Comparison of emergency medical residency pre-board and board exams among universities of medical sciences in Iran

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Abstract

Background: Designing and conducting residency exams have been the province of type I universities since 2005, based on the plans of the Medical Education Council. This study compared emergency medical residency pre-board and board exam results among the universities of medical sciences in Iran.

Methods: This cross-sectional descriptive study consisted of 600 questions from residency pre-board exams and 150 questions from board exams in 2013-2014, as well as 600 questions from residency promotion exams and 150 questions from the board exam in 2013-2014 and 2014-2015 at the Tabriz, Shahid Beheshti, Mashhad, and Tehran Universities of Medical Sciences. All questions were at the level I through III by Bloom's taxonomy. Structural principles were evaluated using Millman's checklist. All data were analyzed using SPSS 18 with chi-square tests.

Results: The mean percent of more contextualized questions of the questions at Bloom's taxonomy levels II and III in residency pre-board exam questions was 76.6% in 2013-2014 and 86.6% in 2014-2015 among the four universities. In terms of structural principles, the percentage of board exam questions that aligned with Millman's structural principles was 100.0% and 99.3% in 2013-2014 and 2014-2015, respectively. For the residency pre-board exam in 2014-2015, the mean discrimination index was 0.14 (low), and the mean of the difficulty factor was 0.64 (appropriate).

Conclusion: Questions at Bloom’s taxonomy levels II and III were higher in 2014-2015 in comparison to those in 2013-2014, and the percentage of the correctly-structured questions was high and did not significantly change from 2013-2014 in comparison to that of 2014-2015.
significantly reduces the power and performance of this type of test. The more questions are used in the design of the test, the more correct the taxonomy will be, resulting in more useful results to support the purpose of the test, which is to measure student attainment and knowledge retention. One method for the preparation of theoretical questions is MCQs, for which Millman has created a checklist to evaluate question design accuracy.

The taxonomy of an exam question is a classification in which the level of testable knowledge is measured. Its stages are Simple Reminder (Level I), Interpretation of information (Level II), and Problem Solving and Application (Level III). In this research, questions designed in Level I are questions with low taxonomy, and questions designed with Levels II and III are questions with high taxonomy. Questions with a higher taxonomy assess more profound understanding of the topic and thus will be of greater importance in measuring knowledge. In Iran, these tests consist of two parts: written and oral, with a four-question written test.

Many studies have been conducted in various fields of medical sciences to examine multiple-choice question: for example, in the research. There was a significant percentage of questions in the four-question Structural Error Exam, and over 90% of the questions in the current study had low cognitive taxonomy. Moreover, studies have also shown that only 6.5% of the items in the Nursing School Questionnaire were designed at Level III. In-country studies also show similar conditions, such that in the studies of Haghshenas and colleagues in Mazandaran, Shakournia and colleagues in Ahvaz a considerable number of questions (54% and 34/8% respectively) had structural problems. Shakournia et al in Ahvaz and Bighlarkhani et al in Hamadan found that most of the questions in the studied medical universities had lower levels of taxonomy: 89.4%, and 68.3%, respectively, and more than 75% of the questions were rated at low cognitive level.

Encyclopedia exams, and promotion of clinical disciplines in medical education residency courses, are conducted annually as a type of certification assessment used to rank and decide the promotion of assistants to higher years or to obtain a degree to serve the community. Since 2006, according to the Secretariat of the Medical and Specialty Education Council, designing and holding exams for promotion of clinical assistantships has been entrusted to type I medical universities to increase the participation of faculty members of medical departments of medical universities of the country, towards the independence of universities, the generalization of the transfer of educational powers. Thus it is necessary to review and evaluate this process (designing questions and conducting university promotion tests).

The purpose of this study was to compare items on the written promotion exams (2013 and 2014) of Emergency Medicine at the Tabriz, Tehran, Shahid Beheshti, and Mashhad Universities of Medical Sciences, with the encyclopedia exam given in the same years, and compare them with the Emergency Medicine Certificate Exam in the same year. For years, particular attention has been paid to quality improvement management and intra-university examinations.

