3.4(0.53)	0.001
9) I learn to work with students who are different from me.	2.8(0.21)	3.6(0.48)	0.001
10) I enjoy the material more when I work with other students.	1.47(0.40)	4.3(0.69)	0.0001
11) My work is better organized when I am in a group.	2.0(0.38)	3.3(0.73)	0.001
12) I prefer that my teachers use more group activities/assignments.	2.57(0.27)	4.1(0.50)	0.01
Total	2.38(0.31)	4.15(0.65)	0.0001

Table 2. Comparison of the level of learners' capabilities before and after the educational intervention

Items	Pretest Mean (SD)	Posttest Mean (SD)	P
1. Understanding the general concepts of learning, teaching, and assessment	2.60(0.72)	4.0(0.33)	0.0001
2. Developing a lesson/course plan	2.30(0.82)	4.0(0.14)	0.0001
3. Delivering lessons based on a logical structure	2.60(0.84)	4.0(0.59)	0.0001
4. Methods of improving motivation among learners	2.48(0.88)	3.6(0.39)	0.001
5. Improving critical thinking among learners	2.29(0.87)	3.6(0.63)	0.001
6. Methods of managing difficult situations in lectures	2.52(0.85)	4.0(0.29)	0.0001
7. Methods of managing difficult situations in the classroom	2.76(0.78)	4.0(0.38)	0.0001
8. Using a variety of teaching materials	2.65(0.88)	3.9(0.49)	0.0001
9. Giving lectures	2.48(0.81)	3.8(0.50)	0.0001
10. Conducting a variety of teaching methods in the classroom setting	2.61(0.79)	4.0(0.31)	0.0001
11. Having effective presentation skills in community or scientific settings	2.61(0.83)	3.8(0.29)	0.0001
12. Implementing the learner's assessment methods	2.54(0.78)	3.9(0.40)	0.0001
13. Designing multiple-choice questions	2.44(0.87)	3.4(0.34)	0.001
14. Interpreting and analyzing the results of learner's assessment	2.16(0.88)	3.5(0.71)	0.001
15. Applying evaluation results	2.20(0.94)	3.8(0.12)	0.001
16. Finding academic information resources	2.20(0.87)	3.6(0.70)	0.001
Total	2.53(0.61)	3.80(0.34)	0.001

The mean age of the participants was 31.4 ± 6 years. Forty-three students (30%) had a teaching experience. The obtained data were tested for normality using the Kolmogorov-Smirnov test ($P=0.08$). The results showed that the scores of the learners' attitude were significantly different before (2.38 ± 0.31) and after (4.15 ± 0.65) the intervention ($P=0.0001$) (Table 1). On the other hand, the results revealed no significant difference in the learners' scores according to their age ($P=0.08$) or gender ($P=0.1$).

The mean score of the learners in the practical assessment was 12.5 ± 3.6 out of 15, and the mean score of the modified essay test was 8.5 ± 1.5 out of 10 after the educational intervention. The results revealed that there was no significant difference in the learners' scores according to age ($P=0.2$) or gender ($P=0.4$). The students reported that their skills before the intervention were at the level of "familiarity without mastery" (2.53 ± 0.61). However, after the intervention, the mean score of the learners was 3.80 ± 0.34 , which is in the category of "implementation mastery".

Moreover, the results showed that the learners' self-perception about their capabilities was significantly different before and after the intervention ($P < 0.05$) (Table 2). Besides, there was a significant difference in the scores of male (3.74 ± 0.41) and female (3.87 ± 0.25) students ($P=0.02$). Although the scores of both groups increased, the scores of women was reported to be higher than men. Nevertheless, the results revealed no significant association between the learners' score and age group ($P=0.09$).

Discussion

Postgraduate programs in health education mainly contribute to the development of teaching skills of learners, who will become junior faculty members in their future careers. The results of the present study showed that the SaT program improved the teaching capabilities of learners. In other words, the attitude, self-perception, and performance of the learners improved after attending the SaT program.

