

COMPARISON OF ONLINE AND TRADITIONAL IN CLASS EXAMS IN COMPUTER SCIENCE COURSES

Delyan Keremedchiev, Juliana Peneva

*Dept. of Computer Science, New Bulgarian University, 21 Montevideo St. 1618 Sofia
delyan.keremedchiev@gmail.com; jpeneva@nbu.bg*

Abstract: *With the development of ICT and the use of Internet, more and more traditional learning tasks are moved to Web. Although there are some well-distinguished benefits to using online testing compared to traditional proctored paper and pen exams mixed indication concerning the effectiveness of online exams exists. In this paper we investigate both types of exams. The purpose of our study is twofold. First we investigate the students' preferences to the way of taking their exams. Second we compare course learning outcomes via students' grades to further analyze students' performance. Data were collected over 11 semesters from students enrolled in an information technology course in bachelor (N=767) and masters programs (N=471) at New Bulgarian University. In each semester the courses were taught by the same instructor. All students were asked to complete both types of exams. We found that students in bachelor programs prefer to do online testing while students in master programs show no preference to the way of examination. Our results suggest that online assessment in compared to pen and pencil exams does not damage students learning and may contribute to positive individual outcomes.*

Key words: *e-learning, in-class exams, online assessment, e-testing*

Introduction

With the development of ICT and the use of Internet, more and more traditional learning tasks are moved to Web. Learning management systems are trying to offer new tools to facilitate instructors' work. Hybrid courses are viewed as a way to create more engaging and student-centered learning environments [1]. Distance and e-learning nowadays are synonymous, absorbing and modifying practically the whole didactic experience. Whenever a major pedagogical change is made instructors have to take into account potential advantages and drawbacks concerning their design solutions.

In Bulgaria almost all universities implement some web-based content delivery system (mainly Moodle and Blackboard) to support both distance and regular education. These systems mostly offer opportunities to test students' knowledge and competence via online testing. In addition examination by tests conforms to state educational requirements. Moreover there are some practical advantages for faculty and administrators. Online exams permit more scheduling flexibility for both students and faculty [2]. Although setting up the question bank is a time consuming activity, test elements can be reused and students' exams are automatically graded.

Furthermore, the immediate scoring of online exams permits students to receive rapid feedback regarding their achievements. With regard to this instructors are transitioning from in-class to online exams.

Although there are some well-distinguished benefits to using online testing compared to traditional proctored paper and pen exams mixed indication concerning the effectiveness of online exams exists. The purpose of this study is twofold. First we investigate the students' preferences to the way of taking their exams. Second we compare course learning outcomes via students' final grades to further analyze students' performance. We tried to determine if there would be a significant difference in the results between students who took the exams online compared to students assessed in the classroom using the traditional proctored paper and pencil test format. We assumed that students who took the online exams would get a higher grade than students who took the classroom exams. As it concerns the students' preference on the way of examination we hypothesized that learners would choose online testing as well.

Literature Review

It is difficult to guess the influence of online testing compared to classical in-class exams on students' achievements and comprehension. If both types of exams are proctored they would possibly produce equivalent outcomes. However, if online exams are unsupervised it is very likely that students might use additional help (books, notes, hints) i.e. adopting bad study habits [3]. An interesting investigation that links students' learning outcomes associated with traditional in-class exams compared to frequent online exams is reported in [4]. The results suggest that frequent online assessments do not interfere with students' learning in comparison to traditional in-class exams. No important difference in student performance on proctored online exams and proctored traditional exams in computer technology courses was found [5, 6]. However other researchers [6, 7, 8, 9] conclude that students scored significantly higher on the online exams compared to students who took the paper and pencil exams in different courses e.g. sociology, marketing and psychology. Our survey on the literature shows that there are mixed findings regarding the equivalency of both types of exams. So, the purpose of this research was to determine if there would be a significant difference in exam performance in an upper-level computer science course between students who took the exams online compared to students who took the exams in the classroom. We also investigated the students' attitude to the exam mode.

Method of study

Participants

Data were collected over 10 semesters from students enrolled in an information technology course (Scripting Languages) in bachelor (N=767) and masters programs (N=471) at New Bulgarian University within the period 2007 - 2016. In each semester the courses were taught by the same instructor using a lecture-based, discussion, lab activity format.

Materials and Procedure

Course materials were kept consistent and regularly updated for all sections of the bachelor and master classes and labs over the 10 semesters of the study. In each class, the same books, lab assignments, and exams were used. Every semester, all students were given access to copies of class handouts and power point presentations through Moodle course delivery system that is implemented at New Bulgarian University.