**Materials and Methods**

In this cross-sectional descriptive study, the samples consisted of 600 questions from residency promotion exams and 150 questions from the board exam in 2013-2014, as well as 600 questions from residency pre-board exams and 150 questions from the board exam in the year 2014-2015 at Tabriz, Shahid Beheshti, Mashhad, and Tehran Universities of Medical Sciences. Sampling was done by a census of all questions in each year. The questions were evaluated using 12 items in Millman's checklist, including stem clearness, negative options for stem, specific options, contrastive options, positive words in stem and options, writing structure of stem, duplicated options, spelling of stem and options, vertical writing of options, positivity of stem and options, and use of the "all of the above" and "none of the above" phrases in options. All questions were found to be at Levels I through III of Bloom's taxonomy and were evaluated independently by two experts in the related fields of medical education and research (including a board member of the pediatric subspecialties holding a master's degree in medical education). Guidelines were sent for each faculty member (experts) to ensure the correct understanding of the taxonomy in order to classify questions based on taxonomic definitions: Level I- ability to recall facts (memories), Level II- ability to interpret information, and Level III- ability to solve a new problem.

If two experts disagreed in their determination of the taxonomy level of an item, a third assessor (specialist in the field and experienced test designer) examined the same item to make a final judgment. Respecting Millman's structural principles, the project manager studied the adjusted checklist. In terms of budgeting, the chapters related to each question were determined and matched with reference books by the project manager. The discrimination index and difficulty factor of promotion questions were obtained from the Tabriz University of Medical Sciences, and the results were compared.

**Results**

**Frequency and taxonomy in the pre-board and national board exam of emergency medicine**

Table 1 shows the frequency and taxonomy in the emergency medicine pre-board exam at the four universities in the years 2013-2014 and 2014-2015 as well as national board exam questions in the same years. The table indicates the frequency and percentage of questions with or without problems (based on Millman's checklist). In 2013, Shahid Beheshti University of Medical Sciences
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Table 1. Taxonomic distribution of questions in written pre-board exam of emergency medicine at the universities studied 2013-2014 and national board exam in the same year

<table>
<thead>
<tr>
<th>University</th>
<th>Exam type</th>
<th>Questions structure</th>
<th>Questions taxonomy</th>
<th>Questions taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahid Beheshti</td>
<td>Pre-board,2013</td>
<td>140 (95.2)</td>
<td>No. %</td>
<td>7 (4.8)</td>
</tr>
<tr>
<td>Shahid Beheshti</td>
<td>Pre-board,2014</td>
<td>148 (97.4)</td>
<td>No. %</td>
<td>4 (2.6)</td>
</tr>
<tr>
<td>Mashhad</td>
<td>Pre-board,2013</td>
<td>148 (98.7)</td>
<td>No. %</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td>Mashhad</td>
<td>Pre-board,2014</td>
<td>148 (98.7)</td>
<td>No. %</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td>Tehran</td>
<td>Pre-board,2013</td>
<td>148 (98.7)</td>
<td>No. %</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td>Tehran</td>
<td>Pre-board,2014</td>
<td>144 (96)</td>
<td>No. %</td>
<td>6 (4)</td>
</tr>
<tr>
<td>Tabriz</td>
<td>Pre-board,2013</td>
<td>148 (98.7)</td>
<td>No. %</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td>Tabriz</td>
<td>Pre-board,2014</td>
<td>136 (90.7)</td>
<td>No. %</td>
<td>14 (9.3)</td>
</tr>
<tr>
<td>National board</td>
<td>2013</td>
<td>152 (100)</td>
<td>No. %</td>
<td>0</td>
</tr>
<tr>
<td>National board</td>
<td>2014</td>
<td>151 (99.3)</td>
<td>No. %</td>
<td>1 (0.7)</td>
</tr>
</tbody>
</table>

had 120 questions (81.6%) in the pre-board exam that were more contextualized according to Levels I and II than the other universities, while the Tehran University of Medical Sciences, with 108 questions (72.0%) in the pre-board exam, had less than other universities.

