

# MODIFICATION OF THE BASE OF TEST EXAM QUESTIONS FROM THE "GYNAECOLOGY AND OBSTETRICS" COURSE FOR EMERGENCY MEDICINE STUDENTS AS A FORM OF IMPROVEMENT OF AN E-EXAM

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## Abstract

Background: Beginning in the academic year 2014/2015, it is possible to get a credit and pass a test exam at Warsaw Medical University using the ASK Systems e-exam platform. An e-exam will be handled properly only if the base of test questions is prepared earlier and it includes a proper number of questions of appropriate easiness and differentiation power.

In the summer session of the academic year 2014/2015, the "Gynaecology and Obstetrics" course for the third year Bachelor's students of Emergency Medicine at the Faculty of Health Sciences, Medical University of Warsaw, is one of the courses that is supposed to end with an e-exam.

Aim of study: The aim of the study was to assess the quality of test questions referring to emergency medicine prepared in order to improve the test exam for the "Gynaecology and Obstetrics" course for the third year Bachelor students of Emergency Medicine at the Medical University of Warsaw.

Material and Methods: 35 test questions, close-ended questions, 4 answer options, only one correct answer.

A detailed analysis of the test questions used in the following years: 2009/2010, 2010/2011, 2012/2013. A comparison of easiness and differentiation power of particular questions and answer options. Descriptive statistics.

Results: An analysis of the quality of test questions measured with two coefficients: differentiation power and easiness of questions demonstrated that 14 out of 35 questions needed modification due to the fact that they were too easy: over 90% of the students had chosen the correct answer in the case of 7 questions and over 80% of the students had chosen the correct answer in the case of the 7 remaining questions (between 80 and 89% of the total). 19 questions had at least one answer option that had not been chosen by any of the students.

Conclusions:

1. The change in test questions based on the data referring to the functioning of test questions in the previous editions of paper-and-pen test exams might prove to be effective and efficient for improving the base of questions that is essential to carry out e-exams.
2. For further improvement of test questions, the functioning of the modified test questions needs to be analysed in detail right after the e-exam is complete.

Keywords: e-assessment, paper-and-pen test, quality of education, health sciences students, educational measurement.

## 1 BACKGROUND

Performing examinations with the use of computers (computer-aided exams, electronic examinations - EE) has now been used for several years in order to assess knowledge of students of medical science and health science as well as to monitor the outcomes of postgraduate education of doctors, nurses and other groups of healthcare professionals. The world literature presents a number of publications describing both advantages and limitations of this form of examination. Many authors draw attention to conditions a university-level school needs to meet before it can start performing electronic examinations as well as suggest a variety of plans of introducing computer-aided examinations. Most publications, however, emphasise the fact that computer-aided examinations are supposed to be introduced gradually, starting with formative tests and only later be used to perform end-of-semester tests and examinations [1-5].

First Department of Gynaecology and Midwifery, First Medical Faculty, Warsaw Medical University organises didactic classes for the "Gynaecology and Midwifery" course for students of different faculties and majors conducted at Warsaw Medical University. The Department runs the above-mentioned classes for a number of faculties, including the Faculty of Health Science, Warsaw Medical University. The "Gynaecology and Midwifery" course in the Department is run for, among others, students of Nursing (third-year full-time Bachelor's degree programme) as well as students of Emergency Medical Services (third-year full-time Bachelor's degree programme) [6].

The "Gynaecology and Midwifery" course is conducted in the form of lectures, seminars, and classes in a total number of 90 teaching hours for students of Nursing and 45 teaching hours for students of Emergency Medical Services. The "Gynaecology and Midwifery" course ends up with a test exam for both students of Nursing and Emergency Medical Services [6].

Previously, until the academic year 2014/2015, the exam for the "Gynaecology and Midwifery" course for students of Nursing and Emergency Medical Services was performed in a traditional form in the auditorium. The test exam comprised 50 questions with 4 answer options and usually two versions of the test were prepared. The range of topics for the exam for Nursing students included the following fields: gynaecology and midwifery (the same number of questions for each field); and for the students of Emergency Medical Services the exam also included gynaecology and midwifery but it also covered questions concerning emergency medicine.

