Guided Exercises – A Case Study

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***Abstract* – Information Communication Technology (ICT) are useful to get attention of the new generation of students and make them interested in subjects. Several studies show that methodologies supported by ICT can be a way of promoting active learning in Higher Education. In this work a case study is presented where a methodology supported by ICT called, Guided Exercises, was implemented. A Guided Exercise helps students to relate models and help them to solve a complex exercise step by step. This strategy has been used in a Civil Engineering Course, Soil Mechanics II, since the academic year 2015/16. The results obtained in academic year 2015/16 sustain that students considered the strategy useful for their learning process. Analyzing their academic performance, it can be concluded that students that used this methodology had better results in the exam and, also, a better approval ratio.**

Keywords – Active Learning; Autonomous Study using ICT, Engineering, Guided Exercises.

INTRODUCTION

Although the technical evolution and the several challenges that teaching in higher education faces, the predominant model of teaching remains the same: a lecture mode model [1].

This extended abstract aims to present a study about the application of Guided Exercises. Guided Exercises is a strategy/methodology based on active learning. The term "active learning" assumes two basic premises: 1) learning is by nature an active effort and 2) different people learn in different ways [2, 3]. This methodology is intended to develop skills in students to prepare them to: i) solve problems and ii) study autonomously.

In this extended abstract, students' perceptions about this methodology are presented and the correlation of its use with students' academic performance is made.

GUIDED EXERCISES

The Guided Exercises [4] strategy was designed after a process of Disciplinary Collaboration [5] with the aim of promoting students' motivation and interest to the study of physics using active learning strategies. The authors found that when students had to solve an exercise, they were only concerned to know which formula to use and they are not concerned in understanding the exercise. This behavior is similar to that reported by Saul [6] and the Heller's team [6,7]. According to them, students are able to solve the typical end-of-chapter exercises from the books, however, this is not an indicator that they understand the physical situation underlying the exercise, i.e., that they are not able to do the connections of the physical concepts with a real situation. To attempting to resolve the problems identified either in literature or in the empirical study by Oliveira [5] a strategy called "Guided Exercises" was designed. This strategy initially developed for physics courses has been adapted and implemented in Civil Engineering Courses, namely in Soil Mechanics.

A Guided Exercise divides a typical exercise in several questions that students must answer in a logical sequence. So, before performing a calculation, students must answer a conceptual question about the concept/phenomenon that is associated with the exercise. This approach is according with the study performed by Hegde and Meera [8], in which the authors argue that the first step to solve problems or exercises, is to identify the physical principle applicable to the situation. The same authors establish that there is a weak association between the students' conceptual structure and the physical principles, which acts as a major difficulty in solving problems. Most often, the technical terms of the exercise can act as a trigger for the demanded equation but, if unable to do so, may block the full resolution of the exercise. Practically, all exercises are elaborated to train a matter and are solved by using formula or mathematical formalism [9] restricting students' understanding of real situations. The aim of Guided Exercises is to encourage the students not only to apply formulas, but also, to associate the formulas with the underlying concepts. Thus, we try that students understand which models and reasoning are required to solve the exercises, and later apply this knowledge in new situations.

CASE STUDY

Since 2015/2016 was introduced in University of Aveiro Soil Mechanics II (SMII) course the Guided Exercises strategy to improve the teaching-learning process keeping the students at the center of the procedure. One of the objectives was address some issues identified during the last years of project-based learning use, namely the fact of some students tending to compartmentalize contents [10].

During that academic year, it was made available in Moodle one or two Guided Exercises per chapter so that students can access and practice. Students' participation was voluntary and didn't influence their final grade. The course had 27 enrolled students from which 22 were evaluated.

At the end of that academic year a questionnaire, with 17 closed questions associated to a Linkert Scale and 3 open questions, was applied and 20 students answered. Its goal was to understand their acceptance about Guided Exercises.

Analyzing the students' answers to the questionnaire, it can be said that:

- For 80% of students, Guided Exercises were important to their learning process;
- For 75% of students, Guided Exercises helped them to understand the steps required to solve an exercise;
- For 70% of students, Guided Exercises oriented them to solve other exercises.
- 50% of students said that they used Guided Exercises to review contents;
- 39% of students explicitly said, in the open questions, that used Guided Exercises to support their study;
- 23% of students said, in the open questions, that Guided Exercises helped guide them through an exercise.

Based in the questionnaire results it can be said that the students' global perception about Guided Exercises is that it is important for their learning process because it permits to organize their response and understand about what they must do in each part of the exercise.

The next step was to try understanding the impact that Guided Exercises had in students learning. For that analysis, it was necessary to define some criteria to consider if a student effectively used Guided Exercises. Those criteria were: a) solved more than 50% of Guided Exercises available; b) had a positive grade in the Guided Exercise. Thus, there were 6 that satisfied both criteria. The other 16 students although having solved some Guided Exercises, didn't satisfy both criteria.

At the end of semester, we compared the exam grades between two groups: the 6 students that solved Guided Exercises; and the rest of their colleagues (16 students). The analysis of exam grades was made using SPSS (Statistical Package for the Social Sciences). Mann-Whitney test was applied between the two groups adjusting the significance level to the number of tests performed. The results revealed significant differences between the ratings of these two groups of students. Comparing the average final scores of the two groups of students, it was found that students who had solved Guided Exercises, obtained a final average rating 23% higher (p = 0,017). It was, also, analyzed the number of students that were approved in the exam. The group of students who had better results was the group that used Guided Exercises (more 37,5% of students approved in the exam, p = 0,022).

CONCLUSIONS

The Guided Exercises is one of several teaching-learning strategies that can be implemented in higher education. The objective of such strategy/methodology is orientating the student reasoning through the resolution of a complex exercise which is divided in several questions addressing the knowledge that students must mobilize and guiding them into simple steps.

So far, the results are encouraging and suggests that the Guided Exercises methodology is a valid complementary strategy to improve the quality of the learning process. This conclusion is supported both by the results of the academic performance and student's perceptions. The statistical analysis performed to the final marks of the students which used Guided Exercises during their study process revealed a statistically significant impact of this learning strategy in their academic performance.

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