



The Biostatistics Graduates' Perspectives Concerning the Curriculum, the Course Educational Topics, and Its Association with Their Career-related Requirements

Mohammadreza Balooch Hasankhani ¹ and Masoud Roudbari ^{1,*}

¹Department of Biostatistics, School of Public Health, Iran University of Medical Sciences, Tehran, Iran

*Corresponding author: Department of Biostatistics, School of Public Health, Iran University of Medical Sciences, Tehran, Iran. Tel: +98-9123887600, Email: roudbari.m@iums.ac.ir

Received 2021 June 09; Revised 2021 September 12; Accepted 2021 September 24.

Abstract

Background: The study and revision of postgraduates syllabus are very important aspects to promote the level of effectiveness of postgraduates' educations. Owing to the requirement of syllabus reform, especially when the speed of useful life of information in the world is less than a decade, it is a serious aspect for the educational programmers.

Objectives: This study aimed to determine the view of biostatistics graduates on the syllabus of the courses, the achievement of learning aims, job requirements, and understanding their educational problems.

Methods: The number of graduates was 245 in the levels of master of science (MSc) and PhD of biostatistics from Tehran, Iran, Shahid Beheshti, Tarbiat Modares University of Medical Sciences, and University of Social Welfare and Rehabilitation Sciences. The participants were graduated from 2011 to 2020. The data were collected by a questionnaire and analyzed using SPSS software.

Results: Of PhD and MSc graduates, 48 (57.1%) and 70 (43.5%) participants declared, respectively, that they received the necessary theoretical and practical skills that they needed for their job. Also, clinical trial courses in both MSc and PhD periods were chosen by the graduates as the most significant courses, and one of the most applied courses in job requirements. Furthermore, statistical methods at MSc level and longitudinal data analysis at PhD level were chosen as the next important courses by the graduates, respectively.

Conclusions: The findings show that the syllabus meets less than half of the graduates' job requirements, so it is not enough and is necessary to reform the contents of educational programs according to their job requirements.

Keywords: Graduates, Biostatistics, Curriculum, Career, Requirements

1. Background

Educational planning, especially assessment planning, is one of the key areas of education that helps educational managers to learn about students' learning (1). Evaluation of educational programs is one of the main tasks of universities, and the level of job abilities of graduates, in order to provide acceptable services to the public, is directly related to the implementation of educational goals and topics of academic disciplines (2).

Factors such as the expansion of medical education, lack of up-to-date programs to learn to medical students, failure to achieve some of the educational goals, especially practical skills, which are an important part of medical graduates' task, have made the medical graduates have less performance in basic medical skills. Many of these graduates have less practical, technical and clinical skills,

which are below the expected level to provide enough patient care after graduation (3). These days, the high education shift from the teacher-centered to learning-based and the education managers prefer periodically checking the learning of the graduates, their abilities, the courses syllabus, and educational program to improve the quality of education in the universities and higher education centers. This needs an assessment movement that was started in 1980s. This assessment can check the effectiveness of funding in public higher educational institutes to evaluate the graduates' learnings to move from traditional toward practical education (4).

Biostatistics is a discipline that deals with the development and application of statistical theories that are used in the study and analysis of biological science phenomena (5). This field has been established with the aim of training graduates who can make use of the statistical knowledge

in various fields of medical sciences, especially in the field of disease prevention, health, and investigation of the incidence and treatment of diseases with the help of health officials. Graduates of this field should also be able to collaborate in most research concerning the treatment of diseases, review new therapies and scientifically compare them with existing methods with relevant researchers. The educational topics of this field have not been reviewed for nearly a decade, while during this period, many changes have taken place in the field of knowledge worldwide. By continuously conducting research on up-to-dating of curricula, we can change the curriculum from static to dynamic and apply the necessary corrections and revisions.

