Original Article Pol J Public Health 2015;125(3): 153-158

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# Comparative analysis of opinions of Warsaw Medical University students on electronic examinations and final tests by their participation in this form of knowledge assessment – preliminary report

**Abstract**

**Introduction.** Apart from the increasing popularity of modern information technologies and the development of e-learning methods used for teaching medicine and health sciences, there was a spike of interest in using modern computer techniques for checking students' knowledge.

**Aim.** The aim of the study was to compare the opinions of students of Medical University of Warsaw about the examinations and final tests conducted using the e-exam ASK Systems platform, measured by their participation in this form of assessmen knowledge.

**Material and methods.** 148 students; group 1 comprised students participating in an e-exam (59 persons) and group 2 included students not participating in an e-exam (89 persons). A voluntary, anonymous questionnaire study, electronic questionnaire, 58 statements measured using the Likert scale. Questionnaire reliability assessment: analysis of internal consistency with Cronbach's Alfa coefficient ($\alpha>0.70$). Statistical analysis: STATISTICA 12.0 licensed to WMU, Mann-Whitney U test.

**Results.** Cronbach's α coefficient for the scale amounted to 0.70. Members of group 1 were more likely to admit that students need to put in extra effort into participating in an e-exam ($p<0.001$) and that test results might be worse than in case of a regular exam ($p<0.050$). Group 1 significantly more often reported that the participation in an e-exam can cause additional examination stress ($p<0.002$) and makes cheating during exams more probable ($p<0.003$).

**Conclusions.** 1. An analysis of the questionnaire demonstrated that this tool is reliable and can be used in further studies. 2. The participation in an e-exam slightly influenced the opinions of students on this form of knowledge assessment, which may mean that the students' expectations concerning e-exams were consistent with the actual course of the exam. Therefore, students do not need any special procedure to prepare for e-exams. 3. This was a pilot study and it needs to be continued among the same group of students before and after the e-exam.

**Keywords:** electronic examinations, assessment quality, modern technologies, students of health sciences, attitudes.

**DOI:** 10.1515/pjph-2015-0044

## INTRODUCTION

Apart from the increasing popularity of modern information technologies and the development of e-learning methods used for teaching medicine and health sciences, there was a spike of interest in using modern computer techniques for checking students' knowledge [1-5]. The use of modern information technologies for examination of students may influence both the examination quality and the overall attractiveness of computer-aided examinations (electronic examinations – EE) [1-5].

An analysis of students' opinions about computer-aided exams is an important part of introducing this kind of examinations into university-level schools. It is particularly important to analyze the opinions of students who had already participated in such examinations as well as of those who had not tried them yet. The comparison of opinions both the students participating in EE and those not taking EE would reveal the accuracy of their expectations and whether they needed any additional preparation for this form of examination.

## AIM

The aim of the study was to compare the opinions of Warsaw Medical University students on examinations and final tests conducted using the e-exam ASK Systems platform by their participation in this form of knowledge assessment.

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## MATERIAL AND METHODS

The study included a total of 148 students, divided into two groups: Group 1 were students who had participated in electronic examinations conducted using the ASK Systems e-exam platform (59 persons) and Group 2 comprised students who had not taken electronic examinations (89 persons). See Table 1 for detailed characteristics of the study group.

Participation in the study was voluntary. An anonymous survey, using an original questionnaire, was conducted between the 22nd and 27th February, 2015. The questionnaire was based on an analysis of the world's scientific literature, articles devoted to analyses of students' opinions on their participation in electronic examinations and final tests.

The questionnaire consisted of 58 statements. A five-point Likert scale was used. Statements were divided into five separate domains: 1. Use of the ASK Systems e-exam platform. 2. Organisation of electronic final tests and exams on the ASK Systems e-exam platform. 3. Attitudes towards evaluation of students' knowledge with the use of e-exam platform. 4. Advantages of electronic final tests and exams, 5. Disadvantages of electronic final tests and exams.

