RDME Research and Development in Medical Education
Res Dev Med Educ, 2017, 6(2), 87-93
doi: 10.15171/rdme.2017.018
http://journals.tbzmed.ac.ir/rdme
TUOMS Publishing Group

Assessment score comparison of knowledge and clinical reasoning of medical students educated by bedside or conference room teaching in internal medicine ward

Sayyed Gholamreza Mortazavi Moghadam[1*]

[1]Internal Medicine Department, Pulmonary Division, Birjand University of Medical Sciences, Birjand, Iran

Article info

Article Type:
Original Research

Article History:
Received: 25 Apr. 2017
Accepted: 10 Aug. 2017
epublished: 30 Dec. 2017

Keywords:
Bedside teaching, Conference room case presentations, MCQ exam, KF exam

Abstract

Background: Evidence shows that bedside teaching is declining in recent years. One reason is the expectation for students to earn credit. Here, the impact of education method on undergraduate assessment score will be tested.

Methods: This is a quasi-experimental study conducted with 66 undergraduate medical students who were allocated into two matched groups on the basis of a pulmonary pathophysiology course score in the internal medicine department of the Birjand University of Medical Sciences (Iran). Chronic obstructive pulmonary disease (COPD) was chosen as the theme of this education. After groups were allocated, training was conducted with 36 students using the Traditional Patient's Bedside Teaching (Tr-BT) method and for 30 students using the Conference Room Case Presentations (Cr-CP) method. Evaluation were conducted at the end of the three-month course period using the Multiple-Choice Questions (MCQ) and Key Feature (KF) examination. Data were analyzed using independent t tests, Mann-Whitney U, and the chi-square test.

Results: Among the collected student the scores of KF, inward ratings and MCQ examinations in intern vs extern were (8.58±1.46 vs 8.31±1.58; $P=0.65$), (14.75±1.54 vs 15.51±1.88; $P=0.08$),(10.77±2.20 vs 10.47±1.61; $P=0.55$) respectively. The mean of the pulmonary pathophysiology score was 13.03±1.66 in the Tr-BT group compared with 12.67±1.92 in the Cr-CP group ($P=0.23$). The means of the MCQ scores were 10.07±2.13 and 11.37±1.56 in the Tr-BT and Cr-CP groups, respectively ($P=0.007$).

Conclusion: The score of the MCQ exam was significantly higher in the group taught using the Cr-CP method. Students and teachers may prefer Cr-CP. To increase interest in bedside teaching, the assessment methods of medical students should be based on practical and clinical judgment evaluation.

Please cite this article as: Mortazavi Moghadam SG. Assessment score comparison of knowledge and clinical reasoning of medical students educated by bedside or conference room teaching in internal medicine ward. Res Dev Med Educ. 2017;6(2):87-93. doi: 10.15171/rdme.2017.018.

Introduction

Bedside teaching has been proposed as one of the ideal methods in medical education. Skills of history taking, physical examination, professional attitude and a comprehensive diagnosis and treatment approach to patients are instructed by this manner. In addition, students learn clinical reasoning and clinical problem solving at the bedside of patients.[1-4] While all human aspects are considered, a real patient provides an opportunity to be trained in real-world procedures.[5] While most doctors would agree that bedside teaching is a necessity in medical educations, in practice the subject is often ignored, so that in 1960 approximately 75% of medical education was conducted at bedside. This amount has now dropped to somewhere around 8% to 19%.[6] This is Sir William Osler's idea that "the best teaching is that taught by the patient himself" and "for the junior student in medicine and surgery it is a safe rule to have no teaching without a patient for a text."[7] When a student is faced with real patients, a situation with patient perception arises which can invoke patient care and improve the practice of medicine.[8] But what is now happening in most educational

