

Delivering first year Physics assignments with limited resources — An Australian three-centre study

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Introduction

Finding the right mix between first year Physics face-to-face tutorial classes and student self guided study with assessable components has been subject to numerous studies over the past decades. The right mix is usually measured by the immediate outcome of a student's performance, i.e., the ultimate bottom line in the final exam. For effective teaching of first year physics students, small tutorial classes are very much desired by students and lecturers alike. Currently, physics majors have the unique privilege of having small tutorial classes. This is because of the number of students enrolled in science degrees, and in particular in physics, has been consistently low for many years. The number of teaching and tutorial staff too has declined in many physics departments throughout Australia; a consequence of budgetary constraints following a supply and market adjustment and a changing economic environment. Fortunately, for physics majors class sizes are not a constraining factor for quality face-to-face tutorials and continuous assignments. The situation is somewhat different for non-physics majors who require a good physics foundation only during their first semester at university. Their background is diverse (biology; chemistry; civil-, computer-, electrical engineering; etc.) and class sizes in this study range from 120 up to 450 students, i.e., 60 to 150 students per lecturer. As a means to practice and test conceptual understanding of the topic as well as problem solving skills, regular assignments serve as benchmark for teachers and students alike. With 60 to 150 students per lecturer and a bare minimum approach for continuous assignments, say per semester five assignments with five problems each, a marker (which in Australia is usually the lecturer) is looking at 1,500 to 3,750 problems to mark; or a total of over eleven thousand problems for the big classes if the task of marking is not shared. In order to have sufficient time for face-to-face tutorial classes, some physics departments in Australia have joined the general international trend to move the task of delivering assignment, practice and tutorial problems and their marking and evaluation to an on-line system, either in-house developed or delivered by a third party.

The aim of the presented three-centre research is to investigate students' acceptance and perception of the merit of a computerized assignment delivery and assessment system, and to find whether perception differs depending on class size and between schools. The study was carried out during semester 1, 2006, simultaneously at three physics departments; the University of Technology, Sydney, The University of Sydney, and The University of Wollongong. The survey is based on responses from a combined number of over 700 students.

Methodology

First year physics for non-physics majors covers very basic, introductory material of fundamental topics such as Mechanics, Electricity, Waves, Optics and Thermal Physics, which serve as foundation for students' further studies in their respective disciplines. Hence, basic lecture content is fairly similar among different physics departments and respective recommended textbooks are either identical or have only superficial differences in content coverage and presentation. This forms an ideal background for studying students' experience with on-line assignments and evaluation systems. The three centres participating in this study all employed the same third party physics assignment delivery and assessment system, *MasteringPhysics* (www.masteringphysics.com, Pearson



Education), for on-line delivery of regular assignments. *MasteringPhysics* is a subscriber based on-line assignment system, which provided a large bank of physics assignments based on a commonly used textbook. The system keeps track of individual students, the time students spent on assignments, the marks they achieved and reporting marks back to them, availability of and deadlines for assignments, any grace periods and students' comments. Assignments are categorised in Skills Builder (SB), Self-Tutoring Problems (STP) and End of Chapter (EOC) problems. SB and STP problems include interactive features that provide intelligent hints which are either provided if the student appears to be on the wrong track of solving a problem or on student's request. Assignment problems are supported by illustrations and animations. The system is delivered through a third party server, which lecturers and students access through an Internet browser. Hence, all students surveyed in this study are subject to similar technical conditions. On-line assignments can be accessed from any internet browser, e.g., from home, work or university.

Each participating university had conducted *MasteringPhysics* on-line assignment related surveys in the past (Lewis, Vickers and Freeth 2005; O'Byrne and Thompson 2005) which all had their own specific purposes and foci. For the three-centre study, a set of questions (Table 1) based on common circumstances was developed to investigate students' experience with non face-to-face delivery and assessment of assignments. The survey was conducted during the general teaching survey period at each participating university, which was about two to three weeks before then end of the semester. Students were asked to give responses on a scale between 1 to 5; strongly disagree (SD), disagree (D), neutral (N), agree (A), strongly agree (SA).

