

A PROPOSAL FOR ENHANCING THE MOTIVATION IN STUDENTS OF COMPUTER PROGRAMMING

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Abstract

Computer programming is known to be one of the most difficult courses for students in the first year of engineering. They are faced with the challenge of abstract thinking and gaining programming skills for the first time. These skills are acquired by continuous practicing from the start of the course. In order to enhance the motivation and dynamism of the learning and assessment processes, we have proposed the use of three educational resources namely screencasts, self-assessment questionnaires and automated grading of assignments. These resources have been made available in Moodle which is a Learning Management System widely used in education environments and adopted by the Telecommunications Engineering School at the Universidad Politécnica de Madrid (UPM).

Both teachers and students can enhance the learning and assessment processes through the use of new educational activities such as self-assessment questionnaires and automated grading of assignments. On the other hand, multimedia resources such as screencasts can guide students in complex topics. The resources proposed allow teachers to improve their tutorial actions since they provide immediate feedback and comments to students without the enormous effort of manual correction and evaluation by teachers specially taking into account the large number of students enrolled in the course.

In this paper we present the case study where three proposed educational resources were applied. We describe the special features of the course and explain why the use of these resources can both enhance the students' motivation and improve the teaching and learning processes. Our research work was carried out on students attending the "Computer programming" course offered in the first year of a Telecommunications Engineering degree at UPM. This course is mandatory and has more than 450 enrolled students. Our purpose is to encourage the motivation and dynamism of the learning and assessment processes.

Keywords: educational resources, self-assessment, screencasts, automated grading, Moodle, tutorials, on-line assessment.

1 INTRODUCTION

Computer programming is known to be one of the most difficult courses for students in the first year of engineering. For most novice programmers, learning to program is hard to understand and this can result in high failure and dropout rates [1-2]. Developing good programming skills typically requires students to do a lot of practice which cannot be sustained unless they are adequately motivated. Students lose enthusiasm and interest in learning computer programming easily when they experience repetitive failure in practicing on their own [3].

Technology is often used to enhance students' engagement in learning and their academic achievement [4]. The programming courses should be designed to be flexible to allow different students to learn in different ways [5].

In order to enhance the motivation and dynamism of the learning and assessment processes, we have proposed the use of three educational resources namely screencasts, self-assessment tests and automated grading of assignments. These resources have been provided through Moodle which is a Learning Management System (LMS) widely used in education and adopted by the Universidad Politécnica de Madrid (UPM). In Section 2 we will detail the scenario where the educational resources have been applied and describe the proposed resources.

The remainder of the paper is organized as follows. Section 3 describes the methodology applied to study the students' use, satisfaction and motivation of the educational resources. Here, we include the methodology's fundamental pillars and a description of the data collection. Section 4 presents the

most relevant results obtained through Moodle reports. Finally, we present our conclusions and propose future work.

2 SCENARIO

Our research took place from February to June 2012 in the context of the "Computer programming" course offered in the first year of a Telecommunications Engineering degree at UPM. This course is mandatory and introduces the fundamental concepts and terminology of programming. Moreover, one of the main goals of the course is developing skills in writing simple computer programs. The programming language used is Java.

A total of 496 students were enrolled in the course this year. They were divided into 9 groups in which one group was for students retaking the course. In this way, 343 students took the course for first time and 143 were repeaters.

In order to enhance the motivation of our students in learning programming we have proposed three educational resources namely screencasts, self-assessment tests and automated grading of assignments.

Fig. 1 shows the proposed educational resources and how these resources can help us to improve the learning, teaching and assessment processes and therefore, enhance the learning motivation. The self-assessment questionnaires and screencasts are provided as Moodle resources and the automated grading of assignments as a Moodle activity. The use of resources by students is optional while the activities are mandatory.

