APIN+: A Framework to Create APIN Missions in High Level

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Abstract

Aiming to solve the problem of the learning difficulty in the early years of the computer courses in disciplines involving logic, which according to some research occurs due to the absence of a prior logical-mathematical basis, was developed the tool APIN – Agência Planetária de Inteligência (Planetary Intelligence Agency). After its development and application in high schools, was observed that the APIN could be improved with some increments. This paper shows one of the improves, the APIN+, a web-based framework to create missions for the APIN tool. This implementation make it possible to plan and start challenges between students and schools, also allowing teachers to create their own mission according to the educational needs in different teaching units.

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1. Introduction

All the modern contemporary societies already incorporate technology as an important component of their culture. It creates, within these societies, a beneficial relationship between technology and cultural advancement. The computing presents itself as a fundamental part of the relationship between technology and cultural advancement, which engenders the need for both teaching and learning to be solid and of quality in this area, in a way that the developments and technological applications based on the computing has effective and efficient fluency in the social environment. Guaranteed quality in education, an important requirement for the quality in learning is that students come to higher education in computing with adequate skills to deal with logic, which is an essential component for learning computing.

As this prior preparation does not happen, or rarely happens, some students opt for a degree in computing without having a basic understanding of the fundamental principles that govern it and (i) end up quitting the course or (ii) have their academic performance affected when they come across disciplines that involve logic, such as algorithms, for example; in both cases, an important reason for the difficulty of the student, which may prove insuperable, may be the facing of something entirely new, for which there was not no prior preparation, or, in addition to or as result of this first difficulty, the finding by the student that the study of computing is not really the object of his interest. According to Santos and Costa [2005] and Pereira Jr. et al. [2005] the difficulties related to the application of logical reasoning in the firsts disciplines of computer courses occurs due to the absence of prior logical-mathematical base, which should be developed before the university.

Other researchers, such as Rocha et al. [2010] and Mota et al. [2009], identify and seek to solve the problem of learning difficulties of these academics applying different teaching methods in the higher education, supported by tools to aid the learning in the own university environment. We believe that this approach is just remedial and do not solve the problem of lack of a logical-mathematical base.

A action in high schools to deal with the problem of poor - or absence of – logical-mathematical base of the students is justified once the Mec [1998] expressed in the National Curriculum Guidelines for Secondary Education that schools should organize their curriculum in order to adopt varied teaching methods that stimulates the reconstruction of the knowledge and mobilize the reasoning, experimentation, problem solving and other higher cognitive skills.

In the research of Lira and Silva [2004] is demonstrated the importance of logical thinking in school, citing the mathematic as field of study that fosters the development of logical reasoning, although the potential of the mathematic is not fully explored by some teachers, that limit it to the application of formulas that do not bring an immediate practical sense for the students and inhibit the need of reasoning development.

In order to help high school students to learn concepts of logic and use them in practical situations, stimulating the thinking and the ability to solve problems in a computational context, was developed at the Educational Computing Laboratory of Federal University of Pará (http://labie.ufpa.br), the tool APIN – Agência Planetária de Inteligência (Planetary Intelligence Agency) [Dim and Rocha 2011], which combines tutorials, exercises and games. As part of the validation stage, the tool was used in two high schools and the results were completely satisfactory, showing that it serves its purpose, although was observed that some improvements could be made.

The focus of this paper is to present an increment, called APIN+, which is a framework that can be used

to create missions in high-level, directed to teachers to create missions according to specifics didactic needs and to students to develop their own missions and challenge other students to solve them.

The paper is sectioned as follows: In the second section is presented the initial problem of the research. The third section presents the APIN tool, showing it as a possible solution of the problem. In the fourth section are briefly reported the experiences of using the APIN tool in high school. The fifth section is dedicated to the description of the framework built as a continuation of the research. The final considerations are presented in Section 6.

2. The Problem in the Absence of Logical-Mathematical Base

Disciplines where logical reasoning is a factor of great importance, such as those dealing with algorithms, for example, are found since the beginning of course in computing, and to attend them with good results has been a challenge for scholars, whose have difficulties in the learning and the practical use of the concepts presented to them.

According to Raabe and Silva [2005] these difficulties are partly responsible for the failures and dropouts in the computing courses. As demonstrative data it can be cited 21 students approved and 15 failed in the discipline of algorithms in a course of Computer Science at the University A and 26 students approved and 35 failed in the discipline of algorithms in a computing course at the University B in the year 2010.

One of the reasons for this scenario is highlighted by Santos and Costa [2005] and Pereira Jr. et al. [2005] as the lack of a logical-mathematical basis to help the development of logical reasoning of the student.

The idea that the absence of a logical-mathematical base brings negative impacts to the learning of students in computing courses is supported by the learning theory known as Constructivism, formulated by Piaget [1973] in his research on the construction of cognitive structure of the subject, the Genetic Epistemology, and the Meaningful Learning theory, formulated by Ausubel [1962].

Piaget [1973] presents on his work two concepts that are the foundation of his idea of constructivism: assimilation and accommodation. All the new knowledge received by the subject will be added to compatible knowledge previously existing in its cognitive structure, in the called assimilation, or will be allocated a new scheme of knowledge, characterizing then the accommodation, in both cases changing the learner's cognitive structure, which adapt itself to the changes.