Most similarities between pre-board exams in 2013 and the national board exam the same year in terms of difficulty of questions belonged to Shahid Beheshti University of Medical Sciences. In 2014, the Shahid Beheshti University of Medical Sciences had 136 questions (89.5%) in the pre-board exam that were more contextualized questions according to Levels I and II than the other universities, while the Tehran University of Medical Sciences, with 121 questions (80.7%) in the pre-board exam, had less than other universities. The Shahid Beheshti University of Medical Sciences had the most similarities between their pre-board exam in 2014 and the national board exam in the same year in terms of question difficulty.

“Budgeting” questions in the pre-board and national board exam of emergency medicine

The number of questions per topic on the national board exam with written pre-board exams at the four universities compared, henceforth referred to as “budgeting” questions.

Emergency medicine, Shahid Beheshti Medical University

In 2013-2014, most of the questions on the pre-board exam for Emergency Medicine at Shahid Beheshti Medical University were on medicine and surgery topics (48, 32.0%), and trauma (23, 15.3%), and heart and specific procedures had the least (1, 0.7%). In 2014-2015, most questions were devoted to medical and surgical topics (49, 32.7%) and trauma topics (28 items, 18.7%), and evidence-based medicine and musculoskeletal and neurological procedures had the least (1, 0.7% of the total).

Emergency medicine, Tehran Medical University

In 2013-2014, most of the questions on the pre-board exam of Emergency Medicine at the Tehran University of Medical Sciences were on medicine and surgery topics (49, 32.7% of the total) and trauma (22, 14.7% of the total) and evidence-based medicine and anesthesia techniques had the least (1, 0.7% of the total). In 2014-2015, most questions were devoted to medical and surgical topics (51, 34.0%) and trauma (33, 22.0%), and gastrointestinal, respiratory procedures, and musculoskeletal and neurological procedures had the least (1, 0.7% of the total).

Emergency medicine, Tabriz Medical University

In 2013, most of the questions on the pre-board exam of Emergency Medicine at Tabriz Medical University were on medical and surgical topics (49, 32.7%) and trauma (22, 14.7%) and neurological and soft tissue procedures and preparedness for disasters had the least (1, 0.7%). In 2014, most items were devoted to medical and surgical topics (31, 20.7%) and trauma (24, 15.8%) and neurological and soft tissue procedures, and American Heart Association (AHA) had the least (1, 0.7%).

National board exam of emergency medicine

In 2013, most of the questions on the national board exam
of emergency medicine were from medicine and surgery topics (60, 39.5%) and trauma (24, 15.8%) and neurological and soft tissue procedures and gynecology had the least (1, 0.7%). In 2014, most questions were devoted to medical and surgical topics (50, 32.9%) and trauma (23, 15.1%), and neurological and soft tissue, heart, and gynecology procedures had the least (1, 0.7%).

**Discrimination index and difficulty coefficient of questions in the written pre-board exam at Tabriz University of Medical Sciences**

The average discrimination index and difficulty factor of the questions were examined for the written pre-board exam questions from emergency medicine at the Tabriz University of Medical Sciences in 2013-2014 and 2014-2015. In 2013, the discrimination index average was 0.18, and the mean difficulty factor was 0.64. In 2014, the discrimination index average was 0.14, and the mean difficulty factor was 0.64 (Figure 1).

**Response pattern in written pre-board exams at the Tabriz University of Medical Sciences**

In 2013-2014, in pre-board exam questions from Emergency Medicine at the Tabriz University of Medical Sciences, the number of questions that had all four options selected totaled 40. These questions are more reliable than other questions in terms of design because examinees chose all four options. That is, these questions were more difficult for examinees in terms of question design. To continue, the number of questions that had three options selected was 59, and the number of questions with two options selected was 40. In 2014-2015, the numbers were similar: 39, 58, and 39, respectively.

**Discussion**

For this study, the researcher made a qualitative and quantitative comparison of written residency pre-board exams in Emergency Medicine at the Tabriz, Tehran, Mashhad, and Shahid Beheshti Universities of Medical Sciences as well as the national board exam in 2013-2014 and 2014-2015.