***Corresponding Author:** Sayyed Gholamreza Mortazavi Moghadam, Email: gmortazavi@yahoo.com

institutions is that education is started at the bedside but the discussion is continued in a corridor or a conference room away from the patient. In other words, bedside rounds and medicinal practice is already being replaced with conference room case presentations currently. Several reasons are cited for the decline of bedside rounds and bedside teaching. One of the main reasons is the shift from patient-oriented medicine to rely on technology and testing to diagnose diseases.[6] However, a key issue, namely educational reasons, is not considered in this regard. Logically students are often concerned with how to achieve assessments in a competitive field. Multiple Choice Questions (MCQ), Key Feature (KF) clinical reasoning and Objective Structured Clinical Examination (OSCE) are main methods for assessing medical students in most academic arenas.[9,10] The impact of educational methods on the outcome of educational assessments has been less studied in educational institutions. A study was conducted to compare exam scores of students after training with one of 2 methods: structured bedside teaching or traditional bedside teaching indicated that the results are not different.[11] Structured bedside teaching is an educational modality designed to fill in gaps found in traditional bedside teaching in medical education. Since bedside learning is very important in the practice of medicine and students tend to be interested in teaching methods that they can earn better scores on exams, the present study was planned to compare the effect of 2 teaching methods, traditional patient's bedside and conference room case presentations, on the most common methods of knowledge and clinical reasoning assessments, including the MCQ and KF clinical reasoning examination respectively.

Materials and Methods

This quasi-experimental study was carried out at the Department of Internal Medicine Hospital affiliated with the Birjand University of Medical Sciences (BUMS) (South Khorasan province, Iran) during 2 consecutive semesters in the 2016 academic year.

Study design

Based on a census of 71 medical students who attended in internal medicine ward for completing the training course, all 71 were selected for the study. All students who passed their pulmonary pathophysiology course with the same teacher were included. Based on pulmonary pathophysiology course score (referred course score based on 20) similar students were placed pairwise. Then pairs were split into 2 similar groups (Figure 1). The object of the study was explained for each group separately. MCQ and KF clinical reasoning examinations were used for the evaluation of knowledge and clinical judgment regarding the theme of chronic obstructive pulmonary disease (COPD) as the topic of educational research. The MCQ exam contained 30 questions and KF contained 7 questions. Each question on the KF exam contained 16 priority options based on clinical decision making.

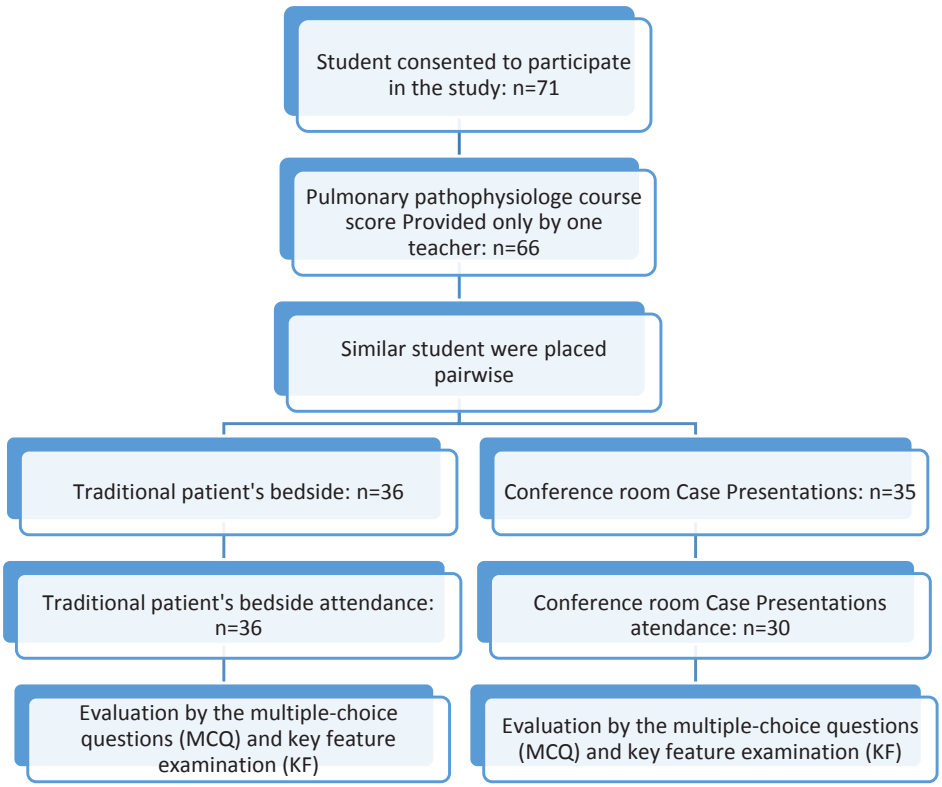

Figure 1. Study protocol flow chart.

