Using Non-graded Formative Online Exercises to Increase the Students' Motivation and Performance in Classroom
A Longitudinal Study from an Undergraduate Information Systems Program in Singapore

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Abstract: In a seven terms (i.e., three and a half years) longitudinal study the author has examined how the use (respectively non-use) of interactive non-graded and formative online exercises has impacted the students' attention and motivation in the classroom and, consequently, their level of performance in graded course assessments. This practice paper describes an interactive online system for non-graded assessments which was conceptualised, designed and implemented at the School of Information Systems, Singapore Management University, and this paper presents an analysis of students' performance data gathered in a large compulsory senior-level course, particularly focusing on the comparison of the system users' performance with the system non-users' performance in selected graded assessment components.

1 INTRODUCTION

This paper reports on the results of a three and a half years longitudinal study in which the author of the paper has examined how the use (respectively non-use) of non-graded formative online assessment exercises has impacted students' motivation and performance level in class.

The paper unfolds the following manner.

In chapter two of this paper, the author undertakes a brief review of the role of formative non-graded assessments in higher education. This review shows that – contrary to graded assessments – the question on how non-graded assessments can be used to enhance students' performance in class has been rarely discussed in the higher education literature.

Chapter three discusses the use of online assessment tools, systems and applications in higher education and examines the role of information technology in the space of higher education assessments.

In chapter four, the web-based system for non-graded formative classroom exercises (FACE) designed and implemented at the School of Information Systems, Singapore Management University, is introduced. The chapter briefly introduces the most important features of FACE and also briefly describes a specific application example of the FACE system.

Chapter five presents a brief analysis of the data which was collected over the period of three and a half years. This chapter not only examines the performance data in FACE exercises, but also conducts an analysis of the correlations between the use of the FACE application and the students' performance in selected graded assessment components in the course.

Chapter six concludes with a brief reflection on the usefulness and effectiveness of formative non-graded online exercises in undergraduate programs and makes suggestions on how such exercises could be used to enhance students' motivation, captivate students' attention, and, consequently, to raise students' performance level in class.

2 THE ROLE OF FORMATIVE NON-GRADED ASSESSMENTS IN HIGHER EDUCATION

While there is an abundance of research concerned with the role of graded assessments and exercises in higher education (Black and Wiliam, 1998); (Cowan, 2002); (Nicol et al., 2005); (Rust et al., 2003); (Taras, 2002); (Zvacek, 1999), only little attention has been devoted to the role of non-graded assessments (Anthony and Raymond, 2004). Moreover, it seems that there is no clear understanding on how summative, formative and self-assessments relate to each other (Taras, 2008b).

Some of the research investigating the effectiveness of non-graded assessments claims that there is a lack of logic in the argument that working in a non-graded context is the best way for students to build up knowledge for formal, graded assessment (Duvall, 1994); (Taras, 2005); (Warren, 1998). Consequently, the non-graded exercises are unlikely to receive the same attention from the students as the graded assessments (Taras, 2008a). Thus, some research argues that – if understanding the graded assessment component is the ultimate goal – then it would be more effective if these were the point of focus and not the non-graded exercises (Anthony and Raymond, 2004).

Selected research, however, shows that all too frequent graded assessments have a "negative impact on motivation for learning that militates against preparation for lifelong learning" (Harlen and Crick, 2003) – this way arguing that non-graded assessment exercises would actually help to achieve the opposite effect.

Some research work seems also to suggest that graded assessments force students to focus on performance rather than learning (Grant and Dweck, 2003). This would, in turn, imply that non-graded assessments support students in focusing on the subject mastery and on the learning process instead of thinking of "passing the course".

3 ONLINE ASSESSMENT TOOLS IN HIGHER EDUCATION

The use of web-based interactive learning and teaching tools has increased tremendously over the past decade. There are numerous commercial and open-source learning and teaching management applications currently available on the market (Blackboard, Desire2Learn, WebCT, Moodle and others).

Recent research has shown that online-based teaching and learning tools may improve students' learning and performance in higher education courses. Selected research has examined the use of interactive, computer-based assessment tools for the purposes of student practice and feedback and found a significant performance difference between students using the computerised practice tests and those who did not (Gretes and Green, 2000). The use of computer-based assessment and practice tools also seems to have a positive impact on students' motivation (Thelwell, 2000).