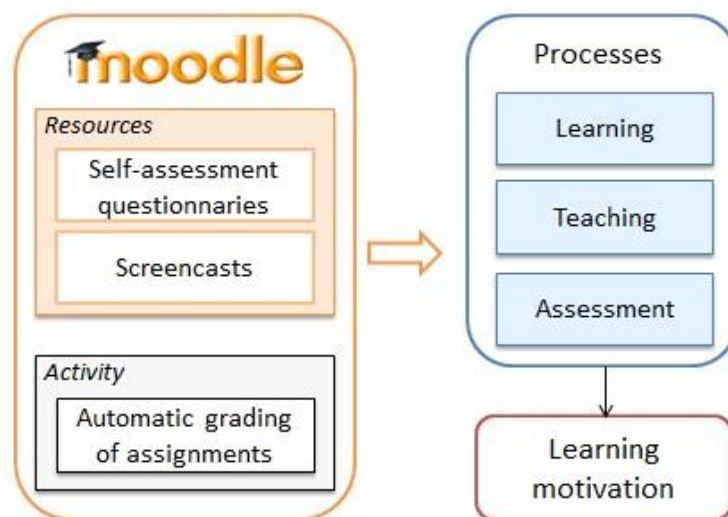


Fig 1. Proposed educational resources and connection with processes and learning motivation

2.1 Proposed educational resources

Next, we describe the proposed educational resources: screencasts, self-assessment tests and automated grading of assignments.

2.1.1 Screencasts

A screencast is a multimedia service that can be used as an efficient tool for teaching, learning and assessment [6]. Screencast produces a video of screen activities, including mouse movements and clicks. An audio commentary can be added to the video to explain the process.

The use of this resource as a tool for improving teaching, learning and assessment has been successfully validated in learning contexts [7-8]. The Educative Innovation project called Comunica-Media has allowed us to evaluate screencasts in some schools at the UPM [9]. Based on this

experience, we have used the BBFlashBack Express [10] tool to create screencasts in the course. Furthermore, a user manual for creating a screencast has been written.

In a computer programming course, screencasts can be useful to explain relevant concepts to students or demonstrate and teach the use of software applications.

We have created different screencasts that explain six main topics of the course:

- The first steps using Eclipse (which is the tool that students use to program during the course)
- Uploading an assignments
- Packing a file
- Debugging
- Fixing exceptions
- Abstract classes and inheritance.

The length of these screencasts was between three and ten minutes and includes an audio description in Spanish. By way of illustration, next figure includes a screenshot of one of the elaborated screencasts.