MCQ and KF questions were approved by an expert at the Education Development Center (EDC) of the BUMS. Content validity of questions was reviewed and approved by 2 independent academic scholars in the Department of Internal Medicine. Due to specific issues, a post-exam split-half reliability test was used to measure the MCQ's internal consistency (Spearman-Brown coefficient value for internal consistency was 0.217). The opinions of 2 academic scholar referees were reviewed and coordinated with the designer of the KF questionnaire to achieve acceptable validity and their agreement in determining the most correct answer (Inter-rater reliability >66%) to achieve acceptable reliability in KF questionnaire. Scores were awarded for each question in the MCQ exam of 0 or 0.66 and the total possible score was 20. In the KF exam, 4 of 16 items with the greatest accuracy must be selected by students. The score for each greatest accuracy answer was 0.72. The score for other options apart from the correct answers up to 4 options was zero. A negative score (-0.72 score) was calculated for every wrong answer with more than 4 elections to avoid distortion of replies. Therefore, no more than 4 options were chosen by students for each question on the KF exam. Finally a score was calculated for each question on the KF exam calculated on the basis of 2.88 and the total score of the KF questionnaire was implemented based on 20. Clinical ward score and pathophysiology scores were also taken into account at a maximum of 20.

Intervention

COPD was chosen as the theme of education and evaluation for the present study. Concomitant routine educational programs in the ward were also held for both groups. Additional training for COPD independent of routine ward curriculum was conducted for one group (36 students) using traditional patient's bedside teaching and for the other group (30 students) lessons were presented by the conference room case presentations method. To start the program in both methods, one student attended the COPD patient's bedside, took the history, carried out the physical examination, collected para-clinical records and became familiar with the prescribed medications. The collected data was then presented in the conference room apart from the patient bedside or at the bedside of the patient based on the educational method. Training in the internal medicine department is carried out over a 3-month period and all education programs continued during the period concomitant with the topic of research. In the traditional patient's bedside teaching manner, COPD training was conducted at the patient's bedside round regarding all aspects of the patient suffering from COPD and/or concurrent diseases. In each training round the following items were discussed: (1) History taking and physical examination; (2) Diagnostic approach to the patient; (3) Para clinical interpretation recorded in the documents of patients; (4) Medications information about prescribed medications for the patient; and (5) Provision of self-care education to the patient. In each round various issues related to the case (the package of patient problems including COPD and other comorbidities) were considered and discussed, so a long time was spent to complete the related topic of COPD. Topics related to COPD were completed during 4 consecutive rounds (1.5 hours for each round for a total of 6 hours). The students were divided into 3 groups (12 students in each group). In the conference room case presentations methods the case presentation and education program was conducted in the conference room away from the patient bedside. A case of COPD was presented and topics related to COPD were discussed and completed in the conference room in one meeting session (1.5 hours with the participation of all student in one session). The students' training activities and self-education were conducted freely in both groups. Evaluations were conducted by the MCQ and KF clinical reasoning examination (all questions related to COPD) at the end of the 3-month period Independent of the routine ward exam. The mean score of the students obtained from all topics of educational programs in the ward was also compared to ensure matching of the 2 groups. Gender, ward educational curriculum and educational level of the student were considered as potential confounders. Stratified analysis by comparing difference in frequency or means of confounders between 2 studied groups was used to remove these effects.

Statistical analysis

Data were analyzed using SPSS 23. Normality and variance homogeneity were tested using the Kolmogorov–Smirnov and the Levene tests. The Spearman-Brown coefficient value was used to test for internal consistency of MCQ questionnaire. Independent *t* tests for data with normal and Mann-Whitney U test for non-normal distribution were carried out in the data analysis. Chi-square test was used to compare difference in frequencies between groups. *P* values of less than 0.05 were considered significant at a 95% CI.