Beginning in the academic year 2014-2015, it is possible to take computer-aided examinations at Warsaw Medical University using the ASK Systems e-exam platform. So far only three medical universities in Poland have introduced electronic examinations (EE) using various systems: ASK Systems platform in the Medical University of Łódź and Warsaw Medical University (since 2014) and OLAT used in the Medical University of Poznań [7-10].

In the winter 2014/2015 session there were three exams conducted on the ASK Systems e-exam platform in Warsaw Medical University (WMU): end-of-semester test for the "Law in Medicine" course for first-year Master's degree students of Nursing, end-of-semester test for the "Health Insurance" course for second-year part-time Master's degree students of Public Health, and the exam for the "Gynaecology and Midwifery" course for third-year Bachelor's degree students of Nursing. As many as 141 students participated in this exam. 26 objections concerning the exam questions were raised during the exam and two of them were granted. Due to the fact that the examination room of the Warsaw Medical University has 30 computer workstations, there were six timings of the examination for the "Gynaecology and Midwifery" course set on February 6th, 2015. The exam database included 120 questions and 60 questions were drawn for each person. The exam lasted 60 minutes. The cut-off score was established at 60%, i.e. 36 points. The maximum final score was 51 points and the minimum final score was 21 points. The mean score was 40 points. See Fig. 1, 2, 3, and 4 for a detailed characteristics of the exam for the "Gynaecology and Midwifery" course for Nursing students of the Faculty of Health Science, Warsaw Medical University [7,8].

Fig. 1. Division of e-exam for "Gynaecology and Midwifery" course into examination rounds: date and time of exam, number of students, mean score, minimum and maximum score

Lp.	Data i godzina pisania egzaminu	Liczba studentów	Średnia punktów	Minimalna ilość punktów	Maksymalna ilość punktów
1.	2015-02-06 08:00	11	37,36	21	46
2.	2015-02-06 09:30	26	39,96	28	51
3.	2015-02-06 11:00	26	41,58	35	51
4.	2015-02-06 12:30	26	42,04	33	51
5.	2015-02-06 14:00	26	41,85	33	49
6.	2015-02-06 15:30	26	40	28	50

(DATE AND TIME OF EXAMINATION; NUMBER OF STUDENTS, MEAN SCORE; MINIMUM SCORE; MAXIMUM SCORE)



Fig. 2. Mean score by round of examination (MEAN SCORE, TIME OF EXAMINATION)

