Using innovative resources to teach programming languages to physics students

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***Abstract*—**In this paper, a new methodological strategy to teach programming languages is presented. The innovative approach was implemented with a group of students of a bachelor degree in physics. A robot was used as a resource to motivate students to program a serie of scripts to move the device along a trail on a race track designed by the students.The results of the experience are summarized.

***Keywords*—** innovation, learning methodologies, physics, programming languages.

I. Motivation

FAILURE and dropout rates in Computer Sciences (CS) courses are unfortunally high [1], [2], [3]. CS instructors are loooking for new methods to teach programming languages in more efficient and engaging ways, especially for those students whose major is not CS, but they are required to take programming or computational courses. Innovative approaches, like the use of robots could provide with sources of highly memorable and game-like effective learning experiences. These could, in turn, generate cognitive gains and significant learning advancements. Any improvement in learning performances of students going through this new approach would translate in successful experiences that could be replicated by other educational institutions.

II. Problem Statement

Problem statement: Some science bachelor degrees include programming languages or computational software courses to fulfill their degree requierements. These students are usually not well motivated to take computational courses, as they see them as complementary courses, and it is hard to get them engaged in learning [4]. Many students left the course before finishing it, and they came back the next year to try again. This produces graduation delays, frustration, and even dropouts from the institution. That is the main reason why more efficient teaching methods are needed.

III. Approach

New methodologies or innovative experiences can be applied to get students involved, enthusiastic, and eager to learn topics that they may feel are not their main focus of study [5]. A programming robot was used to create a group activity that involved the development of C++ scripts, the design of a showcase experiment, and the presentation of the resulting product.

IV. Results

One experimental course was used to implement this new methodological approach. A learning module was tested, taking a four week time period to develop the complete set of planned activities. The students collaborated with enthusiasm and used their creativity to implement the task required. They surpass the instructor's expectations, as this was a combination of a required and an extra-curricular work assignment. The students programmed a robot, making use of C++ language scripts, and designed a small racetrack with a bridge, where the robot run following a trail by means of its sensors. The robot activity was showcased during a scientific open house offered by the Department of Physics to high school students. The students in charge of the robot were explaining to the visitors how they created the scripts, how the robot could follow the traced line in the racetrack, and other questions from the audience.

V. Conclusions

This experience showed to be greatly satisfactory not just as a motivational activity but also as a successful learning strategy, as the physics students who took the programming language class were able to pass the course and at the same time to change their perception of a CS course. This experience will be repeated in the next semester and improved according to the feedback provided by the students. This can be easily replicated by other instructors who are looking into improvements in their programming classes as module robots (using Arduino open source platform for example) are now widely available.

References

[1] N. Hawi, "Causal attributions of success and failure made by undergraduate students in an introductory-level computer programming course", *Computers & Education*, vol. 54, pp. 1127-1136, 2010.

[2] S. Bergin and R. Reilly, "The influence of motivation and comfort-level on learning to program", in Proceedings 17th Annual Workshop of the Psychology of Programming Interest Group, pp. 293-304, University of Sussex, Brighton, UK, Jun. 2005.

[3] J. Bennedsen and M. E. Caspersen, "Failure rates in introductory programming", ACM SIGCSE Bulletin, vol. 39, no. 2, Jun. 2007 [doi>10.1145/1272848.1272879]

[4] A. Forte, and M. Guzdial, "Motivation and nonmajors in computer science: identifying discrete audiences for introductory courses", *IEEE Transactions on Education*, vol. 48, no. 2, pp. 248-253, May 2005.

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[5] N. Gold, “Motivating Students in Software Engineering Group Projects: An Experience Report”, *Innovation in Teaching and Learning in Information and Computer Sciences,* vol. 9, no. 1, pp. 10-19, 2010.