In addition, research has found that online-based or computer-based teaching and assessment tools are also attractive to the teaching personnel as they increase interactivity in the classroom and make assessments and activities more attractive to students (Wolsey, 2008).

Most recently, the term eAssessment has been adopted in the higher education research. Pachler (Pachler et al., 2010) employs the term *formative e-assessment* which he has defined as "the use of ICT to support the iterative process of gathering and analyzing information about student learning by teachers as well as learners and of evaluating it in relation to prior achievement and attainment of intended, as well as unintended learning outcomes" (p. 716). This definition stresses the important role of information technology in the space of higher education assessments and can be applied to graded and non-graded assessments equally.

4 INTRODUCTION TO "FACE"

4.1 The Origins of FACE

The web-based system for non-graded formative classroom exercises (FACE) was fully designed and implemented at the School of Information Systems, Singapore Management University.

When evaluating open-source as well as licensed products currently available on the market, the author of the paper specifically focused on the following requirements:

1) Ability to integrate with university-internal course, curriculum and personnel management systems
2) Ability to facilitate individual use of the system across different groups (i.e., sections) of one and the same course

3) Ability to work with flexible and configurable exercise templates
4) Ability to collect and use student performance data and to monitor students' performance during the course
5) Ability to publish and un-publish exercises for particular weeks

As none of the evaluated systems fully satisfied the requirements, the author has decided for an in-house implementation of the system.

4.2 Functionalities of FACE

The FACE application is a web-based system which has been designed using Microsoft ASP.NET and Microsoft SQL Server technologies. The FACE application uses Windows credentials and Enterprise Single-Sign-On to authenticate the users. Moreover, the FACE application is tightly integrated with a university-internal course management system.

The FACE application has two main interfaces: one interface is exposed to students (i.e., the practicing interface) and one interface is exposed to the teaching personnel (i.e., the administrative interface).

The administrative interface provides the teaching personnel with the following major functionalities:
1) Setting up formative non-graded exercises for a given session based on a range of pre-defined exercise templates
2) Determining the desired number of exercises per session
3) Manually opening and closing the exercises or setting a specific date and time range when the exercise can be accessed
4) Configuring the correct solutions for a given exercise
5) Determining the number of attempts after which the students will be able to access the correct solutions for the given exercise
6) Examining the results of the exercises using graphical data analysis tools

The practicing interface exposes to the students the following major features:
1) Accessing the formative non-graded exercises opened for a given session and executing those exercises
2) Accessing the correct solution for a given exercise after the pre-set number of attempts
3) Monitoring the own performance across several sessions

The exercises in FACE are non-graded, they are formative in nature and there is no specific time limit enforced to complete a certain exercise. Upon saving the selected set of responses, the system notifies the student if the exercise has been solved correctly. Once a certain number of attempts for a given exercise has been reached, the students can (if they chose to do so) access the correct solution for that exercise. Otherwise, the students may re-attempt the exercise until they achieve the correct solution themselves without consulting the solution repository.

4.3 Use of FACE in the Enterprise Web Solutions Course

4.3.1 The Enterprise Web Solutions Course

The Enterprise Web Solutions course is a large compulsory third year course at the School of Information Systems, Singapore Management University. This course focuses on the enterprise portal technologies and it exposes the students to the complete life cycle of an enterprise portal in an organisation.

The course is run both academic terms – in term 1 (August to December) and in term 2 (January to May). In term 1, 160 students in total are taking this compulsory course, in term 2, 80 students are taking this course. Out of the 160 students in the first term, 80 students have been constantly using the FACE application, out of 80 students in the second term, all 80 students have been using the system.

4.3.2 Deployment and Productive use of the System

The initial deployment of FACE took place in January 2010.

To enable long-term comparison, the exercises set up for the Enterprise Web Solutions course were similar across all sections of one particular term, and the exercises were similar across different terms, too. To achieve this similarity, consistently the same exercise templates were employed, and similar and comparable content was used to "feed" the exercise templates.

All formative assessment exercises set up in the FACE application were targeted at students' self-reflection and self-testing. Most importantly, the exercises did not require the students to memorise facts, to copy answers from the given lecture material, or to guess the correct answers.