For the successful completion of the course students have to be tested and to receive a numerical score higher than Poor (2) with the maximum score being Excellent (6). They are graded on the following two course assignments: a written test evaluation which takes place in the middle of the semester and a class project that is an individual work assignment. Students are not allowed to present their projects if they fail on the midterm test. The midterm test aims to verify whether students have mastered the learning content so far. The exam questions reflect the learning content and contain multiple choice questions with five alternatives. The same exam questions for both online and in-class exams have been used. The individual work assignment is to be presented orally in class and evaluated by the instructor. The final grade is formed taking into account the results of both course assignments.

Eight times, students were administered a proctored course exam with the instructor present. During the class room exam mode students were allowed to use computers so as to verify the program code they were supposed to deliver. To avoid cheating the proctor observes that no e-mail and instant messaging programs are used. These exams were technically not timed but all students completed the exams within the 90 minutes allotted for the class period.

Three times the students completed unproctored online midterm exam administrated through Moodle. They were allowed to use their textbook and/or course notes as well as other materials. The test was opened for a couple of days but students had 90 minutes to finish the exam before the course delivery system forced the completion. Additionally, students were told that they were not allowed to help one another with the exam, and if they did so, it would be considered cheating and they would receive Poor (2) in the course. To reduce collaboration among students in the process of electronic test generation shuffling for questions and their answers was

performed. In addition students could not retake midterm and no immediate feedback was provided.

During the traditional test, the identity of the students was not checked. During the online exam mode the authentication is performed via Moodle.

Results

The current research was designed to examine the students' preferences to the way of taking their exams and to compare course learning outcomes via students' final grades to further analyze students' performance. Preliminary analyses were carried out to ensure that students who completed online exams and students who completed classroom exams were comparable with respect to their academic characteristics. Table 1 and 2 summarize exam data for the overall period.

Table 1: Bachelors

Year	Enrolled students	Students that passed the midterm test	Students that passed the final exam
Classroom exams			
2007 - 2008	71	31	27
2008 - 2009	59	31	26
2009 - 2010	74	42	37
2010 - 2011	79	44	37
2011 - 2012	58	34	29
2012 - 2013	83	42	36
2013 - 2014	89	50	43
2014 - 2015	47	23	13
Online exams			
2015 - 2016(1)	60	45	29
2015 - 2016(2)	82	56	38
2016-2017	65	42	32

Table 2: Masters

Year	Enrolled students	Students that passed the midterm test	Students that passed the final exam
Classroom exams			
2007 - 2008	36	30	27
2008 - 2009	33	27	23

2009 - 2010	51	39	33
2010 - 2011	45	34	29
2011 - 2012	54	45	41
2012 - 2013	56	50	34
2013 - 2014	45	39	34
2014 - 2015	42	37	30
Online exams			
2015 - 2016(1)	41	34	30
2015 - 2016(2)	36	25	19
2016 - 2017	32	27	24

To eliminate differences in student numbers over the years we also calculated percentages of the students that passed the midterm test and then the final exam. The results appear in Tables 3 and 4.

Table 3: Bachelors

Year	Students that passed the midterm test	Students that passed the final exam
Classroom exams		
2007 - 2008	43,66%	87,10%
2008 - 2009	52,54%	83,87%
2009 - 2010	56,76%	88,10%
2010 - 2011	55,70%	84,09%
2011 - 2012	58,62%	85,29%
2012 - 2013	50,60%	85,71%
2013 - 2014	56,18%	86,00%
2014 - 2015	48,94%	56,52%
Online exams		
2015 - 2016(1)	75,00%	64,44%
2015 - 2016(2)	68,29%	67,86%
2016 - 2017	64,62%	76,19%

Table 4: Masters

Year	Students that passed the midterm test	Students that passed the final exam
Classroom exams		
2007 - 2008	83,33%	90,00%

2008 - 2009	81,82%	85,19%
2009 - 2010	76,47%	84,62%
2010 - 2011	75,56%	85,29%
2011 - 2012	83,33%	91,11%
2012 - 2013	89,29%	68,00%
2013 - 2014	86,67%	87,18%
2014 - 2015	88,10%	81,08%
Online exams		
2015 - 2016(1)	82,93%	88,24%
2015 - 2016(2)	69,44%	76,00%
2016 - 2017	84,38%	88,89%

Further we calculate the mean and the standard deviation. The results are summarized in Table 5.

Table 5: Mean and standard deviation

	Bachelors		Masters	
	Mean	Standard Deviation	Mean	Standard Deviation
Students that passed the midterm test (%)	52,88	4,65	83,07	4,73
Students that passed the final exam (%)	82,09	9,75	84,06	6,75

To both compare and interpret the results we assume that the distribution is normal and compute the Z-score for online and midterm exams (Table 6).

Table 6 Z-score

	Bachelors		Masters	
	Value	Z-score	Value	Z-score
Students that passed the midterm test (%)	69,30	3.53	78,92	-0,88
Students that passed the final exam (%)	69,50	-1,29	84,38	0.05

A final analysis was conducted to examine the relationship between exam mode and the course grade distribution. The grade distribution for the two exam modes is shown in Table 7 and Table 8.