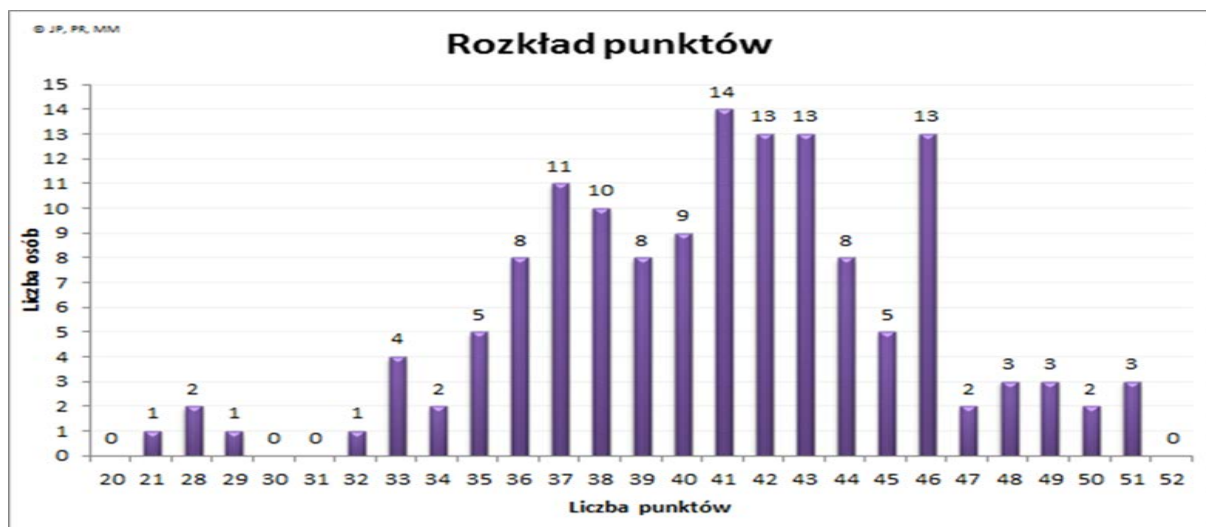


Fig. 3. Detailed distribution of scores achieved by students for "Gynaecology and Midwifery" exam (NUMBER OF PERSONS, DISTRIBUTION OF POINTS, NUMBER OF POINTS)



Fig. 4. Number of particular grades for "Gynaecology and Midwifery" exam (NUMBER OF GRADES; GRADE)

The "Gynaecology and Midwifery" exam for students of Emergency Medical Services is scheduled for the summer 2014/2015 session.

Owing to the fact that a well-prepared database of high-quality questions is one of the preconditions of a well-planned computer-aided exam, questions in the area of "Emergency Medicine" used in the previous years during traditional pen-and-paper exams were analysed in detail.

## 2 AIM OF STUDY

The aim of the study was to assess the quality of test questions referring to emergency medicine prepared in order to improve the test exam for the "**Gynaecology and Obstetrics**" course for the third year Bachelor students of Emergency Medicine at the Medical University of Warsaw.

## 3 MATERIAL AND METHODS

35 test questions, close-ended questions, 4 answer options, only one correct answer. A detailed analysis of the test questions used in the following years: 2009/2010, 2010/2011, 2012/2013. A comparison of easiness and differentiation power of particular questions and answer options. Descriptive statistics.

## 4 RESULTS

An analysis of the quality of test questions measured with two coefficients: differentiation power and easiness of questions demonstrated that 14 out of 35 questions needed modification due to the fact that they were too easy: over 90% of the students had chosen the correct answer in the case of 7 questions and over 80% of the students had chosen the correct answer in the case of the 7 remaining questions (between 80 and 89% of the total). 19 questions had at least one answer option that had not been chosen by any of the students (Tab. 1).

Tab. 1. Detailed characteristics and analysis of 35 test questions on "Emergency Medicine" planned to be used during computer-aided examination for "Gynaecology and Midwifery" course for third-year students of Emergency Medical Services, Faculty of Health Science, Warsaw Medical University

Questions for EE database 2014 /2015	2009/2010			2010/2011			2012/2013		
	question number	easiness	differentiation power	question number	easiness	differentiation power	question number	easiness	differentiation power
1	a						3	0.02	0.01
	b							0.12	-0.00
	c							0.65	0.07
	d							0.2	0.02
2	a						7	0.04	-0.05
	b							0.24	0.07
	c							0.12	0.29
	d							0.59	-0.32
3	a								
	b								
	c								
	d								
4	a						8	0.02	0.08
	b							0.14	-0.20
	c							0.67	0.08
	d							0.14	0.11
5	a						9	0.06	0.07
	b							0.00	-0.00
	c							0.10	0.09
	d							0.84	-0.04
6	a								
	b								
	c								
	d								
7	a						10	0.41	-0.16
	b							0.57	0.17
	c							0.00	-0.00
	d							0.02	0.11
8	a								
	b								
	c								
	d								
9	a			60	0.02	0.1	11	0.00	-0.00
	b				0.02	0.1		0.04	0.09
	c				0.55	-21		0.31	-0.10
	d				0.42	0.12		0.65	0.13