The authors have not found any research regarding viewpoints of biostatistics graduated on the course syllabus, the fulfillment of learning objectives, job requirements, and their education problems. However, over the past years, researches have been conducted to evaluate curricula, and the degree of adaptation of the course content to the job requirements of individuals, mostly in a different discipline. Some of these results are as follows. Shadfar et al. performed a research with the aim of investigating the fulfillment of course planning in the management discipline with the scientific, personal, social and professional needs of students. They concluded in their research that the degree of adaptation of the curriculum to the needs of students is below average (6). Entezari did not consider higher education curricula successful in helping students achieve the necessary employment skills (7). Woya concluded in his research that the skills and knowledge acquired by the statistics graduates of Bahir Dar University in Ethiopia have been very useful and relevant to their current careers (8). Martin and Cary evaluated the teaching method and clinical education and concluded that students sought to improve learning experiences, participated in their academic progress, created a teamwork environment, and worked with lecturer to increase the quality of self-mastery. Therefore, they evaluated the current education to some extent as desirable (9).

The strength of curriculum planning is the possibilities of evaluation of the program and to understand the degree of compliance of the current curriculum and the public requirements to improve the curriculum, although the restrictions of administrative affairs, financial, and educational issues are some of the drawbacks of the curriculum planning.

Postgraduate and in-service evaluation is better and more reliable as graduates will assess their academic abilities in the face of the public requirements and evaluate the topics they have learned based on these gained abilities (10). Therefore, the public needs proper curriculum planning to train skilled and high-ability graduates to meet the

society requirements and also to save the high cost of university education. Obviously, these universities not only can train high-ability graduates to fulfill the public needs but also encourage students all over the world to pursue their high education in these high standard universities.

2. Objectives

The present study is an attempt to examine the viewpoints of biostatistics graduates on the abilities and skills they have acquired during their studies and also the relevance of these skills to the needs and expectations of the public. Therefore, the research results can help the educational planner to modify the current educational method and plan to overcome the educational defects.

3. Methods

This cross-sectional study can be regarded as an educational evaluation that has been performed on 245 graduates of master of science (MSc) and PhD degrees in biostatistics from Medical Sciences Universities located in Tehran, including Tehran, Shahid Beheshti, Iran, Tarbiat Modares, and Welfare and Rehabilitation Sciences Universities, who graduated during the years of 2011 to 2020. The research was conducted in 2020 at Iran University of Medical Sciences (IUMS). The target population was estimated to be 280 to 300 graduates of the universities, and the questionnaire was sent to all of these graduates by email. Almost all graduated participants returned the questionnaires, and only a few percent of them did not receive the questionnaire due to incorrect email addresses. Two hundred and forty-five questionnaires were returned with the response rate of more than 81%. The inclusion criteria were the graduates of biostatistics from 2011 to 2020, being interested in participating in the study, and sending his/her email address to the researchers, whereas the exclusion criteria were other discipline graduates, people who were graduated before 2011 or after 2020, and sending an incomplete questionnaire.

The data collection tool was a researcher-made questionnaire divided into four sections: the demographic characteristics of the graduates (three questions for both disciplines), the educational and employment status of the graduates (16 and 21 questions for MSc and PhD graduates, respectively), the evaluation of the graduates about the significance of the courses (15 and 8 questions for MSc and PhD graduates respectively) taken in MSc and PhD degrees, designed in the format of the 5-point Likert scale (very low = 1, low = 2, medium = 3, high = 4 and very high = 5) in which the average score of significance concerning each course

was calculated in the range of 1 to 5, and the final part of the questionnaire was an open question by which the graduates were asked to express their opinions, suggestions, needs, and strategies for improving their educational level.

Research data were collected by stating the objectives of the research to the participate graduates via email. To correspond with the graduates, the information of students and graduates available on the websites of the above five universities, information obtained from the departments of biostatistics, and faculty members of this field about students and graduates, and information of graduates of their peers were used. A limited number of graduates were unable to participate in the study due to the lack of access to their e-mail or telephone by researchers or were not interested in taking part in the study.