Generally, the SaT approach is integrated in graduate and postgraduate programs to prepare the learners for their various future roles, such as teaching (1). Six roles have been identified for a teacher in the medical education system, which include the planner, information provider, facilitator, resource developer, evaluator, and role model. This framework of teacher roles can be helpful in clarifying the expected roles, identifying the necessary skills for teaching at universities, and recognizing the recruitment needs of faculty members (23). It seems that this framework can be applied to the SaT programs.

In the present study, the main competencies of the defined teaching roles in the classroom were considered. The capabilities were associated with roles, such as the planner, information provider, facilitator, evaluator, and role model. The essential skills of an excellent teacher are defined as having small-group teaching skills, providing feedback, understanding the learners' needs, and assessing the learners (3, 10, 23, 24), which were also considered

in the SaT program of the present study. Besides, it is important for the participants to learn to establish an interactive relationship with the learners (reciprocal and non-judgmental interaction) and support them in the teaching-learning process (10, 13, 25). These skills are defined as the curricular priorities of SaT programs (5), similar to our program.

Generally, the goal of SaT programs is to consider the learner's preparation for applying an active learning approach in the future and changing his/her attitude. In the present study, the learners were involved in an active learning process that led to the acquisition of teaching skills and promoted a positive attitude toward the active learning approach. Similarly, a systematic review of RaT programs showed positive changes in the participants' attitudes toward teaching. Also, the participants' knowledge about the educational principles increased, which is in line with the present results (26). The results of different studies support our findings regarding the positive effects of SaT on the teaching skills, and attitude about student-centeredness (27, 28).

The establishment of student-centeredness and active learning approaches, which focus on acquiring knowledge through thinking, discussion, and participation in group activities (29), is needed to change various components of the educational system, such as human resources and infrastructure. Also, the preparation of postgraduate students, who will be junior faculty members in the future, can expand these approaches at universities. Besides, it is recommended to apply teaching methods, such as large and small group discussions, role-play, and videotaped vignettes in the SaT curricula, to expand the attitude and preparedness of future teachers (17).

According to the present results, the learners assessed their skills to be at the level of "familiarity without mastery" before the intervention, which is consistent with the results of previous studies (18, 19). The learners stated that "understanding the general concepts of learning, teaching, and assessment", "delivering the lesson plan based on a logical structure", and "improving critical thinking among learners" were the most needed aspects of education; this result is in line with the findings of previous studies among postgraduate students (19). Moreover, the present results showed that after the intervention, the learners' capabilities improved to a higher level, which confirms the effectiveness of SaT interventions in improving the teaching skills of learners.

The learners evaluated their abilities to be at the level of "implementation mastery" and their practical and cognitive skills to be at an "optimal level". The results showed that the learners assessed their skills in understanding the adult learning principles, instructional design, and implementation of teaching method domains to be higher than the assessment domain. In line with the present findings, a review study of the SaT curricula showed that the teaching behaviors and confidence of learners improved after attending the program (17). According to the results of a study by Donovan, the program directors

believed that improvement of teaching skills helped the residents to become better healthcare providers. It was concluded that the SaT program prepared the learners to play effective teaching roles, which helped them become professionals (30).

In line with the present study, the results of a study by Hosein Nejad et al. showed that the residents' attitude toward teaching abilities improved significantly after the intervention; however, there was no significant difference in the teaching performance of the residents from the viewpoint of interns (31). These results may be attributed to the educational methods that were used in their study. In the present study, the learners engaged in active learning methods that can improve the performance of learners. Also, the discrepancy between the findings may be due to differences between the evaluators in these studies. Besides, in the study by Hosein Nejad et al., the learners' performance was assessed from the viewpoint of consumers, which is different from our study. Other limitations of the present study include its single-group design and lack of a control group. Also, assessment of the learners' practical skills was performed only after the intervention, which is another limitation of the present study. It is recommended that future longitudinal studies assess the impact of SaT interventions on the participants' teaching behaviors.

Conclusion

The results of the present study indicated the improvement of the teaching abilities of learners who attended the SaT program. Overall, the use of an interactive learning approach in SaT programs can improve the students' skills and attitude as future teachers. It is recommended that SaT programs be developed as elective courses to improve the teaching skills of learners who want to become university instructors in the future.