Results

During 6 months, 66 undergraduate students, including 24 (36.4%) male and 42 (63.6%) female were enrolled in a study. Interns and externs were included 25 (37.9%) and 41 (62.1%) respectively. No differences in frequency in gender or educational level (as confounder factors) were observed between 2 studied groups (Table 1). Because of personal problems, 2 of the students (intern) did not participate in the final ward assessment, but participated in all programs of training and assessment related to theme of the research. Among participants, 36 students (54.5%) were trained by traditional patient's bedside teaching manner. Among student allocated to the conference room case presentations method group, five did not attend in class and were excluded from the study, and the remaining 30

Table 1. Demographic characteristic in traditional patient bedside (n = 36) and conference room case presentations teaching method (n = 30) group

Demographic character	Traditional bedside teaching	Conference case presentation	Total	Chi-square test	*P* value
Gender, No. (%)				0.218	0.64[a]
Male	14 (58.3)	10 (41.7)	24 (100)		
Female	22 (52.4)	20(47.6)	42 (100)		
Education level, No. (%)				1.80	0.17[a]
Intern	11 (30.6)	14 (46.7)	25 (100)		
Extern	25 (69.4)	16 (53.3)	41 (100)		

[a] Adjustment for gender and educational level confounder in 2 studied groups.

Table 2. Comparison of mean scores between students trained by traditional patient bedside and conference room case presentations method

Type of assessment	Number	Score (Mean±SD)	Mean difference	95% CI of the difference Lower/Upper	*t* or Z value	*P* value
MCQ						
Total	66	10.66±1.99				
Tr-BT	36	10.07±2.13	1.30	0.36/2.24	t=2.78	0.007
Cr-CP	30	1.37±1.56				
KF						
Total	66	8.48±1.50				
Tr-BT	36	8.56±1.50	-0.18	-0.93/0.55	Z=-0.54	0.58
Cr-CP	30	8.37±1.52				
WR						
Total	64	15.02±1.69				
Tr-BT	34	15.05±1.80	-0.05	-0.9/-0.8	t=-0.12	0.90[a]
Cr-CP	30	15±1.60				
Pathophysiology score						
Total	66	12.70±1.78				
Tr-BT	36	13.03±1.66	-0.33	-1.18/0.51	z=-1.18	0.23
Cr-CP	30	12.67±1.92				

Abbreviations: Tr-BT, Traditional Patient's Bedside Teaching; Cr-CP, Conference room Case Presentations; MCQ, Multiple Choice Questions; KF, Key Features clinical reasoning examination; WR, Ward Rating score.
[a]adjustment for clinical ward educations in two studied groups.

student (45.5%) remained in the group. The overall score and scores in each experimental group are shown in Table 2. The MCQ score was significantly higher in the group of conference room case presentations methods (Table 2). The ward rating scores (as one confounder factor) in the traditional bed side teaching and conference room case presentation method were 15.05±1.80 and 15±1.60 respectively (P=0.90). Scores on the KF clinical reasoning, ward ratings, and the MCQ exam showed no difference between interns and externs (Table 3). There was also no difference in assessment scores of all evaluation topics between men and women in the study (Table 4).

Discussion

In comparing scores of various evaluations in the present study, ward ratings of the studied students had the highest score. In this regards, no significant difference was observed between the traditional patient bedside and conference room case presentations teaching method. Ward rating scores are based on collective opinions of several training providers. It seems that diverse views of several training providers reduce the validity and reliability of student evaluations.[12] In a qualitative study conducted with students by Calman and colleagues, they claimed that clinical assessment instruments pay little attention to clinical skills.[13] Chapman believes that overcoming mental judgments in medical students' clinical competency evaluation are difficult.[12]

Students taught with the conference room case presentations teaching method earned higher scores in the MCQ exam than those trained with traditional patient bedside teaching manner. However, the results sometimes overlapped and more people are needed to differentiate the methods more precisely. In a study carried out by Landry et al, they conclude that students are more comfortable asking questions in a classroom setting and getting an answer.[14] In this sense, it seems that case presentations in the conference room setting provides more opportunities