The face validity of the questionnaire was approved by a few faculty members of the biostatistics department of IUMS. For content validity, a panel of 10 faculty members of biostatistics department of some Iranian Medical Universities approved the multi-choice questionnaire regarding the importance of the courses. The content validity for different questions was from 0.80 to 1.0. Also, the reliability of MSc and PhD questionnaires was 0.91 and 0.85, respectively.

In order to analyze the data, SPSS 24 and descriptive statistics (frequency, central tendency, etc.), inferential statistics, Chi-square, independent sample *t*-test, and logistic regression were used. The study was approved by the Ethics Committee of IUMS with the ethics ID no (IR.IUMS.REC.1399.543).

4. Results

Of 245 biostatistics graduates in Tehran City Universities of Medical Sciences with an average age of 35.0 ± 5.57 years, 84 (34.3%) were male, and 161 (65.7%) were female, 103 (42%) were single, and 142 (58%) were married. Also, 161 (65.7%) participants were MSc, and 84 (34.3%) were PhD graduates. Most of the graduates were from Tehran University of Medical Sciences (75 graduates equal to 30.6%), Shahid Beheshti University of Medical Sciences with 68 (27.8%) graduates, and Tarbiat Modares University with 52 (21.2%) graduates were at next orders.

Of the total number of graduates, 88 (35.9%) declared their postgraduate status to continue their studies. Most of the graduate students (80 graduates, or 49.7%) announced the duration of their MSc course as six semesters, and most of the PhD graduates (29 graduates equal to 34.5%) announced the duration of their PhD course as 10 semesters (Figure 1).

Of the total number of PhD and MSc degree graduates, 48 (57.1%) and 70 (43.5%), respectively, stated that the theo-

retical or practical skills acquired during the PhD and MSc studies (Content of the field of study) had met their job and career requirements (Figure 2).

In terms of employment status, 159 (64.9%) of the total graduates were employed, and 86 (35.1%) were unemployed. One hundred and fifteen (72.3%) graduates were employed in the public, 42 (26.4%) were employed in the private sector, and there were two (1.3%) graduates with unknown employment status. The job of 128 (80.5%) graduates related, and 29 (18.2%) graduates did not relate to the field of biostatistics. Also, two (1.3%) graduates did not answer this question. The job titles of 62 (39%) graduates were faculty members, 54 (34%) graduates were expert statisticians, 23 (14.4%) graduates had other job titles, and 20 (12.6%) graduates had not specified their job titles. Chi-square test or independent sample T-test showed that there was no significant association between gender ($P = 0.775$, $P = 0.095$), marital status ($P = 0.697$, $P = 0.936$), age ($P = 0.229$, $P = 0.339$), employment status ($P = 0.265$, $P = 0.833$), and university of study ($P = 0.325$, $P = 0.452$) with the question of meeting job requirements with the content of the field of study for MSc and PhD graduates, respectively.

Also, explaining the content of the field of the study in meeting or not meeting job requirements (response variable), in terms of some predictor variables (gender, marital status, age, employment status, and university of study), showed that none of the variables were included in the model using logistic regression. The average response score of the graduates, according to their opinion about the importance and professional application of the content of the courses, is presented in Tables 1 and 2. Based on the opinions of graduate students, clinical trial and medical demography courses with the average of 4.18 and 2.29 out of 5 were the most important and the least important courses, respectively.

Also, according to Table 2, the highest average (out of 5) among the PhD courses was related to the clinical trial course with an average of 4.45, and the lowest average was related to the random processes course with an average of 2.3.

The summarized results of the graduates' opinions, needs, and strategies for improving their education and their educational problems, as well as the graduates' suggestions, are presented in Tables 3 and 4 by the participants' degrees.