10	a									
	b									
	c									
	d									
11	a						13	0.06	0.06	
	b							0.00	-0.00	
	c							0.35	0.03	
	d							0.59	0.00	
12	a						16	0.10	0.17	
	b							0.71	0.29	
	c							0.08	-0.25	
	d							0.10	-0.24	
13	a									
	b									
	c									
	d									
14	a				57	0.62	0.27	24	0.76	0.22
	b					0.38	-0.22		0.22	-0.21
	c					0.00	-0.00		0.00	-0.00
	d					0.00	-0.00		0.02	0.19
15	a							26	0.10	0.21
	b								0.18	0.35
	c								0.67	-0.59
	d								0.04	0.02
16	a				19	0.05	-0.01			
	b					0.42	-0.30			
	c					0.52	0.33			
	d					0.00	-0.00			
17	a				21	0.08	0.09			
	b					0.02	-0.05			
	c					0.08	0.17			
	d					0.83	-0.08			
18	a				22	0.08	-0.13			
	b					0.03	0.18			
	c					0.05	-0.23			
	d					0.83	0.16			
19	a				23	0.26	-0.09			
	b					0.49	0.21			
	c					0.03	-0.15			
	d					0.22	-0.02			
20	a				24	0.75	0.60			
	b					0.17	0.27			
	c					0.08	0.13			
	d					0.00	0.00			

21	a				26	0.11	0.20			
	b					0.48	0.27			
	c					0.12	0.20			
	d					0.29	0.33			
22	a	29	0.02	0.16	27	0.00	-0.00			
	b		0.00	-0.00		0.00	-0.00			
	c		0.00	-0.00		0.00	-0.00			
	d		0.98	-0.13		1.00	0.00			
23	a				36	0.57	0.12			
	b					0.40	-0.02			
	c					0.03	-0.15			
	d					0.00	-0.00			
24	a				55	0.08	-0.05			
	b					0.03	-0.15			
	c					0.00	-0.00			
	d					0.89	0.20			
25	a				56	0.05	-0.01			
	b					0.08	-0.05			
	c					0.00	-0.00			
	d					0.88	0.12			
26	a				59	0.00	-0.00			
	b					0.02	-0.05			
	c					0.31	0.03			
	d					0.66	0.04			
27	a	11	0.02	-0.21						
	b		0.04	-0.11						
	c		0.00	-0.00						
	d		0.94	0.27						
28	a	12	0.02	-0.24						
	b		0.00	-0.00						
	c		0.98	0.28						
	d		0.00	-0.00						
29	a	13	0.02	-0.14						
	b		0.00	-0.00						
	c		0.08	-0.06						
	d		0.90	0.19						
30	a	14	0.88	0.47						
	b		0.04	-0.13						
	c		0.04	-0.11						
	d		0.00	-0.39						
31	a	17	0.16	-0.30						
	b		0.29	0.03						
	c		0.02	0.01						
	d		0.53	0.25						

32	a	18	0.00	-0.00						
	b		0.82	0.40						
	c		0.14	-0.23						
	d		0.00	-0.22						
33	a	19	0.00	-0.00						
	b		0.00	-0.00						
	c		0.98	0.24						
	d		0.02	-0.20						
34	a	24	0.06	0.08						
	b		0.02	0.16						
	c		0.02	0.16						
	d		0.90	-0.15						
35	a	25	0.10	-0.06						
	b		0.90	0.12						
	c		0.00	-0.00						
	d		0.00	-0.00						

A detailed analysis of questions allowed for an assessment of their quality so that they can be used in a computer-aided examination. As mentioned before, as many as 35 questions had been analysed and 14 of them needed a significant modification. "A head of a question" was improved in the case of two questions, but most often, it was the incorrect answer options (distractors) that had to be changed.

Table 2 shows an exemplary way of improving a question during the modification process before using it in a computer-aided examination.

Tab. 2. Exemplary way of improving a test question during the modification process before using it in a computer-aided examination.

A pregnant woman (approx. 5-6 weeks pregnant) presented to Hospital Emergency Department in the evening due to mild bleeding from the birth canal and pain in the lower abdomen. It emerged that on the day before ~~in the morning~~ she had had an ultrasound which had not presented a pregnancy sac. A doctor performing the ultrasound told the patient that the appearance most probably corresponded to early normal pregnancy.