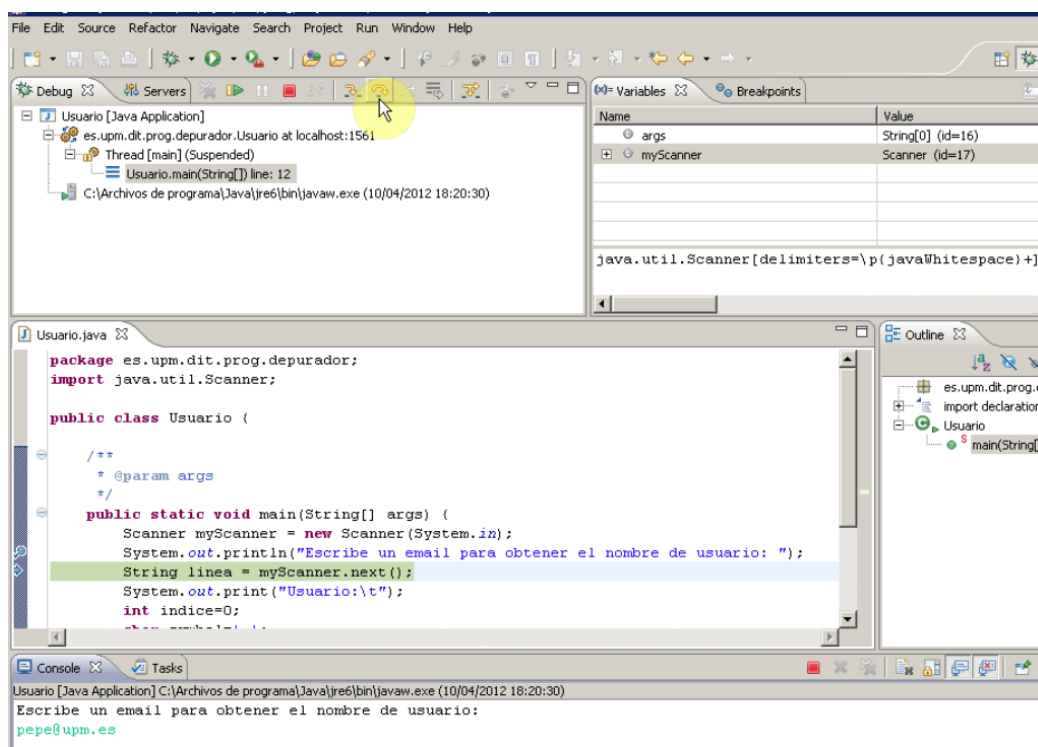


Fig 2. Screenshot of the debugging topic screencast

2.1.2 Self-assessment tests

The self-assessment tests are questions available for students that can carry out independently to check their knowledge in a specific topic. We have designed different tests with the goal of reinforcing the main concepts of the course.

A total of 140 questions has been created and uploaded in Moodle. We divided them into eight tests, one per course's topic. The first four topics have required a bigger number questions than the other topics because of they cover the main concepts of programming. Table 1 presents the distribution of these questions per topic.

Table 1. Self-assessment tests and topics

Topic	Number of questions
1. Classes and objects	35
2. Types and simple expressions	26
3. Functions and methods	21
4. Sentences	25
5. Encapsulation	4
6. Polymorphism and inheritances	17
7. Library	10
8. Input and output	2

The elaborated tests are optional and not marked as part of students' assessments. However, the use of this educational resource can allow us to evaluate the students' motivation.

2.1.3 Automated grading of assignments

The programming course involves theoretical and practical sessions. The assessment process of practical's assignments is usually a hard task for teachers due to the amount of students. For this reason, an automated grading of assignments has been implemented to check and mark the practical assignments.

The main goal of the automated grading of assignments is to allow students to know an approximation of their marks and mistakes, if any, immediately. Thus, students obtain an early feedback of their programs.

We have integrated the automated grading module into Moodle as a mandatory assignment activity. This module provides support for ad-hoc programming assignments management, and advanced programming features such as compiling the source code, running the resulting programs, testing their functionality, and checking the coding style [11]. The features are provided in a sandboxed computer to avoid damaging the Moodle server. The module also integrates with Moodle marking system.

The automated grading has been used for the first time during this course in the delivery of the programming assignments.

3 METHODOLOGY

Three main phases have been carried out to evaluate our research work. First, we have collected students' data from Moodle on the use of the mentioned resources. Second, a survey to collect opinion from students about the proposed educational resources has been designed. Finally, last year marks and present year marks have been compared in order to evaluate whether students marks have improved. The main results of the first phase related to Moodle reports are presented in this paper.

For the first two phases (Moodle reports and students' survey) we examined the possibility of establishing a control group to analyze and recognize differences between students using the new educational resources and students without the new educational resources. However, this possibility was rejected for a variety of reasons. First, it was not possible to separate students of the same course because it was unfair with students who have not the proposed educational resources. Second, we could choose students taking a similar course in other subject but we do not have access to a group in comparable conditions. For instance, we thought of another programming course but all of them were addressed to students more advantaged in programming and the situation was not comparable. Moreover, this course is responsibility of other team and we do not have the same possibilities.

3.1 Data collection

In this section, multiple data collection methods are explained to evaluate the students' motivation using the screencasts, the self-assessment tests and the automated grading of assignments. These methods are summarized in the Table 2.

Table 2. Data Collection methods

Method	Data Type	Purpose
General statistics (Moodle's reports)	<ul style="list-style-type: none"> - No. users - Activity report - Participation report 	Evaluate student's use of the proposed activities
Screencast resource (Moodle)	<ul style="list-style-type: none"> - No. views - Total time for viewing a screencast 	Evaluate student's motivation in learning any topic
Self-assessment resource (Moodle)	<ul style="list-style-type: none"> - Answers - No. views - Right and wrong answers - No. attempts per student and group 	Evaluate student's motivation in testing their knowledge on a topic.
Assignment activity (Moodle)	<ul style="list-style-type: none"> - No. views - No. attempts - Marks - Comments - No. attempts per student and group 	Evaluate student's motivation in improving their assignments until a high mark is returned.
Survey	<ul style="list-style-type: none"> - User profile - Resources evaluation - Resource use - Satisfaction and motivation regarding the proposed resources - Comments and feedback 	<p>Evaluate why and when students have used the resources</p> <p>Evaluate the impact of the resources in the student's motivation</p> <p>Get students' personal opinion of resources</p> <p>Identify future improvements in the resources</p> <p>Get students feedback</p>
Comparison between present year marks and last year marks	<ul style="list-style-type: none"> - Final marks 2010-2011 - Final marks 2011-2012 	Evaluate whether the proposed resources have allowed improve final marks