Table 7: Bachelors

Year	Satisfactory (3)	Good (4)	Very Good (5)	Excellent (6)
Classroom exams				
2007 - 2008	1	8	12	10
2008 - 2009	2	4	11	14
2009 - 2010	1	1	16	24
2010 - 2011	1	7	19	17
2011 - 2012	4	15	8	7
2012 - 2013	12	19	8	3
2013 - 2014	12	21	9	8
2014 - 2015	5	5	7	6
Online exams				
2015 - 2016(1)	3	14	17	11
2015 - 2016(2)	2	5	16	33
2016 - 2017	3	8	22	9

Table 8: Masters

Year	Satisfactory (3)	Good (4)	Very Good (5)	Excellent (6)
Classroom exams				
2007 - 2008	2	7	13	8
2008 - 2009	1	3	10	13
2009 - 2010	2	18	17	12
2010 - 2011	2	5	13	14
2011 - 2012	3	10	23	9
2012 - 2013	17	9	13	11
2013 - 2014	1	9	22	7
2014 - 2015	7	8	9	13
Online exams				
2015 - 2016(1)	1	1	6	26
2015 - 2016(2)	0	2	5	18
2016 - 2017	1	2	10	14

A chi square test for independence where the degree of freedom = $(r-1)(c-1) = 3$ and N is the number of the students who successfully completed the course revealed

a significant relationship between exam mode and grades, with a higher percentage of students in the online exam mode earning 6s and 5s than students in the classroom exam. Results are:

- Bachelors $\chi^2(3, N = 440) = 10,818, p=0,012$.
- Masters $\chi^2(3, N = 397) = 47,99, p=0,000$.

Both p-values, $p=0,012$ for bachelors and $p=0,000$ for masters are less than 0,05 and are highly significant, indicating that there is an association between the variables. It is obvious that increased emphasis on grades of students in the online exam mode is not due to random variation.

The results are summarized in Table 9.

Table 9: Course grade distribution

Course grade								
	6		5		4		3	
Exam format	N	%	N	%	N	%	N	%
Bachelors								
Classroom exams	89	29,97	90	30,30	80	26,94	38	12,79
Online exams	53	37,06	55	38,46	27	18,88	8	5,59
Masters								
Classroom exams	87	27,97	120	38,59	69	22,19	35	11,25
Online exams	58	67,44	21	24,42	5	5,81	2	2,33

Discussion

One of the purposes of this study was to examine the students' preferences to the way of taking their exams. The findings, not surprisingly, indicated that bachelors prefers the online exam mode ($Z=3,53$). As it concerns the masters there is no big difference in the preferences concerning the exam mode ($Z = -0,88$). The class project requirement for successful graduation decreases the number of students who take the final exam successfully.

In this study grades are compared too. The findings suggest that in online exam mode there is a noticeable course grade increase. A higher percentage of students ($\chi^2 > 10$) who completed the online exams earned 6s and 5s compared to students who took exams in the classroom. These unproctored online exams can be treated as learning activity instead of primary graduation methods. Mixing online exams with classroom activities can give us more precise grades.

Conclusion

In this paper we explore students' attitude towards the way the exams are conducted. This survey encompasses 8 classroom and 3 online exams within 11 courses. Over 1200 students take part in the study. As a result it is clear that students in the bachelor program prefer online exams while students in the master program are highly motivated to take both exam modes. The grades analysis shows that students who take online exams earn higher grades compared to students who take classroom exams.

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СРАВНЕНИЕ НА ИНТЕРАКТИВНОТО И ТРАДИЦИОННО ТЕСТВАНЕ ПРИ ИНФОРМАТИЧНИ ДИСЦИПЛИНИ

Юлиана Пенева, Делян Керемедчиев

С развитието на информационните технологии все повече традиционни учебни дейности се осъществяват през интернет. Въпреки някои добре различими ползи от он-лайн оценяването в сравнение с традиционния присъствен писмен изпит, съществуват различни мнения относно ефективността на електронното изпитване. В настоящия доклад изследваме двата типа изпит в две направления. Първо, изследваме предпочитанията на студентите при полагане на изпит. Второ, сравняваме резултатите от учебната дейност посредством оценките и следващите изяви на студентите. Данните са натрупани в продължение на 11 семестъра за студенти в курсове по информационни технологии в бакалавърска и магистърска програми на НБУ. Курсовете са провеждани от един и същи лектор. На студентите са предлагани и двата типа изпитване. Намираме, че студентите от бакалавърската програма предпочитат он-лайн изпитване, а в магистърската студентите не изявяват предпочитания. Според нас он-лайн оценяването не влошава учебния процес и може да е в подкрепа на индивидуалния стил на учене.