Rather than that, the exercises encouraged the students to seek for the underlying meanings, to explore relationships between different concepts, or

to compare advantages and disadvantages of specific approaches. In addition to that, one of the most essential intrinsic values of those exercises was their non-graded nature.

This means, that the students were able to complete those exercises without any fears of earning a bad mark or negatively impacting their score for the course.

5 DATA ANALYSIS

5.1 Data Collection

The FACE system collects diverse quantitative data on students' performance in the exercises.

Firstly, the system captures the number of attempts which a particular student needs to complete a given exercise. Secondly, for a given attempt of a particular exercise, the system captures the "correctness" or "incorrectness" not only for the exercise as a whole but also for every individual response within a given exercise. Thirdly, the system captures the time elapsed between a particular student's attempts of the same exercise.

This quantitative data captured within the system is used in several ways.

During the course, the teaching personnel can use charts and other visualisation means produced by the application, to display to students the overall class performance in terms of attempts needed to complete the exercise. The system also uses this data to provide the students with an immediate feedback concerning the correctness of their individual solution. In addition to that, the system allows the students to monitor their own performance across several sections of the course – e.g., monitoring how many attempts they need to solve a given exercise, how this number has changed over time. Moreover, the data is used by the teaching personnel to capture the most frequently made mistakes in a given exercise – and those problematic cases are usually selected as topics when carrying out the FACE exercise review at the beginning of each subsequent class.

In order to enrich the insights delivered through the quantitative data, the author of the paper has also conducted three informal student focus groups on the use of the FACE application. The first focus group was conducted one month after the introduction of the tool in the course. This focus group was primarily concerned with discussing with students their perceptions as to the use of the tool itself – the accessibility of the system, friendliness of

use, any desired new features etc. The second focus group was conducted at the end of the first year of the system's use. This discussion particularly focused on the students' perception of the usefulness of this tool for their understanding of the course concepts. The third focus group was conducted at the end of the second year of the system's use and it was primarily concerned with understanding how the use of the FACE system is correlated with the students' performance in other course assessments.

5.2 Data Analysis

Although the data collected by the FACE application was used for different purposes, the most interesting findings were generated when analysing the correlation between the use (respectively non-use) of the FACE application and the students' performance in other assessment components of the course (the paper uses the data of one sample graded assessment of the course, namely, quizzes, and examines how the use (respectively non-use) of the FACE applications impacted students' performance in this particular assessment).

The performance data was analysed along three different dimensions: average time needed to complete the exercises, average number of attempts needed to complete the exercises, and average number of errors per attempt. Interestingly, while there is a clear positive change in students' performance within a particular term (e.g., the students need far more time to complete the exercise at the beginning of the term and considerably less at the end of the term), there are no changes in the performance across different terms – the pattern stays the same across all the examined terms.

The similar pattern across all examined academic terms is, however, easily explainable.

Due to the almost non-existent exposure of students to similar formative non-graded exercises in other courses, the students seemed to have considerable difficulties in developing the appropriate attitude to such exercises. Moreover, the students doubtlessly needed some time to develop adequate reasoning and evaluation skills – as the exercises primarily required the students "to look beyond the scenes" instead of memorising and reproducing some given facts.

The consistent pattern across all four terms under examination clearly suggests that non-graded formative exercises can considerably contribute to the development of such skills. With a comparably small time investment during the class (the Enterprise Web Solutions course devoted

approximately 15 minutes to the completion of the exercises and additional 10 minutes to the discussion of the previous week's exercises), the students appeared to considerably improve in their abilities to quickly evaluate given concepts, assess the relationships among those concepts, to reflect on different aspects of those concepts (disadvantages vs. advantages, pros vs. cons), or to establish logical combinations of those concepts.

Further development of these abilities, in turn, seemed to have positive influence on the students' performance in other course assessments.

A comparison of the performance level in the quiz assessment for the students who used the FACE application versus the students who did not use the FACE application (considering the time period of the entire study reported in this paper – from term 1, 2009 to term 1, 20012) support this assumption.