Table 1. Survey questions

1	The on-line assignment server was always accessible.
2	I participated in the on-line <i>MasteringPhysics</i> assignments regularly.
3	I made frequent use of on-line <i>MasteringPhysics</i> tutorial problems.
4	I did not like the on-line assignments at the beginning of the semester.
5	The 'Introduction to <i>MasteringPhysics</i> ' assignment was useful.
6	I found it convenient to submit assignment problems on-line instead of having to come to the university to hand in a paper version.
7	The number of assessable assignment problems was just right.
8	The number of tutorial problems was just right.
9	The on-line assignment workload for this subject was just right.
10	Continuous assignments have been useful to stay on track in this subject.
11	The on-line assignments help me in problem solving in Physics this semester.
12	The on-line assignments and practice problems helped me understanding of concepts in Physics this semester.
13	The marks I received for the <i>MasteringPhysics</i> assignments are a reasonable indication of my effort and to my understanding of material.
14	I had problems with using appropriate significant figures for solving problems.
15	I found it useful to receive immediate feedback on my marks.
16	I found it useful to receive immediate feedback on my answers.
17	I received prompt responses to questions in Comment after completion of assignments.
18	I found it useful to see solutions of expired assignment problems.
19	I found it useful to have some assignment solutions shown at the university web pages.
20	I believe having done most of the assignments I am better prepared for the final exam than having done no assessable assignments at all.
21	It was easy to get to the solution of an on-line problem by trial and error.
22	Instead of having any marked assignments I prefer to have more weight on the final exam.
23	It does not concern me much that some students may have tried to cheat the on-line system.
24	I am of age ...16-17 18-20 21-23 24-26 >26

Survey results

Several years ago, students frequently reported having problems accessing interactive on-line material from work or home, and in some cases even from within the university. Since then, internet accessibility, bandwidth and browser compatibility have improved tremendously. This development is reflected in our study by only one percent of students indicating that they had problems with accessing the server. The survey does not reveal the actual nature of access problems, i.e., whether it was indeed a server problem or a non-technical related inability of a student to access the Internet. *MasteringPhysics* assignments were assessable at all three universities although with slightly different weight with respect to the final marks for the respective classes (weights ranging from 5%-15% of the total marks). For the purpose of brevity and for highlighting the essential outcome of the survey, the following summary draws conclusions from only the clearly messaged ends of responses, i.e., A+SA and D+SD, leaving out neutral N answers which in general followed the overall majority trend.

Regular participation in on-line assignments was high with only 1%-5% (D+SD) of students not participating regularly. Regular participation in on-line tutorial problems (i.e., non-assessable on-line problems) differed considerably between the universities ranging between 30%-70%, raising the question of what actually encourages or discourages students to participate in non-assessable, non face-to-face tutorials. This has been the only response where the trend of responses differed among the three universities. Generally, students did not like on-line assignments at the beginning of the semester, 45%-65% (SD+D) while toward the end of the semester 62%-75% (A+SA) of students welcomed to have had regular on-line assignments to keep them on track and 55%-68% found the assignments improved their problem solving skills, and 56%-71% felt that the assignments helped their understanding of concepts in Physics, and 68%-70% felt that after having done the on-line assignments they were better prepared for the final exam (at the conclusion of semester 1, 2006, data should become available to evaluate the correlation between students' perception of effectiveness of the on-line assignments and students' actual performance in the final exam). Students very much appreciated the convenience of being able to do and submit their assignments from any place and at any time, 75% (A+SA), compared to paper based assignments (only 5%-10% (D+SD) favoured paper based assignments) and they very useful to receive an immediately marked feedback on their answers, 79%-86% (A+SA), and on their performance, 63%-84% (A+SA). There was a very narrow range of distribution in students' age with 73%-87% aged between 18 and 20.

A more refined analysis of the survey needs to be done, in particular with respect to students' end of semester outcomes. At this preliminary stage though it appears that first year physics on-line delivery and assessment of assignments have become well accepted and appreciated by students; so much that it has become the preference over paper based assignments. This gives teachers the confidence that carefully implemented "outsourcing" of common tasks can indeed be beneficial to both students and teachers with no adverse affect on overall students performance.

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References

- Lewis, R.A., Vickers, R.E.M. and Freeth C.A. (2005) *Mastering Physics? Proceedings of the Blended Learning in Science Teaching and Learning Symposium 2005*, 171-172.
- O'Byrne, J. and Thompson R. (2005) The tutorial benefits of on-line assignments: *MasteringPhysics* in first year physics at The University of Sydney. *Proceedings of the Blended Learning in Science Teaching and Learning Symposium 2005*, 81-92.