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References

1. Marušić M, Mimica M, Mihanović F, Janković S. Doctoral degree in health professions: professional needs and legal requirement. *Acta Med Acad.* 2013;42(1):61-70. doi: 10.5644/ama2006-124.72. [PMID: 23735068].
2. Hafler JP. Residents as teachers: A process for training and development. *J Nutr.* 2003 Feb;133(2):544S-6S. doi: 10.1093/jn/133.2.544S. [PMID: 12566499].
3. Blanco MA, Maderer A, Oriol A, Epstein SK. How we launched a developmental student-as-teacher (SAT) program for all medical students.

4. Kurczek J, Johnson J. The student as teacher: reflections on collaborative learning in a senior seminar. *J Undergrad Neurosci Educ.* 2014 Mar 15;12(2):A93-9. eCollection Spring 2014. [PMID: 24693265]. [PMCID: PMC3971000].
5. Rana J, Sullivan A, Brett M, Weinstein AR, Atkins KM, Group SDW. Defining curricular priorities for student-as-teacher programs: A National Delphi Study. *Med Teach.* 2018 Mar;40(3):259-266. doi: 10.1080/0142159X.2017.1401216. [PMID: 29171329].
6. Freret T, Rana J, Schwartzstein RM, Gooding HC. Twelve tips for implementation of "student-as-teacher" programs. *Med Teach.* 2017 Dec;39(12):1221-1226. doi: 10.1080/0142159X.2017.1333591. [PMid:28598708].
7. Mann KV, Sutton E, Frank B. Twelve tips for preparing residents as teachers. *Med Teach.* 2007 May;29(4):301-6. doi: 10.1080/01421590701477431. [PMID: 17786741].
8. Bensinger LD, Meah YS, Smith LG. Resident as teacher: the Mount Sinai experience and a review of the literature. *Mt Sinai J Med.* 2005 Sep;72(5):307-11. [PMID: 16184293].
9. Post RE, Quattlebaum RG, Benich III JJ. Residents-as-teachers curricula: a critical review. *Academic Medicine.* 2009;84(3):374-80. *Acad Med.* 2009 Mar;84(3):374-80. doi: 10.1097/ACM.0b013e3181971ffe. [PMID: 19240450].
10. Martins AR, Arbuckle MR, Rojas AA, Cabaniss DL. Growing Teachers: Using Electives to Teach Senior Residents How to Teach. *Acad Psychiatry.* Jul-Aug 2010;34(4):291-3. doi: 10.1176/appi.ap.34.4.291. [PMID: 20576990].
11. Dewey CM, Coverdale JH, Ismail NJ, Culberson JW, Thompson BM, Patton CS, et al. Residents-as-teachers programs in psychiatry: a systematic review. *Can J Psychiatry.* 2008 Feb;53(2):77-84. doi: 10.1177/070674370805300202. [PMID: 18357925].
12. Mclean M, Cilliers F, Wyk JV. Faculty development: Yesterday, today and tomorrow. *Med Teach.* 2008;30(6):555-84. doi: 10.1080/01421590802109834. [PMID: 18677659].
13. Hesketh E, Bagnall G, Buckley E, Friedman M, Goodall E, Harden R, et al. A framework for developing excellence as a clinical educator. *Med Educ.* 2001 Jun;35(6):555-64. doi: 10.1046/j.1365-2923.2001.00920.x. [PMID: 11380858].
14. Molenaar W, Zanting A, Van Beukelen P, De Grave W, Baane J, Bustraan J, et al. A framework of teaching competencies across the medical education continuum. *Med Teach.* 2009 May;31(5):390-6. doi: 10.1080/01421590902845881. [PMID: 19811129].
15. Burgess A, McGregor D. Peer teacher training for health professional students: a systematic review of formal programs. *BMC Med Educ.* 2018 Nov 15;18(1):263. doi: 10.1186/s12909-018-1356-2. [PMID: 30442139]. [PMCID: PMC6238310].
16. Muir F, Bruce J, McConville K. Teaching, reflecting, and learning: The value of an intercalated medical education programme. *Med Teach.* 2020 May;42(5):523-528. doi: 10.1080/0142159X.2019.1708290. [PMID: 31935150].
17. Wamsley MA, Julian KA, Wipf JE. A literature review of "resident-as-teacher" curricula. *J Gen Intern Med.* 2004 May;19(5 Pt 2):574-81. doi: 10.1111/j.1525-1497.2004.30116.x. [PMID: 15109328]. [PMCID: PMC1492323].
18. Keshmiri F, Mosayebi A. Teaching Competency Assessment Of PhD Students: Needs Based Assessment Study. *Payavard.* 2014; 8(4) :332-42. [In Persian]