The quiz assessment is conducted three times per term. The first quiz is conducted in week 4, the second quiz in week 9, and the third quiz in week 12. The complexity of the quizzes increases from assessment to assessment: while the first quiz has 5 questions and 5 minutes allocated to it, the next quiz has 6 questions (to be completed in 6 minutes), and the last quiz has 7 questions which need to be finished within 7 minutes. The quizzes conducted in the Enterprise Web Solutions course are a combination of two types of questions – multi-select questions or short-answer questions. Contrary to typical single-choice or multiple-choice quizzes, the quizzes conducted in this particular course are not targeted at memorisation and reproduction of facts or data. Rather than that, the students need to evaluate the plausibility of given statements, assess the possibility of combining different options, exclude or include various alternatives.

While the difference in the maximum marks in this particular assignment is small (FACE users vs. FACE non-users), very interesting is the pattern concerning the minimum mark achieved in this assessment.

As indicated above, the first quiz is conducted in week 4 (the FACE exercises start in week 2). Consequently, there is not much opportunity for students to practice on the non-graded exercises until the first quiz. Thus, the impact of those exercises on the actual assessment seems to be low. For quizzes conducted in weeks 9 and 12, however, the impact seems to steadily increase as the minimum mark (and, consequently, the average mark) for those assessments for students using the FACE application is consistently higher than for those students who do not use FACE (e.g., considering all terms under examination, for quiz 2, the non-users of the FACE system achieved the minimum mark of 2.0, but the FACE users the minimum mark of 3.8, for quiz 3, the non-users had the minimum mark of 2.0, the users the minimum mark of 4.1 out of 10).

To obtain some qualitative data supporting the results of the quantitative data analysis, three information focus groups were conducted with students of the course.

While the first focus group was primarily focusing on the design aspects of the tool (and led to several changes in the layout of the practicing and student-facing interface), the most important insights concerning the perceived usefulness of the tool from the students' perspective was gained through the second and third focus group.

One of the most frequently discussed aspects was the students' difficulties in getting "used" to the nature of the tool.

One of the participators of the focus group 2 formulated this aspect in the following way:

The most difficult thing here is to get used to the fact that the exercises are non-graded. Personally, I did not take them seriously at the beginning. I thought: I do not get a mark for this thing, so why should I be doing it?

Another student of the same focus group added:

For me, it was not taking it seriously or not. I was actually afraid of doing them. I was afraid of making mistakes. I thought that somehow it will impact my grade for the course. So it took for me a long time to see that nothing bad happens if I make a mistake. That I can start over again and try to fix it.

Most students clearly confirmed the fact that there was a considerable effort involved in getting used to the nature of the exercises and accepting the fact that those exercises are neither graded, nor taken into account when assigning the final mark for the course.

However, it seems that most students – particularly later in the course – started to appreciate the non-graded and formative character of the exercises and feedback given to those exercises. As one of the participants of the third focus group noted:

Towards the end of the course, I started to feel so good about those exercises. The main thing was that the pressure was gone. I knew that I have the freedom in doing them the way I like. Making mistakes ... trying out ... looking for the right answers ... yes, thinking about them.

Moreover, the students pointed out to the fact that those exercises were particularly useful because of their online availability. In fact, most of the students stated that they continued to look at those exercises in their time outside the actual class, too, and that they used those exercises to prepare for the final exam of the course.

Additional features appreciated by students was the immediate feedback which the system returned upon each of the attempts, the possibility of monitoring own performance across several sections of the course and the accessibility of the correct answers after a specific number of attempts (although most students indicated during the focus groups that the temptation to access the correct solutions as soon as they got available considerably decreased over time – instead, most students attempted to finish the exercise without consulting the solution repository). Moreover, most students also considered the "post-exercise" review done during the subsequent class very useful for their understanding of the concepts and topics covered in class.

6 CONCLUSIONS

The current study has shown that non-graded formative online exercises have the potential to considerably improve students' understanding of complex concepts and their underlying meanings. The study has also demonstrated that such exercises are helpful in emphasizing learning and reinforcing important concepts covered in a course, and they also may be instrumental in increasing students' motivation and engagement in class.

Although the current study has been carried out in the context of Information Systems education, the insights gained through this study appear to be applicable to any higher education program which is motivated to provide students with a greater choice and ownership in their learning and which is determined to emphasize student-centered and student-focused teaching and learning.

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