Table 3. Comparison of mean scores between intern and extern students

Type of assessment	Extern number, score (mean±SD)	Intern number, score (mean±SD)	Mean difference	95% CI of the difference Lower/Upper	*t* or Z value	*P* value
MCQ	41, 10.77±2.20	25, 10.47±1.61	0.30	-0.71/1.31	t=0.59	0.55
KF	41, 8.58±1.46	25, 8.31±1.58	*0.27*	-0.49/1.04	Z=-0.4	0.65
WR	41, 14.75±1.54	23, 15.51±1.88	-0.75	-1.62/0.11	t=-1.73	0.08
Path.ph	41, 13.25±1.72	25, 12.14±1.76	0.95	0.11/1.79	Z=-2.18	0.02

Abbreviations: MCQ, Multiple Choice Questions; KF, Key Features clinical reasoning examination; WR, Ward Rating score; Path.ph, Pathophysiology score.

Table 4. Comparison of mean scores between male and female students

Type of assessment	Male number, score (mean±SD)	Female number, score (mean±SD)	Mean difference	95% CI of the difference Lower/Upper	*t* or Z value	*P* value
MCQ	24, 10.69±2.05	42, 10.64±1.97	-0.04	-1.06/0.98	t = 0.08	0.93
KF	24, 8.35±1.49	42, 8.55±1.52	0.19	-0.58/0.96	Z = -0.75	0.45
WR	22, 15.34±1.64	42, 14.86±1.72	-0.47	-1.37/0.41	t = -1.06	0.28
Path.ph	24, 12.64±1.75	42, 13.02±1.83	0.37	-0.50/1.25	Z = -1.06	0.28

Abbreviations: MCQ, Multiple Choice Questions; KF, Key Features clinical reasoning examination; WR, Ward Rating score; Path.ph, Pathophysiology score.

for students to be more successful in their MCQ exam. Currently, in most educational institutions, most exams are held using the MCQ exam.[15] There are several reasons for this institutional orientation to the MCQ exam. When students are confronted with the well-designed MCQ, application of knowledge and problem-solving skills will be assessed in an acceptable and consistent level.[9] Other advantages include encompassing wider dimensions of knowledge, minimum impact of examiner, targeted, and good ability to compare students.[16] Therefore if the MCQ exam is going to be carried out in educational institutions to assess a student's educational status, learning by conference room case presentations method appears to be a more useful method for student to be more successful in their exams. In a study conducted by Chéron et al, it was suggested that students prefer case-based teaching and the MCQ exam.[17] Case-based teaching in Chéron and colleagues' study is partly in accordance with the conference room case presentations method in our study.

The mean score of the KF clinical reasoning exam in the group trained by the traditional patient bedside teaching manner was higher than the group educated by the conference room case presentations method. But the difference was not statistically significant. The KF Question is one type of curriculum evaluation that is used to assess clinical reasoning and clinical judgment in medical students. Fischer et al believes that the KF Questions is a reliable method for clinical competency evaluation.[10] The KF exam can be designed with varying numbers of questions and is able to distinguish between the experienced and the beginner student.[18] The KF exam is generally seen as an appropriate method of clinical reasoning evaluation and able to predict clinical practice authority in the future, although it is not possible to evaluate all clinical aspects by this method.[18] Higher scores on the KF exam can be a sign of being a more efficient physician in clinical practice in the future. One thing that should not be forgotten is lack of popularity of this type of exam and also relying on classroom-based student learning in most educational institutes, including this teaching hospital. Therefore, if the student and educational institutional experiences are improved with this type of exam, more accurate and more reliable results will be obtained. Some studies that have been conducted in the United States, Canada and the United Kingdom show that when students are trained in heart murmurs at bedsides of patients will have better performance in detecting heart murmurs than when they learn this practice by sound simulation out of the bed.[19-21] It is assumed that more experience in clinical practice, must be accompanied by better scores on the KF exam in interns in comparison with externs.[18] However, this was not true in our study and there was no difference in KF exam scores between externs and interns. One reason may be that our students have less exposure in a clinical setting at bed side and thus do not learn clinical reasoning in practice during their externship. It was pointed out by some studies that bedside teaching practice has significantly declined in recent years.[1] The status in the study's teaching hospital somewhat is similar to other educational institutions and so clinical experience of interns is not expected to be different from that of externs. Time spent in engaged in the traditional patient's bedside teaching manner was much higher. Clinical teachers argue that they do not have enough time to teach at the bedside. In addition, time constraints on behalf of students lead to less interest in students' attendance at the bedside.[1] Overall, if the assessment is supposed to be conducted on the basis of multiple-choice questions, both teachers

and students will prefer education by the conference room case presentations method. However, unwanted effects of conference room case presentations will be surface rather than deep education and training.[22] The researchers suggest that a combination of knowledge and practice evaluation methods should be applied in medical student assessment.[23]