Frequency and taxonomy for the pre-board and national board exams of Emergency Medicine showed that in 2013-2014, the average of Level II and Level III questions in the promoting exam questions across all four universities was 76.6% in 2013-2014 and 86.6% in 2014-2015. The statistics show more contextualized questions and an increase in questions at Levels II and III. For the emergency medicine questions of the national board exam in both 2013-2014 and 2014-2015, the Levels II and III averages were 91.4% and 92.8%, respectively. In one study, Mohagheghi et al evaluated written pre-board exam questions and found that 38.7 ±18.9% of questions were designed at Levels II and III in 25 specialized clinical fields in 2007. These figures were 45±19.3 and 56±15.5 percent in 2008 and 2009, respectively, and indicate a growing trend of questions in terms of higher taxonomy levels. Shakournia et al, in a study of 2400 residency exam questions at Jundishapur University of Medical Sciences, found that more than two-thirds of the questions were at Level I and only 28% were at Levels II and III. In a study conducted by Sanagoo et al in the nursing field, 523 questions (fewer than 5%) were at Levels II and III. However, as mentioned, this number has an upward trend.

In the present study, comparing promotion exam questions in emergency medicine at the aforementioned universities showed an increase in the number of questions at Levels II and III between the years 2013-2014 and 2014-2015. Questions at Levels II and III increased from 114 (76%) to 134 (89.3%) at Mashhad University of Medical Sciences; from 115 (76.7%) to 130 (86.7%) at Tabriz University; from 108 (72%) to 121 (80.7%) at Tehran University; and from 120 (81.6%) to 136 (89.5%) at Shahid Beheshti University. At 13.3%, Mashhad University of Medical Sciences had the highest increase in designing more contextualized questions. In 2014-2015, the promotion exam questions, in terms of difficulty, were more similar to the national board exam in the same year: the number of questions at either Level II or III was 141 (92.8%). In this respect, the questions designed at Shahid Beheshti and Mashhad Universities of Medical Sciences were most similar to the questions in the national board exam.

In Sayyahmelli and colleagues’ study comparing the promotion exam questions at Tabriz University of Medical Sciences in 2000 and 2001 in internal medicine, pediatrics, general surgery and gynecology, a significant improvement in designing questions at more profound levels of learning Levels II and III was noticed, indicating improved skills of faculty members in designing questions. If exam questions only require the memorization of answer, students will be encouraged to memorize; however, if the question requires a need to interpret or solve a problem, students are encouraged to think critically and apply knowledge.

The exam questions were also examined in terms of structural problems of design. In 2013-2014 and 2014-2015, the questions on the national board exam of
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Mazandaran University noted that holding workshops has emphasized the need for more training courses, educational groups be organized to help improve these exams through continuous assessment of teaching proper design of questions accompanied by clear, objective, and applied use of questions designed on the residency exam for each department in order to obtain feedback during the workshop. Meyari et al. found that holding workshops on teaching proper design of questions accompanied by clear, objective, and applied examples was useful.

Overhauling memory-based questions is a longstanding problem in the medical education system. It can be said that this problem was seen in almost all exams at all educational levels. This situation pushes students to
acquire knowledge that is shallow and easily memorized. One of the reasons for the over-use of such knowledge level questions is that such questions are efficiently designed compared to higher levels of the taxonomy. However, in recent years, a considerable number of questions have been designed at more cognitively complex levels due to the emphasis of the Council of Medical Specialties in the Ministry of Health. Efforts of the learning management system have been effective in encouraging designers to prepare questions.

Ethical approval
This article is the result of a master’s thesis approved by the Department of Medical Education, which has passed the approval process according to the approvals of Tabriz University of Medical Sciences. This study did not have specific ethical considerations.

Competing interests
The authors declare that there is no conflict of interest.

Authors’ contributions
Data collection was done by FR, AG and AHJ. Data were analyzed by MR, AHJ and RG. The manuscript was written by AHJ and RG and manuscript edition was done by HS and SE. Final confirmation of this article was done by AHJ, HS and SE.

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