**TABLE 1. Detailed characteristics of the study group of students.**

| Feature | | Group 1 | Group 2 |
|---|---|---|---|
| Number of study participants | | 59 | 89 |
| Gender (%) | Women | 59 | 55 |
| | Men | - | 25 |
| Age | | 24.96 years min.21, max.44 SD: 5.54 | 22.53 years min.19, max.32 SD: 2.15 |
| Mode of study | Full-time | | 74 |
| | Part-time | | 6 |
| Level of study | Long-cycle program | - | 55 |
| | First-cycle program | 20 | 13 |
| | Second-cycle program | 39 | 12 |
| Year of study | first year | 32 (second-cycle) | 26 |
| | second year | 7 (second-cycle) | 12 |
| | third year | 20 | 36 |
| | fourth year | - | 3 |
| | fifth year | - | 2 |
| | sixth year | - | 1 |
| Faculty | 1st Faculty of Medicine | - | 28 |
| | 2nd Faculty of Medicine | - | 13 |
| | Faculty of Pharmacy | - | 12 |
| | Faculty of Medicine and Dentistry | - | 5 |
| | Faculty of Health Science | 59 | 22 |
| Major | Laboratory medicine | - | 1 |
| | Nutrition | - | 1 |
| | Pharmacy | - | 11 |
| | Physiotherapy | - | 1 |
| | Medicine | - | 40 |
| | Medicine and dentistry | - | 4 |
| | Nursing | 54 | 8 |
| | Midwifery | - | 9 |
| | Dental technology | - | 1 |
| | Public health | 5 | 4 |
| Participation in another form of e-exam | | 25 | 80 |

The questionnaire was distributed in electronic form, with direct links to the survey referring to an external server, which provided anonymity.

The questionnaire for Group 1 comprised all five thematic domains and could be found following the link:

https://docs.google.com/forms/d/1XKw459AQXvfKhZrwayTDkLnlEENeFl0XVtXMoJFP5_o/viewform

Due to the fact that Group 2 students had not participated in any e-exams, they did not complete the part devoted to the use of the ASK Systems platform and the questionnaire for Group 2 comprised three thematic domains and was located at:

https://docs.google.com/forms/d/1cPHRzpLoDBMgfi5c4BktwJVDEW_Wd3RJ7O2CR6R1XwM/viewform

At the beginning of the summer semester, the University Examination Board, MUW staff sent the link to Group 1 students three times.

The link to the questionnaire was sent to Group 2 by the Student Government of Medical University of Warsaw.

### Questionnaire reliability analysis

The reliability of the questionnaire was checked through an internal consistency analysis that was conducted for the entire scale and for selected subscales by determining appropriate reliability coefficients in accordance with Cronbach's formula [6]. In compliance with the Nunnally criterion, a level of reliability was established at $\alpha>0.70$ [7]. An inter-correlation matrix was determined and consistency criterion was established at $r>0.10$ to estimate the "internal" accordance of particular statements.

### Analysis of differences between groups of students

The non-parametric statistic Mann-Whitney U test for two groups was used to analyze the significance of differences between Group 1 and Group 2 (assuming that $\alpha=0.05$).

## RESULTS

### Questionnaire reliability analysis

Cronbach's α coefficient for the total scale was 0.70, for three subscales (IA, II, III) it was over 0.8, and for the IB subscale it did not reach the recommended minimum value of 0.7 (0.64) (Table 2).

**TABLE 2. Questionnaire reliability analysis.**

| | All students* | Students before the e-exam (n=89)* | Students after the e-exam (n=59)* |
|---|---|---|---|
| Entire scale | 0.705 | 0.723 | 0.645 |
| Subscale I-A | 0.892 | 0.910 | 0.849 |
| Subscale I-B | 0.645 | 0.612 | 0.705 |
| Subscale II | 0.814 | 0.839 | 0.753 |
| Subscale III | 0.882 | 0.895 | 0.857 |

* Cronbach's Alpha coefficient

An analysis looking at the significance of differences in opinions between students who had already participated in e-exams (Group 1) and those who had not (Group 2) revealed that the differences in particular subscales were statistically insignificant (Table 3). Hence, the results obtained in Groups 1 and 2 would not differ significantly with reference to the students' attitudes, advantages and disadvantages of electronic examinations.

In case of the study group, the participation in an e-exam (EE) had a major impact on the attitudes toward EE. The individuals who had taken EE were significantly more likely to claim that e-exams require some additional effort on the students' side ($p<0.001$), compared to Group 2. They also believed that results of electronic final tests might be worse than in case of regular tests ($p<0.050$). See Table 4 for detailed data.

Students' opinions about the disadvantages of electronic examination was another issue analyzed in the questionnaire. The individuals who had already taken part in EE (Group 1) significantly more frequently said that participation in e-exam increased examination stress ($p<0.002$) compared to Group 2. They also believed that it lowered the risk of cheating during exams ($p<0.003$). See Table 5 for detailed data.