5. Discussion

Based on the research findings, out of a total of 245 graduates, 118 graduates (48.2%) stated that the theoretical or practical skills acquired during their studies (course content) met their job requirements, and 90 graduates

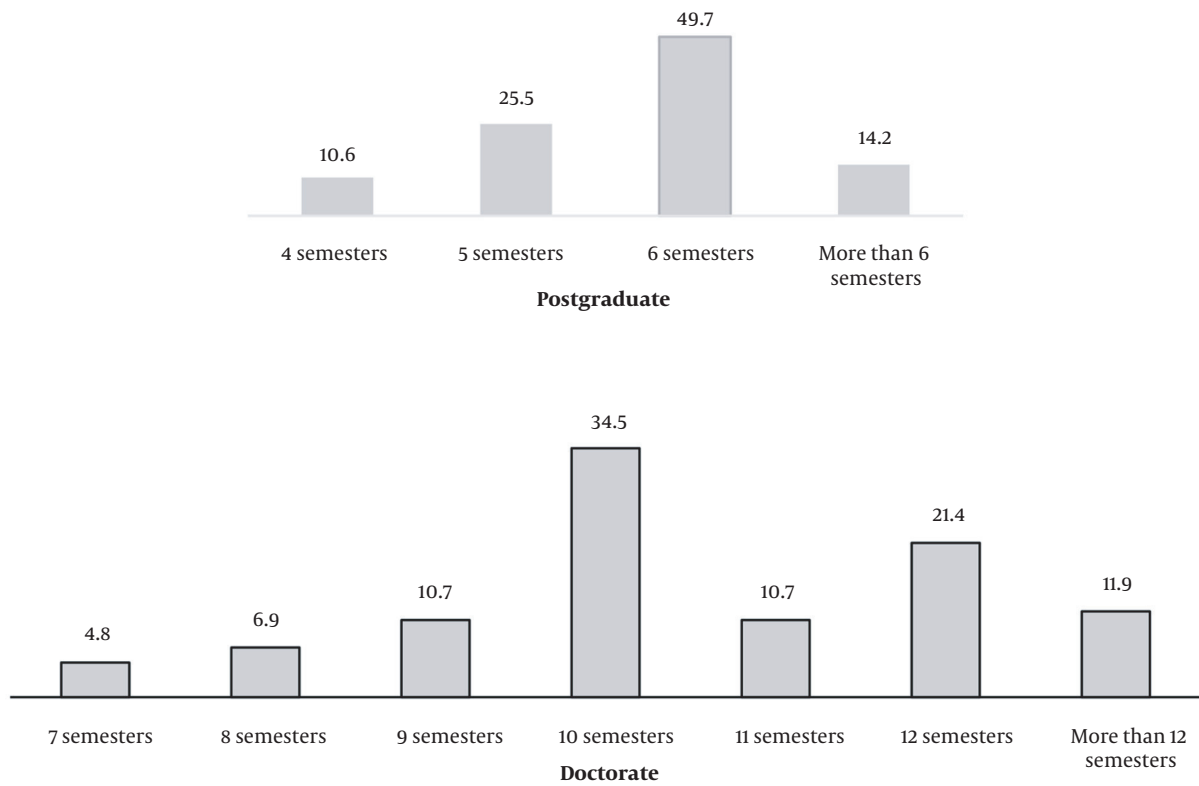


Figure 1. Frequency distribution of study period of biostatistics graduates according to their degrees.

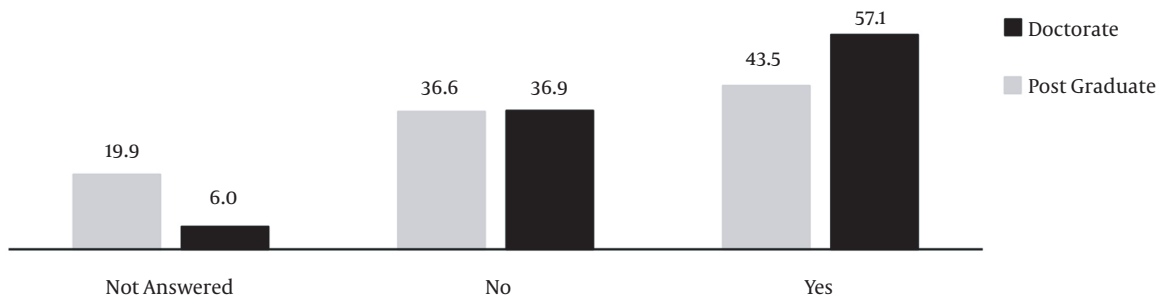


Figure 2. Relative frequency (%) distribution of biostatistics graduates' answers regarding the appropriateness of the content of the field of study to career requirements by their degrees.

