Online Self-Assessment as a Learning Method

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Abstract

Algorithms and Programming Languages is a core subject in the BS Degree in Mathematics at the authors' university. Some of the students are very interested in computer programming but most of them find the subject quite hard. This situation is particularly stressed when concerning theoretic and, in fact, many students point at these contents as the main difficulty of the subject. Because of this, the authors decided to explore new ways to improve the student learning of theoretical concepts. Thus, they analyzed the use of online self-assessment tools as a self-learning system. To perform this analysis two different kinds of tools were chosen and the authors developed an experiment to evaluate, on one hand, the possible use of self-assessment tools as self-learning systems and, on the other hand, to compare the tools to each other.

1. Introduction

Algorithms and Programming Languages (APL) is a first year core subject in the BS Degree in Mathematics with 120 class hours. Some of the students in the subject have experience in computer programming, but for most of them this subject is their first contact with computers so it turns out to be quite hard. Three months after the beginning of the classes a poll was conducted, it implied three main conclusions: (1) the students felt very positive about the subject and the teachers. (2) They thought the subject was important and difficult. (3) The students declared to study little or nothing, in special theoretic. Such results made the teachers perplexed and pushed them to explore new ways to face the big problem: the learning of theoretical concepts.

2. Exposition of the Problem

While the teachers were conducting the poll, they wondered about offering on the website a multiple-choice self-assessment tool. This tool would allow the students to assess the learning they had acquired. This approach was pretty simple but raised some questions. It could convince the students that the subject would be assessed with multiple-choice questions whereas the exams would have a more practical nature. If the tool only provided answers, but no explanations, it could dissuade the students from using the tool or, worst, frustrate them.

That's why different options were looked for. After a pretty exhaustive research the authors found a self-assessment tool with a different approach: Duck[1]. Three things distinguish Duck from multiple-choice tools: (1) The kind of questions available, (2) the assessment and (3) the navigation style. Such characteristics made Duck an interesting possibility to offer a self-assessment tool that would provide added value to the students. So, considering the need of new ways of improvement in the learning of theoretical concepts, the teachers saw the need of analyzing multiple-choice tools and others such as Duck.

3. Background

There are many literature about the influence of assessment on learning; however, although most of the references state an improvement in the learning, the authors have not found any reference that provided strong evidences to establish an unambiguous relationship between both phenomena. For instance, Sly and Rennie talk about a computer based tool to perform formative assessment [4]. However, no data about the influence of assessment on learning are provided. Lapidot describes some experiences that show how off-line self-assessment can act as a powerful motivation technique [2] but does not give any data about the influence of self-assessment on learning. So, this paper intends to provide some evidences about the effectiveness of self-assessment as a learning method by means of a rigorous experiment to link unambiguously self-assessment and self-learning.

Two kinds of learning appear in self-assessment tools: operant learning [3] and meaningful learning [1]. Operant learning is a learning process by which the behavior of an individual takes place based on its consequences. On the

[1] `http://bcrc.bio.umass.edu/projects/duck/`

other hand, meaningful learning is acquired when the student establishes relationships between his previous knowledge and the new knowledge. If these concepts are translated to the experiment described in this paper, it can be found that multiple-choice tools can fit into operant learning while Duck helps to reach a meaningful learning because when the student answers a question he does not get a score but a feedback that helps the student to elaborate his own reasoning and reach the most suitable solution.

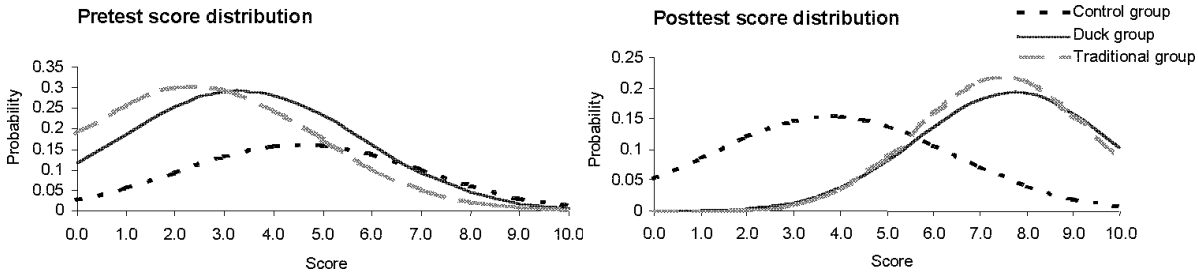

Figure 1. Score distributions in pretest and posttest

4. Hypothesis and Research Methodology

The hypothesis to prove was: "Use of web based self-assessment tools improves the students learning of computer programming theoretical concepts". The independent variable was the use or absence of self-assessment and the dependent variable was the academic performance.

The population chosen to perform the experiment comprised the students of APL for the academic year 2001/2002. A stratified random sampling was conducted. Afterwards, a number of individuals were randomly chosen from each subgroup and assigned to the groups I, II and III. The nature of each of the groups (experimental or control) was also randomly decided.

The experiment is a bivalent design pretest-posttest with one control group –C– and one experimental group for each of the self-assessment tools (duck –D– and traditional –T–). The control group would not receive treatment while the experimental groups would experiment two different levels of the independent variable: group D would use the tool Duck and group T would use a traditional multiple-choice tool.

In the first session a Likert scale was administered to the students in order to find out their attitude to the subject. Later, they took a pretest –which penalized random answers– to determine their academic performance before the experiment. At this first session groups D and T received their first treatment session. The treatment administered to group T consisted in the use –1 hour per session– of a multiple-choice tool. Group D used a tool based on Duck with the same items and choices. However, the answers were neither right nor wrong but provided feedback about their suitability.

To finish the experiment, a week after the conclusion of the treatment the three groups were administered a Thurstone scale to evaluate the students home work performance during the four weeks taken by the experiment. Moreover, the three groups took a posttest.

6. Discussion of Results and Conclusions

This experiment provided data to determine the students' attitude toward the subject, their knowledge before the treatment (pretest), their knowledge after the treatment or in its absence (posttest), and their performance. Because of the brevity of the paper, we cannot provide numeric results but only a short discussion of the conclusions drawn from them[2]. The scores reached by the three groups in all the measurements follow a normal distribution and show homogeneous variances. Applying ANOVA to the results obtained in the pretest, the posttest, and the attitude and home work performance tests showed that the three groups were statistically equivalent. What this means is that the noticeable differences in the posttest –see Figure 1– can only be ascribed to the self-assessment tool used in the experiment. So, we can state that the use of web based self-assessment tools improves the students learning of computer programming theoretical concepts.

References

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[4] Sly, L., and Rennie, L.J., Computer managed learning: Its use in formative as well as summative assessment, in Proceedings of the 3rd Annual CAA Conference, June 1999, Loughborough University.

[2] An extended version of this paper can be found at `http://www.di.uniovi.es/~dani/publications/extended-icalt2003.pdf`