Considering students' opinions about the advantages of EE, there was only one statistically significant difference between Group 1 and 2 namely regarding the opinion whether EE minimized the risk of cheating during exams ($p<0.001$). Group 1 significantly more often considered this to be an advantage of this form of exam compared to Group 2. See Table 6 for detailed data.

**TABLE 3. Analysis of significance of differences regarding attitudes, advantages and disadvantages of EE in particular subscales of questionnaire.**

| | Sum of ranks Students before the e-exam (N=89)* | Sum of ranks Students after the e-exam (N=59)* | U | p* |
|---|---|---|---|---|
| Subscale I-A | 6640.0 | 4386.0 | 2616.0 | 0.972 |
| Subscale I-B | 6369.0 | 4657.0 | 2364.0 | 0.307 |
| Subscale II | 6357.0 | 4669.0 | 2352.0 | 0.285 |
| Subscale III | 6333.5 | 4692.5 | 2328.5 | 0.246 |

* non-parametric Mann-Whitney U test

**TABLE 4. Attitudes of students towards knowledge testing with the use of e-exam platform.**

| | Question | Strongly disagree /Disagree | | No opinion | Strongly agree /Agree | | U/p |
|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Total | Group 1 | Group 2 | |
| 1 | An e-exam is an effective way of testing the medical and health sciences students' knowledge. | 23/39% | 42/47% | 49/33% | 25/42% | 38/43% | 2562.5 /0.807 |
| 2 | E-exams may positively influence the assessment of quality. | 24/41% | 41/46% | 47/32% | 26/44% | 38/43% | 2597.5 /0.914 |
| 3 | E-exams may positively influence the outcomes of education and effectiveness in teaching students. | 17/29% | 48/54% | 51/34% | 23/39% | 32/36% | 2217.0 /0.110 |
| 4 | E-exams are practical, safe, and reliable. | 15/25% | 44/49% | 53/36% | 29/49% | 38/43% | 2356.5 /0.293 |
| 5 | E-exams are quick and comfortable. | 5/8% | 13/15% | 74/50% | 48/81% | 68/76% | 2218.5 /0.111 |
| 6 | E-exams allow for developing questions that would prove too long to be asked using the traditional pen-and-paper form. | 33/56% | 39/44% | 47/32% | 8/14% | 29/33% | 2147.5 /0.061 |
| 7 | E-exams are fair and accurate and they also ensure that human error is avoided. | 21/36% | 26/29% | 59/40% | 31/53% | 52/58% | 2275.5 /0.171 |
| 8 | Passing e-exams requires some additional intellectual effort. | 19/32% | 48/54% | 32/22% | 29/49% | 21/24% | 1761.0 /0.001 |
| 9 | Students use computers on a daily basis, so they will not find e-exams difficult. | 16/27% | 24/27% | 65/44% | 35/59% | 57/64% | 2204.0 /0.099 |
| 10 | E-exams should be closely related to e-learning classes. | 17/29% | 38/43% | 45/30% | 28/47% | 31/35% | 2175.5 /0.078 |
| 11 | E-exams are simply another fad in the field of knowledge testing. | 18/31% | 28/31% | 49/33% | 18/31% | 26/29% | 2606.5 /0.942 |
| 12 | Exam results should be provided right after completing the examination. | 9/15% | 19/21% | 59/40% | 44/75% | 53/60% | 2293.0 /0.194 |
| 13 | Exam results should be given at a later time after all the results have been analyzed. | 32/54% | 37/42% | 41/28% | 16/27% | 30/34% | 2409.0 /0.398 |
| 14 | I believe that e-exam results might be worse. | 17/29% | 39/44% | 44/30% | 28/47% | 30/34% | 2123.5 /0.050 |
| 15 | I do not accept e-exams in any form. | 26/44% | 43/48% | 53/36% | 15/25% | 35/39% | 2597.0 /0.913 |
| 16 | The answers to the questions should be given immediately after each question without a possibility of returning to a question, which would positively influence the quality of education. | 47/80% | 66/74% | 19/13% | 7/12% | 14/16% | 2617.5 /0.977 |