(36.7%) stated that the content of the field of study did not meet their job requirements. This indicates that the educational content is not completely in line with the professional needs of the graduates, and needs to be approved. Therefore, it is necessary to make changes in the content and curriculum of this field in accordance with the professional requirements of the graduates.

The results of Woya's study reveals that the skills and

knowledge acquired by the statistics graduates of Bahir Dar University in Ethiopia have been very useful and relevant to their current careers (8); therefore, the result is against the current study. Hanani et al. studied the compliance of the content of the educational topics of the undergraduate course of occupational health with the functional aspects expected the graduates working in Kashan region in 2014, and concluded that the content of courses

Table 1. Average Score of Biostatistics Graduates on the Importance and Job Application of Postgraduate Courses

Courses	Number of Response	Mean
The design and analysis of clinical trials	160	4.18
Statistical methods (2)	160	4.03
Statistical methods (3)	159	4.03
Survival data analysis in medical research	157	4.03
Statistical methods in epidemiology	157	4.03
Categorical data analysis	153	3.99
Principles and methods of epidemiology	157	3.88
Statistical methods (1)	159	3.83
Applied multivariate analysis	160	3.61
Medical information systems	155	3.03
Statistical inference	160	2.74
Generality of medicine	159	2.74
Medical demography	152	2.29

Table 2. Average Response Score of Biostatistics Graduates About the Importance and Job Application of PhD Courses

Courses	Number of Response	Mean
The design and analysis of clinical trials	84	4.45
Longitudinal data analysis	84	4.42
Survival analysis	84	4.33
Categorical data analysis	84	4.29
Linear models	84	4.04
Special topics	84	3.2
Bayesian computational statistics	84	3.06
Statistical inference	84	3.01
Random processes	84	2.3

and educational programs has to some extent met the job requirements of occupational health graduates (2). Abdelsalam et al. showed that students are satisfied with the curriculum developed for dentistry in Saudi Arabia and that it is commensurate with the teaching requirements of the faculty members (11). Both studies are not consistent with the result of the current study. Shadfar et al. performed a research with the aim of investigating the fulfillment of course planning in the management discipline with the scientific, personal, social and professional needs of students. They concluded in their research that the degree of adaptation of the curriculum to the needs of students is below average, so the result is similar to the current study (6). Hennemann and Liefner, in their study of the employment

of geography graduates at the University of Giessen in Germany, concluded that traditional geography curricula do not adequately prepare German geographers for their jobs (12); therefore, the result is the same as the current study. In another research in Taiwan with a sample of 105 hospital industry's managers and 193 senior students of hospital equipment, it was shown that both of the managers and students believed that the students had not enough skills to employ in hospital equipment industry due to inadequate compliance of curriculum and the job requirements (13), so the result is consistent with the current study.

The results of this study showed that the duration of education for most graduates of MSc and PhD degrees was 6 and 10 semesters, respectively. It seems that most of the graduates had completed their studies within the allowed period. This period is shorter than the study of Roudbari et al., who showed that the duration of study of MSc and PhD graduates at Tehran University of Medical Sciences was 32.3 and 56.8 months, respectively (14). According to the results of the present study, the course of the design and analysis of clinical trials was the most important and practical course among all the courses of great importance from the graduates' point of view for job requirements. It seems that clinical trial is more useful than other courses due to its association with human health and its important application in studying the effects of new medications and treatments. According to the research results, it can be suggested that all MSc and PhD courses in this field need to be evaluated and reviewed every two to three years, and the necessary changes should be applied to the course titles and contents. This is possible by consulting the biostatistics departments in the Medical Sciences Universities. Announcement of some main optional courses to give the student the right to choose the courses that are more applicable in their employment or continuing the student's education is another necessity. Introducing practical presentation of courses that facilitate the student's learning by practical work, including clinical trial and statistical methods courses, is another suggestion. Adding courses such as internships (especially in the postgraduate courses), research methods, teaching statistical software, and principles of statistical counseling are some suggestions that can further enhance the abilities of graduates.