- The patient is in a good general condition. Because of a threatened abortion you recommend contacting attending gynaecologist urgently ~~tomorrow~~.
- If **bHCG is below 500UI/l**, you recommend another urgent transvaginal ultrasound to exclude pathology in the uterine appendages and only then you safely discharge the patient home.
- You keep the patient in hospital for further diagnosis because you cannot exclude ectopic pregnancy on the basis of the ultrasound image.**
- You inform the patient that since the pregnancy sac is not revealed ~~and she has had these symptoms and signs, for sure~~ **probably** this is incomplete miscarriage and she should stay in hospital for dilation and curettage of uterus.

## 5 DISCUSSION

The available Polish and world scientific literature does not present any publications devoted to methods of preparing databases of test questions for e-exams. The subject matter of e-exams is very often discussed in the world literature in various context. Authors analyse satisfaction of students with this form of examination, point out its advantages and disadvantages as well as potential risk of a breakdown during the computer-aided exam. Perhaps there is no such an analysis because of the fact that the improvement of test questions for computer-aided exams requires the same preparation and analysis as for traditional test exams. Phrasing and evaluation of multimedia questions is another



issue, but owing to the fact that the present article focuses only on phrasing and evaluation of traditional test questions, the issue of phrasing and evaluation of multimedia questions shall be deliberately omitted.

The present paper analysed in detail 35 questions in the area of Emergency Medicine that were supposed to be included into the database of test questions for the "Gynaecology and Midwifery" exam for the second-year full-time Bachelor's degree students of Emergency Medical Services. The analysis concerned the easiness and differentiation power of each question and each answer option (Tab. 1).

The analysis was performed in the Division of Teaching and Outcomes of Education, Faculty of Health Science, Medical University of Warsaw.

The analysis of the quality of test questions measured with two coefficients: differentiation power and easiness of questions demonstrated that 14 out of 35 questions needed modification due to the fact that they were too easy: over 90% of the students had chosen the correct answer in the case of 7 questions and over 80% of the students had chosen the correct answer in the case of the 7 remaining questions (between 80 and 89% of the total). 19 questions had at least one answer option that had not been chosen by any of the students.

Therefore, a detailed analysis of questions was performed by persons responsible for didactics in the First Department of Gynaecology and Midwifery, First Medical Faculty, Warsaw Medical University in order to improve those questions. During a training on the improvement of the quality of test questions, the staff of the Division of Teaching showed the staff of the First Department of Gynaecology and Midwifery the questions that had been structured incorrectly and proposed a number of technical possibilities of improving them. Suggestions mostly concerned the modification of those answer options that were either too easy or were not at all taken into consideration by students when choosing the correct answer.

Staff responsible for didactics of the "Gynaecology and Midwifery" course for the students of Emergency Medicine provided the Division of Teaching with the corrected versions of questions prepared for the June 2015 exam on the ASK Systems e-exam platform. After the aforementioned exam, the questions shall be analysed again in order to assess whether their modification influenced their easiness and differentiation power, and thus whether it improved the examination tool. If the questions meet their tasks, they shall remain in the database, but if not – they will be modified once again.

The present paper demonstrated an exemplary and pilot model (used in Warsaw Medical University) of the improvement of the quality of test questions during the process of preparing them for the database of questions used in e-exams. This was the first such an analysis of database of questions and a proposition of their modification conducted in the Division of Teaching and Outcomes of Education, Faculty of Health Science, WMU. In the next years, as the database of test questions used in e-exams for various courses develop in Warsaw Medical University, this kind of analyses shall be conducted systematically.

## **5.1 Limitations of the study results and further directions of studies:**

The fact that only 35 questions were analysed and only 14 of them were modified constitutes a significant limitation of the study. The present authors aimed to demonstrate the methodology of modification of a database of questions for a selected course rather than conduct an in-depth analysis. Therefore, the study is now being continued so that, after collecting a larger material, exams for many courses that previously had been examined in a traditional form could be analysed in detail.

## **6 CONCLUSIONS**

1. The change in test questions based on the data referring to the functioning of test questions in the previous editions of paper-and-pen test exams might prove to be effective and efficient for improving the base of questions that is essential to carry out e-exams.
2. For further improvement of test questions, the functioning of the modified test questions needs to be analysed in detail right after the e-exam is complete.

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