* non-parametric Mann-Whitney U test

**TABLE 5. Opinions of students on the drawbacks of final course tests and examinations in the electronic form.**

| | Question | Strongly disagree /Disagree | | No opinion | Strongly agree /Agree | | U/p |
|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Total | Group 1 | Group 2 | |
| 17 | Applying new technologies to checking students' knowledge. | 15/25% | 35/39% | 35/24% | 26/44% | 37/42% | 2443.5 /0.477 |
| 18 | Risk of error/technical failure in the examination system. | 4/7% | 11/12% | 16/11% | 49/83% | 73/82% | 2420.0 /0.422 |
| 19 | Students' have no experience taking e-exams. | 13/22% | 27/30% | 25/17% | 13/22% | 55/62% | 2593.5 /0.902 |
| 20 | Participation in e-exams boosts exam-related stress. | 13/22% | 46/52% | 27/18% | 38/64% | 31/35% | **1821.0 /0.002** |
| 21 | Concentration problems when reading questions on the screen. | 17/29% | 36/40% | 14/9% | 37/63% | 48/54% | 2422.0 /0.427 |
| 22 | Noise caused by using a computer keyboard. | 31/53% | 46/52% | 25/17% | 20/34% | 33/37% | 2579.5 /0.859 |
| 23 | No possibility of taking notes during the exam. | 20/34% | 29/33% | 35/24% | 26/44% | 48/54% | 2480.5 /0.571 |
| 24 | Drawing of an individual set of test questions. | 19/32% | 29/33% | 38/26% | 28/47% | 44/49% | 2572.5 /0.837 |
| 25 | Using multimedia material: photographs, films, and audio materials in test questions. | 22/37% | 38/43% | 49/33% | 21/36% | 31/35% | 2564.0 /0.811 |
| 26 | No chance to discuss the questions after the exam due to the drawing of questions. | 14/24% | 18/20% | 28/19% | 38/64% | 57/64% | 2529.5 /0.708 |
| 27 | It minimizes the chance of cheating in exam. | 19/32% | 46/52% | 24/16% | 28/47% | 22/25% | **1878.5 /0.003** |

* non-parametric Mann-Whitney U test

**TABLE 6. Students' opinions about the advantages of e-exams.**

| | Question | Strongly disagree /Disagree | | No opinion | Strongly agree /Agree | | U/p |
|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Total | Group 1 | Group 2 | |
| 28 | E-exams making exams more practical. | 14/24% | 36/40% | 36/24% | 27/46% | 35/39% | 2356.0 /0.292 |
| 29 | E-exams are more fair. | 28/47% | 47/53% | 38/26% | 18/31% | 28/31% | 2524.0 /0.692 |
| 30 | E-exams are better for testing students' knowledge compared to traditional pen-and-paper exams. | 35/59% | 52/58% | 36/24% | 13/22% | 22/25% | 2520.5 /0.682 |
| 31 | E-exams check the knowledge about the subject and computer skills. | 18/31% | 37/42% | 51/34% | 26/44% | 29/33% | 2194.5 /0.092 |
| 32 | The way that e-exams are arranged allows students achieve a better result. | 40/68% | 44/49% | 53/36% | 6/10% | 17/19% | 2162.5 /0.070 |
| 33 | Immediate information about passing/failing the test. | 5/8% | 12/13% | 28/19% | 47/80% | 63/71% | 2388.5 /0.354 |
| 34 | Drawing of an individual set of test questions. | 28/47% | 47/53% | 35/34% | 20/34% | 28/31% | 2409.5 /0.399 |
| 35 | Possibility of changing the answer to a question during the examination. | 4/7% | 18/20% | 12/8% | 52/88% | 65/73% | 2338.5 /0.262 |
| 36 | Possibility of raising objections to test questions during the examination. | 4/7% | 17/19% | 17/11% | 51/86% | 63/71% | 2177.0 /0.079 |
| 37 | Using multimedia material: photographs, films, and audio materials in test questions. | 9/15% | 18/20% | 53/36% | 31/53% | 52/58% | 2347.0 /0.276 |
| 38 | It minimizes the odds that students cheat during the exam. | 11/19% | 36/40% | 45/30% | 37/63% | 30/34% | **1728.0 /<0.001** |
| 39 | Shorter duration of participation in the exam. | 13/22% | 23/26% | 40/27% | 37/63% | 44/49% | 2477.0 /0.562 |
| 40 | Students can choose the date of the exam. | 11/19% | 14/16% | 26/18% | 40/68% | 64/72% | 2497.0 /0.616 |