4 RESULTS

In this section we include the most relevant results obtained through Moodle reports. We have used some activity reports generated by Moodle to evaluate the use of the proposed resources. The data that we have collected from Moodle are the following:

- Number of views per student and group to each proposed educational resource
- Number of attempts to complete the self-assessment tests per student and group
- Number of attempts using the automated grading of assignments per student and group

All the data collected can be divided into two groups of students: new students and students repeating a year. Next, we include the main results for each educational resource.

4.1 Screencasts

With respect to screencast, the data generated by Moodle about the number of views per screencasts has shown in Table 3.

Table 3. Number of views of the screencasts in Moodle

Screencast	New students	Repeat students
1. First steps with Eclipse	202	51
2. Uploading a assignments	72	43
3. Packing a file	14	5
4. Debugging	162	74
5. Fixing exceptions	26	13
6. Abstract classes, inheritance	35	16

The results allow us to identify that the screencast related to the first steps with Eclipse was the most viewed for the students enrolled for first time. On the other hand, the screencast number 4 about debugging was the most viewed for repeat students. The screencast number 3 that describes the process of packing a file was considered as less interesting by the two groups.

4.2 Self-assessment tests

Regarding to self-assessment tests, we have obtained the number of students' attempts of self-assessment tests per topic (which is shown in Table 4). It is important to highlight as students of both groups were losing interest on the use of this resource. The last topic related to "Input and output" was the least seen.

Table 4. Number of attempts with the self-assessment tests in Moodle

Self-assessment tests	New students	Repeat students
Topic 1	238	103
Topic 2	166	77
Topic 3	173	73
Topic 4	136	53
Topic 5	96	28
Topic 6	67	21

Topic 7	51	11
Topic 8	31	6

4.3 Automated grading of assignments

Finally, with respect to automated grading of assignments, students had to use it to submit their assignments. Table 5 shows the number of attempts by assignments. The automated grading feature was available in Moodle from the third assignment on. This is the reason the number of attempts is bigger than the first ones.

Table 5. Number of attempts with the assignments in Moodle

Assignments	New students	Repeat students
Assignment 1	408	162
Assignment 2	509	179
Assignment 3	2188	825
Assignment 4	2573	977
Assignment 5	2051	748
Assignment 6	284	54
Assignment 7	108	77

5 CONCLUSION AND FUTURE WORK

In this paper we have presented three educational resources we have applied to enhance students' motivation when learning computer programming. We have chosen these resources taking into account the special features of the course such as the majority of students do not have experience in programming or the large number of students enrolled. Moreover, we have included a description of the data collection that we use in our research work and the main obtained results of Moodle's reports.

The results show us the use that students have made of the proposed resources. We can observe that the self-assessments and screencasts were used in lesser proportion than the automated grading of practical assessments. We deduce that it could be because the first resources were optional whereas the automated grading of assessments was a mandatory activity.

Furthermore, we presume that the automated grading of practical assessments has enhanced the students' motivation to improve their marks. Most of students uploaded more than once their practical assignments until they obtained a high mark.

On the other hand, although the self-assessments and screencasts were used in lesser proportion, we consider they have been useful for students to learn specific topics. According with the number of views and attempts as well as the feedback received from students, students have used the educational resource and understand the content.

Finally, it is important to point out our future work. A questionnaire survey that students have answered is being analysed to obtain students' personal opinion about the proposed educational resources. It will allow us to evaluate the efficiency and usefulness of the proposed educational resources and if students were motivated. Specifically, we will know why and when students have used the resources and the impact of the resources in their motivation. Moreover, we will obtain students' feedback which can allow us to identify future improvements in the resources. Additionally, a comparison between present year marks and last year marks will be carried out in order to evaluate whether the proposed resources have allowed students to improve their final marks.

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