5.1. Conclusions

The design and analysis of clinical trials in both MSc and PhD periods of biostatistics were considered as the most important courses of the two levels by the participants. The courses of statistical inference, generality of medicine, and medical demography were introduced as the least important courses of MSc level. Furthermore, the Bayesian computational statistics, statistical inference,

Table 3. Educational Problems and Suggestions of MSc Graduates of Biostatistics

Area	Subject
Educational changes and programs	The lesson plan, the references used, and teaching methods are not in line with the needs of the up to date requirements for data analysis. Therefore, it is necessary to update the lesson plan and references.
Add courses and schedules	Longitudinal data analysis, time series, simulation, Bayesian statistics, sampling, data mining, programming, numerical analysis (or methods of finding), statistical software training, statistical consulting training, article writing, article reviewing, research methodology, proposal providing machine learning, image processing, text processing, bioinformatics, environmental data analysis, spatial and spatiotemporal data analysis, and internships should be added to this course or replaced by less used courses.
Delete a course	The seminar course is not taken seriously by lecturer and students, and all of them wanted to eliminate it.
Suggestions	Employing graduate students as assistants of the lecturers; Holding specialized workshops, seminars, and permanent communication with the Department of Bioinformatics; Issuance of statistical methodology certificate to biostatistics graduates to surveillance the thesis and dissertation statistical methodology. Holding a short-term compulsory internship, with students only facing job-related issues; Courses should be project-based and practical work with data (project-based classes).

Table 4. Educational Problems and Suggestions of PhD Graduates in Biostatistics

Area	Subject
Educational changes and programs	Some courses, such as statistical inference and survival data analysis in MSc and PhD degrees, are not so different, and it is better to offer these courses at the same time.
Add courses and schedules	Meta-analysis, data mining (big data), multivariate analysis, statistical software, simulation, coding skills, database training, metadata training, programming language training such as Python, SQL, and Oracle, machine learning, network training artificial neurology, artificial neural network, Markov chain, time series, professional behavior, emotional intelligence, genetic science, bioscience, bioinformatics, research methodology, advanced paper writing, should be added as optional courses.
Suggestions	Practical presentation of courses, especially survival analysis and clinical trial; Updating topics, holding mandatory workshops and seminars, and presenting projects; Providing courses that enhance the medical knowledge of statistical graduates such as epidemiologists so that they do not lose their job's position in the market; Changing the title of the course to "specific topics" and specifying its subject.

and random process from PhD level of biostatistics were declared as the least important courses of PhD level. Also, only less than half of the participants believe that the curriculum of both MSc and PhD levels can meet the career-related requirements.

Acknowledgments

This article has been done in the form of approved research plan No. 16432 in Iran University of Medical Sciences. Therefore, the researchers sincerely thank the officials of Iran University of Medical Sciences for their support and funding. We also appreciate all esteemed graduates of Tehran Universities of Medical Sciences for advocating the time and participating to make this study practical.

Footnotes

Authors' Contribution: Balooch: Collecting and analyzing the data; Roudbari: Analyzing the data and writing the paper.

Conflict of Interests: The authors declare no conflict of interests.

Ethical Approval: The study was approved by the Ethics Committee of IUMS with the ethics ID no (IR. IUMS. REC.1399.543).

Funding/Support: This article has been done in the form of approved research plan No. 16432 in Iran University of Medical Sciences. Therefore, the researchers sincerely thank the officials of Iran University of Medical Sciences for their support and funding.