Incorporation of interns and externs in the study groups could lead to bias in the study. According to non-significant difference in frequencies between interns and externs in the current study's groups, this effect is minimal. That issue can also partly be adjusted by statistical analysis on gender. The overall mean scores in evaluations of clinical ward education did not differ significantly between the 2 study groups, so the effect of this confounder is also minimal.

In addition to COPD in the present study, the internal medicine ward training encompassed several dimensions of education. Therefore, in the perspective of a broad spectrum of education and, of course nil impact of research topic (COPD) education programs on the assessment score of ward rating, the ward rating score could not be used to compare the 2 groups for the final outcome. However, the lack of statistically significant differences between the scores of ward assessments in the 2 groups of study students can prove relatively matched conditions. The 2 groups were matched on the basis of the pulmonary pathophysiology lesson scores. In fact, similarity between the 2 study groups in the ward educational curriculum and finally lack of statistically significant differences between the scores of ward assessments in the 2 groups minimizes the confounding effect of ward educational program on research results.

The attendance of all students in programs at the same time was a limitation. The problem was solved by putting the students in groups of their choice in traditional bed side teaching manner. But in the conference room case presentations group, five students were unable to attend in the classes and therefore were excluded from the study after selection. Concomitant attendance of externs and interns in study groups and concomitant implementation of ward education courses were other limitations. One additional limitation was selecting just one topic of educational program (COPD) for research and so restrictions in designing large number of questions to maximize reliability of questionnaire. Finally we need to have a larger population and broader issues of educational topics for more precise results.

Conclusion

The score of the KF exam was not statistically different in 2 groups of student with 2 methods of education. Although they are overlapped, the score of the MCQ exam was significantly higher in the student group using the conference room case presentations method than in those using the traditional patient's bedside teaching manner. In addition, students spent less time in the conference room case presentations method. This means that if students must be evaluated and compared by the MCQ exam, they would prefer to be taught by conference room case presentations method, something that would not be appropriate in all practical terms in medical education but is less time consuming and more convenient for teachers and students. The suggestion is to emphasize practical and clinical judgment assessment instead of only knowledge evaluation in determining a student's certification. In addition it is appropriate to suggest conducting a study on a larger population, with similar educational levels and also with similar, and broader, educational topics.

Ethical approval

The project was approved by the Research Committee of Birjand University of Medical Sciences (No. 1134). The methods of our study were also reviewed and approved by Birjand University of Medical Sciences Ethics Committee (Ethical code: IR.BUMS.REC.1394.398).

Competing interests

There are no competing interests to declare.

Acknowledgments

The founding support for the present research was provided by the research committee of Birjand University of Medical Sciences. It is necessary to thank the supporting institution, the students who participated in this study and also Ms. Ramezani, Kh.N (an expert on Medical Education Development Center in Birjand University of Medical Sciences) who provided helpful guidance on writing proposals. It is also necessary to thank the faculty member's referee and students who helped to run the program.

