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Designing formative assessment in physics course in higher education

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Abstract: Assessment in education through web tools, which is also known as e-assessment, deals with the main question of how to use technology in an effective way that supports a successful pedagogy. The aim of this study was to investigate the learning outcomes and the attitudes of students to online Moddle quizzes as part of the course. The research population included 204 students who participated in an introductory physics course at the college. Learning model was designed based on face to face large traditional lectures, practice sessions held with smaller groups of about 25 students and a rich Moodle learning environment. The students' knowledge was assessed by ordinary short written tests and online quizzes. Attitudes were investigated by a questionnaire. Results indicate a general positive attitude towards online quizzes with no differences in respect to gender. A positive significant correlation was found between attitudes and scores in online quizzes. Compering data from the first and the last attempts in the online quiz revealed significant improvements in the time spent solving and the grade. Three variables were found as significant predictors of the grade in the final exam: science department, average grade in written tests and average grade in online quizzes.

Keywords: Formative assessment, Virtual learning environment, Higher education, Design research

Introduction

High education is changing. The old days, where an all-knowing instructor was talking in front of eager students who wrote every single word, can last no more. Today, most, if not all the students have access to learning materials via the internet (Brown, 2006). The students expect to be guided through their learning process. They expect the instructor to teach them to build their knowledge and comprehension of the given subject. Even more than that, they expect them to use technology to do this. Instructors must meet with this challenge and integrate technology into their courses in an effective way that assists the learning process of the students. To do so, the instructors have to be confident that the investment is worthwhile, that effective use of new tools leads to better outcomes both in students' views and in their professional understanding. According to Trow (1999), studies are needed in this area to help teaching staff in colleges, universities, the possibilities of using technology as effective tools in the teaching process and the positive outcomes that it may bring about. Investigations of knowledge through purposeful design features in the learning environment are part of the designed-based research approach (Bell, 2004; Faste & Faste, 2012; Kali, 2006). This present study falls in this category. We studied the implementation of Moddle quizzes in a physics college course for life – sciences students. The focus was on investigating the role of the online quizzes as part of the learning environment.

The main goal of this research was to study the learning outcomes and the attitudes of students to online Moddle quizzes in order to improve instructional design. 204 students participated in an introductory physics course at the college. Blended learning model was used based on face to face large traditional lectures, practice sessions held with smaller groups of about 25 students and a rich Moodle learning environment. The students' knowledge and understanding were assessed weekly,

throughout the semester, using an ordinary short written tests and online quizzes in the Moodle environment.
The quizzes had a random factor that the Moodle environment allows, so that in the next attempt, the student was required to answer the same questions as in the previous attempt, but with different numbers. A full and richer feedback, including a verbal feedback and clues about how the questions could be solved, was given at the end of the week. We checked the behavior of the students in this content: how many attempts did they use, was there an improvement from the first attempt to the last one, how much time did the students spend during a single attempt, did it change from the first attempt to the last one, and was there a correlation between the outcomes in quizzes and the score in the final exam. We conducted an attitudes questionnaire (Cronbach alpha reliability coefficients was $\alpha = 0.887$). The students were asked whether they preferred online quizzes or written tests, and were required to explain their choice. In addition they were asked about the number of attempts they recommend in the online quiz.

Results

120 students answered the questionnaire, 66 of them (55%) were males and 54 (45%) females. Results indicate a general positive attitude towards online quizzes. No differences were found in respect to gender. The results are shown in Table 1

Table 1. Students' attitudes toward online quizzes sorted by categories

Category	Mean Min=1, Max=5	S.D.	Example of statement
Feelings	3.36	1.02	"I feel relaxed when I solve the online quiz"
Behaviors	4.06	0.79	"in preparation for an online quiz I solve exercises, just like I prepare for a written test"
Contribution to self-assessment	3.44	0.88	"solving the quiz helped me to figure my problems in the course material"
Using parametric strategy	3.35	1.01	"I used parametric manipulation when I solved the quiz"

We calculated correlation between the attitudes and the scores in online quizzes, using linear regression. A positive significant correlation was found ($F=16.065$, $p=0.000$, $r^2=0.131$, $y = 41.938+ 8.537x$, $Zy = 0.361*zx$). 76% of the students preferred online quizzes. 3.57% would recommend only one attempt, 34.82% recommended 2 attempts, 40.18% recommended 3 attempts, 12.50% recommended 4 attempts and 8.93% recommended 5 attempts for each quiz. Compering data from the first attempt versus the last attempt in the last online quiz revealed significant improvements in the time spent solving the online quiz and the grade. Table 2 presents the results.

Three variables were found as significant predictors of the grade in the final exam: science department, average grade in written tests and average grade in online quizzes. The results are presented in Table 3.

Table 2. First attempt vs. last attempt in the last online quiz

Category	First attempt		Last attempt		t-test
	Mean	S.D.	Mean	S.D.	
Grade in online quiz	53.38	31.12	82.39	22.99	t = -10.69*
Time spent solving the online quiz (minutes)	38.85	15.26	26.13	13.49	t = 7.09*

* P<0.001

Table 3: Regression models for predictors to final grade

Model	Significance	r^2	Regression equation	Standardized equation
Regression model for predictor: department	F=3.916 p=0.050	0.042	y=71.795-4.082x	Zy=-0.205*zx
Regression model for predictor: average grade of written tests	F=40.036 p=0.000	0.292	y=37.520+0.419x	Zy=0.541*zx
Regression model for predictor: average grade of online quizzes	F=24.677 P<0.003	0.203	y=23.264+0.521x	Zy=0.450*zx

Learning outcomes and the attitudes of the students to online Moddle quizzes were used to improve instructional design demonstrating formative assessment in higher education. Improvement-oriented evaluation (IOE) is a utilization focused evaluation. It is a form of evaluation that stresses making things better. Gathering data about strengths and weaknesses and using it for inform an ongoing cycle of reflection is the main objective (Gray, 2008).

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