Work In Progress - Using Lego Mindstorms and Robolab as A Mean To Lowering Dropout and Failure Rate In Programming Course

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Abstract – Programming is a required course for engineering freshmen students enrolled at Universidad Autónoma de Baja California. This course has high dropout or failure rate since most students have difficulties in creating structured algorithms and learning a high level programming language. An elective course called Introduction to Programming teaches algorithm problem solving methods in order to facilitate student success in the Programming course. Nevertheless, this course is still very abstract to students since it’s mainly creating flowcharts and pseudo code of their algorithm. Students also have several handicaps to overcome: very limited computing knowledge, if any at all, English (used while programming) and some come from very limited income households. This paper will present the use of Lego Mindstorms and Robolab in the introductory programming course in order to overcome the handicaps by the time they enroll to their first programming course.

Index Terms – freshmen course, Introduction to Programming, programming handicaps, Robolab.

INTRODUCTION

Engineering freshmen students enrolled at Universidad Autónoma de Baja California (UABC) are required certain courses before selecting their engineering major (computer, mechatronics, electronics, chemistry or industrial). Programming is one of those required courses. Currently, once they are accepted to matriculate, engineering freshmen students are required to enroll in a pre-math course in order to obtain a certain level of abstraction, formal reasoning and refresh their math knowledge. In addition, this pre-math course impacts other courses such as programming and physics, since they have difficulties comprehending and expressing descriptive problems.

Some students express concern on their first week of class regarding having no previous programming experience, considering themselves in disadvantage with other students who do have some skills. Therefore, Programming is taught assuming no previous knowledge, at a pace and level that students comprehend the language in more depth so they learn new or more information than they learned in high school. Still students with limited knowledge express that it is too much information and the pace is too fast for them to keep up.

Programming per se is hard enough for many students to express their ideas in a structured methodical manner, and adding learning new statements in a foreign language contributes to its hardship as shown by [1].

For students that come from households with limited income their difficulty is in investing study time in their homes since some of them don’t have a computer or Internet access nor enough time since they have to work fulltime after school.

In order to facilitate their success in the Programming course, an elective course called Introduction to Programming (Metodología de la Programación) is offered. It is a 6 credit course (2 hour lecture and 2 hour workshop).

In order to grasp algorithm problem solving and overcome some of the handicaps previously mentioned, before they enroll to their first programming course, a pilot group using Lego Mindstorms and Robolab (as a GUI programming language) is being evaluated. Cliburn [2] reports that this type of activity was well received by undergraduate students.

PILOT GROUP

One, out of the six Introduction to Programming groups offered during the 2007 Spring Semester, was picked as the pilot group that will be using Robolab and Lego Mindstorms. The main reasons for just selecting one group was the limited amount of Lego Mindstorms available: there are only 7 available (containing: 1 RCX programming brick, 2 motors, 2 touch sensors, 1 light sensor, 4 wheels and a tower) but only have two Robolab Starter Sets [3] (enough to build 4 robots).

This pilot group is composed of 35 students. This particular group has their lecture and workshop sessions imparted 1 hour a day, Monday through Thursday.

The pilot group answered a survey in order to assess their self-view regarding computer literacy, knowledge of English and the influence of their family income in their study time. Only 28 of the 35 enrolled students answered the survey.

As shown in figures 1 and 2, over 57% of the group have very little knowledge of English (≤ 60%); 47% have a hard time understanding description based problems; 60% have never programmed before. These numbers indicate that the factors previously stated are evident in freshmen students, which can difficult their programming learning experience.
Session F4A

First Evaluation.

An exam was applied in order to evaluate creating flowcharts, algorithm rules and interpreting a verbal problem. By this time, the group had only attended two workshop sessions introducing them to handling Robolab. Results of the first exam, shown on Table 1, indicate that 72.4% of the class did not pass the evaluation even though 72% of the class saw them selves as managing well this skill.

TABLE 1
RESULTS OF FIRST EXAM.

<table>
<thead>
<tr>
<th>Grade Range</th>
<th>Frequency</th>
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<tbody>
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<tr>
<td>0-9.99</td>
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</tr>
<tr>
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<tr>
<td>90-100</td>
<td>0</td>
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</table>

CONCLUSION

The semester is not over but progress can be seen on student’s homework: comprehension of structured algorithms have improved with fewer mistakes in the use of pseudocode and flowcharts. They still have difficulty with creating flowcharts of nested structures, but their idea of structure has more form.

They have to do a final challenge of a “maze solver” using Robolab. Some students have even bought their own Lego Mindstorms in order to work at home or stay after school in order to use the ones in school.

Videos of the activities are posted on the web http://youtube.com/ProgDig.

The impact of this work in progress will be monitored the following semester when they enroll in the Programming course with students that might have taken Introduction to Programming but did not use Robolab as part of their activities.

REFERENCES

[2] Cliburn, Daniel; “Experiences with the Lego Mindstorms throughout the Undergraduate Computer Science Curriculum”; 36th ASEE/IEEE Frontiers in Education Conference; T2F-2; 2006