References

- Maki PL. Developing an assessment plan to learn about student learning. *J Acad Librariansh.* 2002;**28**(1-2):8-13. doi: [10.1016/s0099-1333\(01\)00295-6](https://doi.org/10.1016/s0099-1333(01)00295-6).
- Hannani M, Khoramabadi H, Rastgar M, Motalebi-Kashani M. [The Views of Occupational Health Graduates Working in Kashan Iran on Compliance of Curriculum Content with Occupational Requirements]. *Stride Dev Med Educ.* 2016;**13**(1):84-91. Persian.
- Vogel D, Harendza S. Basic practical skills teaching and learning in undergraduate medical education - a review on methodological evidence. *GMS J Med Educ.* 2016;**33**(4):Doc64. doi: [10.3205/zma001063](https://doi.org/10.3205/zma001063). [PubMed: [27579364](https://pubmed.ncbi.nlm.nih.gov/27579364/)]. [PubMed Central: [PMC5003143](https://pubmed.ncbi.nlm.nih.gov/PMC5003143/)].
- Tam M. Outcomes-based approach to quality assessment and curriculum improvement in higher education. *Qual Assur Educ.* 2014;**22**(2):158-68. doi: [10.1108/qa-09-2011-0059](https://doi.org/10.1108/qa-09-2011-0059).
- Chiang CL. What is biostatistics? *Biometrics.* 1985;**41**(3):771-5. [PubMed: [4074826](https://pubmed.ncbi.nlm.nih.gov/4074826/)].

6. Shadfar H, Liaghatdar M], Sharif M. [Investigating Conformity Scope of Educational Planning and Administration Curriculum with Students Needs]. *J Res Plan High Educ.* 2012;**17**(4):123–46. Persian.
7. Entezari Y. *Knowledge-based Entrepreneurship Necessary Condition for Effective Employment of Graduates of Higher Education.* Tehran: Institute of Research and Planning in Higher education; 2006.
8. Woya AA. Employability among Statistics Graduates: Graduates' Attributes, Competence, and Quality of Education. *Educ Res Int.* 2019;**2019**:1–7. doi: [10.1155/2019/7285491](https://doi.org/10.1155/2019/7285491).
9. Martin JA, Carey RM. The student-initiated, faculty-assisted system of evaluation of clinical teaching at the University of Virginia. *Acad Med.* 1991;**66**(12):773–5. doi: [10.1097/00001888-199112000-00014](https://doi.org/10.1097/00001888-199112000-00014). [PubMed: [1750958](https://pubmed.ncbi.nlm.nih.gov/1750958/)].
10. Badger T, Rawstorne D. An evaluative study of pre-registration nursing students' skills in basic life support. *Nurse Education Today.* 1998;**18**(3):231–6. doi: [10.1016/s0260-6917\(98\)80084-1](https://doi.org/10.1016/s0260-6917(98)80084-1).
11. Abdelsalam M, Rodriguez TE, Brallier L. Student and Faculty Satisfaction with Their Dental Curriculum in a Dental College in Saudi Arabia. *Int J Dent.* 2020;**2020**:6839717. doi: [10.1155/2020/6839717](https://doi.org/10.1155/2020/6839717). [PubMed: [32322273](https://pubmed.ncbi.nlm.nih.gov/32322273/)]. [PubMed Central: [PMC7168716](https://pubmed.ncbi.nlm.nih.gov/PMC7168716/)].
12. Hennemann S, Liefner I. Employability of German Geography Graduates: The Mismatch between Knowledge Acquired and Competences Required. *J Geogr High Educ.* 2010;**34**(2):215–30. doi: [10.1080/03098260903227400](https://doi.org/10.1080/03098260903227400).
13. Wang Y, Tsai C. Employability of Hospitality Graduates: Student and Industry Perspectives. *J Hosp Tour Educ.* 2014;**26**(3):125–35. doi: [10.1080/10963758.2014.935221](https://doi.org/10.1080/10963758.2014.935221).
14. Roudbari M, Barfei F, Refa S. [Cooperation of Supervisor, Co-Supervisor, and Statistical Advisor with Thesis and Dissertations in Tehran University of Medical Sciences: Postgraduates' Viewpoints]. *Iran J Med Educ.* 2014;**13**(10):830–9. Persian.