* non-parametric Mann-Whitney U test

## DISCUSSION

The world scientific literature available (PubMed, Scopus, Embase, ProQuest, key words: computer-based assessment, e-assessment, students of medicine and health sciences, final examinations, years: 2000-2015, articles in English) included five publications devoted to opinions of students on participating in computer-aided exam [8-12]. Studies were conducted in New Zealand (2006, Faculty of Medicine, University of Otago) [8], the United Kingdom (2007, University of Bradford) [9], Saudi Arabia (2009, College of Medicine, King Abdulaziz University) [10], Germany (2011, Medical Clinic University of Heidelberg) [11], and Pakistan (2013, Dow University of Health Sciences International Medical College, Karachi) [12].

This issue has not been discussed in Polish literature yet, aside from the articles published by the authors of this very work [13,14]. However, neither the world's nor Polish literature has shown publications comparing opinions and attitudes of students regarding computer-aided examination by their participation in this kind of knowledge testing. Therefore, the present publication is innovative in the Polish scientific literature.

No information has been found about reliability of the research tools used to conduct the study in the available publications [8-12]. A pilot study on the opinions of students participating in computer-aided examinations at Warsaw Medical University was conducted, as well as an analysis of questionnaire reliability [14]. These findings show that authors' own questionnaires are reliable research tools that can be used in evaluating attitudes toward EE among students. Thus, the present study used the same tool (its reliability was later reassessed and compared using the two subgroups). Similarly to the findings of the previous study, the questionnaire was regarded as a reliable tool that measures the students' attitudes toward EE and can be used in further studies [14].

In case of the study group, having participated in an e-exam had no significant impact over the opinions and attitudes toward this. Regardless of whether students had or had not taken computer-aided examinations, their opinions on EE were similar. However, the individuals who had already taken an e-exam were more likely to say that participation in EE required additional intellectual effort from students, due to an increased examination stress and minimized the risk of cheating in exam. Moreover, they believed that the results of electronic examinations could be worse.

The authors believe that small differences between the two subgroups demonstrate that students' expectations about EE that are based on stereotypes, are in fact compliant with opinions based on real experiences with e-exams. Therefore, students have good knowledge of the organization and course of EE and they do not require any additional organizational preparation before taking this form of assessment. This is also confirmed by the survey itself, where students admitted that they did not need any special training before taking e-exam. Hence, we believe that a further study needs to focus solely on an analysis of opinions of students about the use of e-exam platform and not on students' attitudes towards computer-aided assessment.

## RESULTS

A small questionnaire return rate in both groups constitutes a significant limitation for the study results. The authors believe electronic exams can indeed have a smaller return rate. However, due to the fact that the questionnaire concerned electronic examination, the authors decided that this form was adequate to the present issue and an electronic form of the survey is going to be used in the further study as well. However, the time of performing the survey is going to be modified and in the next study, the survey is going to be conducted directly after taking a final test or exam on the e-exam platform.

The report described here is only a pilot study. Nevertheless, it is worth emphasizing that two independent groups of students, namely those taking and not taking EE, were compared which constitutes a limitation of the study results. The next study would analyze the opinions of the same group of students, elicited from them prior to taking the exam and after. It is possible that this may significantly influence the change of opinions about EE, yet further verification is needed.

### Further direction of study

The authors will continue to conduct surveys looking at students' opinions about e-exams. Furthermore, at the beginning, the survey will be conducted both before and after taking an electronic final test or exam. Thanks to this, it would be possible to obtain reliable feedback from a larger number of students. Moreover, a comparative analysis of the survey performed before and after EE might improve the process of organization of e-exams and their quality at Warsaw Medical University.

Finally, the authors would also look at the opinions of academic teachers on computer-aided examinations and their attitudes toward this form of assessment.

## CONCLUSIONS

1. The analysis of reliability of the questionnaire demonstrated that the tool might be used in further studies of students' opinions on participating in electronic final tests and exams.
2. The participation in an e-exam slightly influenced the opinions of students on this form of knowledge assessment among the study group, which may mean that the students' expectations concerning e-exams were consistent with the actual course of the exam, therefore students do not need any special procedure to prepare for e-exams. However, this thesis needs to be confirmed in further studies.
3. The present study is a pilot and requires continuation among the same group of students before and after taking EE, which would increase reliability of the study results and may show a much larger variety of opinions of students on EE depending on their participation in this form of examination.

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