References

1. Crumlish CM, Yialamas MA, McMahon GT. Quantification of bedside teaching by an academic hospitalist group. J Hosp Med. 2009;4(5):304-7. doi: 10.1002/jhm.540.
2. Salam A, Siraj HH, Mohamad N, Das S, Rabeya Y. Bedside teaching in undergraduate medical education: issues, strategies, and new models for better preparation of new generation doctors. Iran J Med Sci. 2011;36(1):1-6.
3. Qureshi Z, Maxwell S. Has bedside teaching had its day? Adv Health Sci Educ Theory Pract. 2012;17(2):301-4. doi: 10.1007/s10459-011-9308-1.
4. Qureshi Z. Back to the bedside: the role of bedside teaching in the modern era. Perspect Med Educ. 2014;3(2):69-72. doi: 10.1007/s40037-014-0111-6.
5. Bokken L, Rethans JJ, Scherpbier AJ, van der Vleuten CP. Strengths and weaknesses of simulated and real patients in the teaching of skills to medical students: a review. Simul Healthc. 2008;3(3):161-9. doi: 10.1097/SIH.0b013e318182fc56.
6. Peters M, Ten Cate O. Bedside teaching in medical education: a literature review. Perspect Med Educ. 2014;3(2):76-88. doi: 10.1007/s40037-013-0083-y.
7. Ramani S. Twelve tips to improve bedside teaching. Med Teach.2003;25(2):112-5.doi:10.1080/0142159031000092463.

8. Schmidt HG, Rikers RM. How expertise develops in medicine: knowledge encapsulation and illness script formation. Med Educ. 2007;41(12):1133-9. doi: 10.1111/j.1365-2923.2007.02915.x.
9. Al-Wardy NM. Assessment methods in undergraduate medical education. Sultan Qaboos Univ Med J. 2010;10(2):203-9.
10. Fischer MR, Kopp V, Holzer M, Ruderich F, Junger J. A modified electronic key feature examination for undergraduate medical students: validation threats and opportunities. Med Teach. 2005;27(5):450-5. doi: 10.1080/01421590500078471.
11. Hill DA, Lord RS. Complementary value of traditional bedside teaching and structured clinical teaching in introductory surgical studies. Med Educ. 1991;25(6):471-4.
12. Chapman H. Some important limitations of competency-based education with respect to nurse education: an Australian perspective. Nurse Educ Today. 1999;19(2):129-35.
13. Calman L, Watson R, Norman I, Redfern S, Murrells T. Assessing practice of student nurses: methods, preparation of assessors and student views. J Adv Nurs. 2002;38(5):516-23.
14. Landry MA, Lafrenaye S, Roy MC, Cyr C. A randomized, controlled trial of bedside versus conference-room case presentation in a pediatric intensive care unit. Pediatrics. 2007;120(2):275-80. doi: 10.1542/peds.2007-0107.
15. Al-Rukban MO. Guidelines for the construction of multiple choice questions tests. J Family Community Med. 2006;13(3):125-33.
16. Gajjar S, Sharma R, Kumar P, Rana M. Item and Test Analysis to Identify Quality Multiple Choice Questions (MCQs) from an Assessment of Medical Students of Ahmedabad, Gujarat. Indian J Community Med. 2014;39(1):17-20. doi: 10.4103/0970-0218.126347.
17. Chéron M, Ademi M, Kraft F, Loffler-Stastka H. Case-based learning and multiple choice questioning methods favored by students. BMC Med Educ. 2016;16:41. doi: 10.1186/s12909-016-0564-x.
18. Hrynchak P, Takahashi SG, Nayer M. Key-feature questions for assessment of clinical reasoning: a literature review. Med Educ. 2014;48(9):870-83. doi: 10.1111/medu.12509.
19. Gale CP, Gale RP. Is bedside teaching in cardiology necessary for the undergraduate education of medical students? Med Educ. 2006;40(1):11-3. doi: 10.1111/j.1365-2929.2005.02357.x.
20. Favrat B, Pecoud A, Jaussi A. Teaching cardiac auscultation to trainees in internal medicine and family practice: does it work? BMC Med Educ. 2004;4:5. doi: 10.1186/1472-6920-4-5.
21. Sverdrup O, Jensen T, Solheim S, Gjesdal K. Training auscultatory skills: computer simulated heart sounds or additional bedside training? A randomized trial on third-year medical students. BMC Med Educ. 2010;10:3. doi: 10.1186/1472-6920-10-3.
22. Newble D. Revisiting 'The effect of assessments and examinations on the learning of medical students'. Med Educ. 2016;50(5):498-501. doi: 10.1111/medu.12796.
23. Epstein RM. Assessment in medical education. N Engl J Med. 2007;356(4):387-96. doi: 10.1056/NEJMra054784.