19. Najafi M, Najafi M, Keshmiri F. Gap analysis of skill and educational need's Ph.D. students in Tehran University of medical science as regards teaching skill. *Razi J Med Sci.* 2014;21(118):32-42. [In Persian]
20. Farhadian F, Tootoonchi M, Changiz T, Haghani F, Oveis Gharan S. Faculty Members' Skills and Educational Needs Concerning Clinical Teaching Methods in Isfahan University of Medical Sciences. *Iran J Med Educ.* 2007; 7(1):109-18. [In Persian]
21. Farzaneh N, Nejadansari D. Students' attitude towards using cooperative learning for teaching reading comprehension. *Theory and Practice in Language Studies.* 2014;4(2):287. doi:10.4304/tpls.4.2.287-292
22. Moeen-uz-Zafar, Badr-Aljarallah. Evaluation of modified essay questions (MEQ) and multiple choice questions (MCQ) as a tool for assessing the cognitive skills of undergraduate medical students. *Int J Health Sci (Qassim).* 2011 Jul; 5(2 Suppl 1): 43-4. [PMID: 23284579]. [PMCID: PMC3533348].
23. Harden R, Crosby J. AMEE Guide No. 20: the good teacher is more than a lecturer—the twelve roles of the teacher. *Med Teach.* 2000;22:334-47. doi:10.1080/014215900409429.
24. Tucker C. If medical education was a discipline, she would have five core competencies. *Med Teach.* 2017 Jul;39(7):783-784. doi: 10.1080/0142159X.2016.1270435. [PMID: 28097957].
25. Zabar S, Hanley K, Stevens DL, Kalet A, Schwartz MD, Pearlman E, et al. Measuring the competence of residents as teachers. *J Gen Intern Med.* 2004 May;19(5 Pt 2):530-3. doi: 10.1111/j.1525-1497.2004.30219.x. [PMID: 15109318]. [PMCID: PMC1492315].
26. Hill AG, Yu TC, Barrow M, Hattie J. A systematic review of resident-as-teacher programmes. *Med Educ.* 2009 Dec;43(12):1129-40. doi: 10.1111/j.1365-2923.2009.03523.x. [PMID: 19930503].
27. DaRosa D. Residents as teachers: evaluating programs and performance. In: Edwards JC, Friedland JA, Bing-You R, eds. *Residents' Teaching Skills.* New York: Springer; 2002:100-14.
28. Morrison EH, Shapiro JF, Harthill M. Resident doctors' understanding of their roles as clinical teachers. *Med Educ.* 2005 Feb;39(2):137-44. doi: 10.1111/j.1365-2929.2004.02063.x. [PMID: 15679680].
29. Cantillon P, Wood D, Yardley S. *ABC of Learning and Teaching in Medicine.* New Jersey: John Wiley & Sons; 2017.
30. Donovan A. Radiology residents as teachers: current status of teaching skills training in United States residency programs. *Acad Radiol.* 2010 Jul;17(7):928-33. doi: 10.1016/j.acra.2010.03.008. [PMID: 20447842].
31. Hosein Nejad H, Bagherabadi M, Sistani A, Dargahi H. Effectiveness of resident as teacher curriculum in preparing emergency medicine residents for their teaching role. *J Adv Med Educ Prof.* 2017 Jan;5(1):21-5. [PMID: 28124018]. [PMCID: PMC5238492].