The Ausubel's [1962] Meaningful Learning Theory can be understood as the center of the assimilation's mechanism. This is the process of binding the cognitive structure of the subject to the new information received, being essential that the subject has prior knowledge that will serve as anchors for the new information.

Based on these two theories of learning we can see the reason to the need for a logical-mathematical basis for computing students. Without prior knowledge to serve as anchors in the cognitive structure for the new knowledge that involve logic, these will be accommodated in a new cognitive schema and the learning will be slower in this case, since the students will have to start learning something totally new, rather to receive the knowledge and quickly learn what it is and with what to link.

3. APIN Aiding the Development of Logical-Mathematical Base

In order to help the development of a logical-mathematical base in high school students, was developed the APIN tool, which has a system of tutorials and exercises that contains educational material about different types of logic, and a game system where there are challenges of logic resolvable through a combination of methods, or actions, of a character that interacts with different environments in different missions.

The APIN represents a fictitious agency responsible for the security of the planet, in which the student enters as an apprentice in the subdivision APIN Academy; there the students have class about different kinds of logic, with each one being a stage in this tutorial system. After the student "graduated" at the APIN Academy, it becomes an Official Agent of the Agency.

The tutorial system of the APIN consists of screens with educational materials and objective questions on four types of logic in a beginner and inclusive context, organized in the following order: Propositional Logic, Predicate Logic, Binary Logic and Logic Programming. It also provided a module that abstracts the idea of initial training classes that represent the agent's preparation for the control of a robot used to complete the missions requested when the learner become a agent in the APIN.

After concluding the tutorial-exercises stage, the student enters the APIN as an agent and receives preventive or reactive missions on behalf of the safety of the planet. In these missions the student must use the knowledge previously acquired at the APIN Academy, having to deal with logic puzzles and problems to be solved.

In the Missions the student interprets the logical puzzles that can be present in the mission's announcements and/or in the scenario and think about how to use the available functions of the robot to solve them. The announcement of the mission appears on the screen when it is initiated, after the agent's request. The request is made through the click in a button specific for this purpose. After receiving the mission, the agent decides which actions the robot must do in order to accomplish it, choosing them in the correct sequence.

The APIN also incorporates a module for competition, which goal is to perform Logic Olympics in schools or between schools. The idea is abstracted in the tool as "Intelligence Joint Training Operations" between the various APIN branches around the universe.

4. APIN in the High School

In order to collect baseline data for the validation of the tool APIN, were held two APIN workshops in two high schools. After the workshops, students answered a questionnaire anonymously, through which they left their impressions about the APIN tool and about the use of it in the high school.

Using the data collected from the students scores and the questionnaires, it was verified that the students had a good performance regarding the learning. They rated the logic as an important item that should be learned in the high school, also saying that the APIN tool accomplishes its goal in a fun way. But despite these initial good results of the study was observed, for appointments made by the students themselves, that some modules of the tool require a revision for improvement: the modules predicate logic, propositional logic and binary logic were considered of difficult learning by the students, and the instructions for the Missions APIN appears to have insufficient information to the immediate understanding of the game system. Additionally, we have defined other possible ways to improve the tool:

- Building a framework for the creation of missions: it would allow generating files of missions working at a high level, without the context of system programming, being essential the development of the file's reader to interpret them. This would make the system more dynamic, allowing teachers to build missions using high-level language. Also, it would allow students to creating challenges for other students.
- Creation of an online repository for mission's file: Extend the possibilities of doing challenges, making the process more agile regarding the distribution of files;

Considering the possibility to work incrementally, was then developed the framework for the creation of missions, called APIN+. The next section presents its details.

5. A Framework to Create APIN Missions

To make the APIN tool more interesting and to provide extra possibilities in aiding the development of a logical-mathematical suitable for high school students, especially those who are candidates for attend computing in higher education, we developed an extension module called APIN+.

The APIN+ is a framework for creating missions for the APIN in high-level, without the need for programming code, which makes possible the construction of missions to be performed by teachers and students without skills with computer programming. The framework has an interpreter of missions files, so users can open and try to solve them.

The idea of this framework first emerged due to the impossibility of teachers to create missions for their students, since they would have to access the system source code, as well as to know the programming language in which it was programmed. The idea was then expanded to the possibility of enhancing the process of development of the student's logical-mathematical basis with the encouragement of challenges between them, where they would build their own missions.

The APIN+ is divided into two modules: A mission editor and a mission interpreter. The editor has a tutorial explaining step by step how to build missions and an analytic system to verify if the created mission is valid. The **Erro! Fonte de referência não encontrada.** shows the interface of the editor. To add the elements of the scenario and set its attributes the user just clicks the appropriate button.

Assuming the user wants to create a mission that requires a computer to be triggered, and that it can only be activated if a CD with the correct data has been inserted in, the procedure would be: Click on "Insert Ground" and indicate which areas will have ground; click on "Insert Item" and indicate which, how many and where the CDs will be in, as well as the information for each one; click on "Insert Device" and select the computer, where it will be and the area of the CD necessary to it; click on "Define Goal" and select the computer area; click on "Define Instructions" and write the premise of the mission, its goal and the logic puzzles that will help to accomplish it; click "Save Mission" and choose the appropriate location to save the file.

The mission's interpreter basically have the same interface as the module APIN Missions, with the addition of two options: Load and Save commands. These options are important because they allow

students to save the commands that solve the mission and to send to the teacher or the student who challenged him, in order to see if they really completed the mission and to evaluate the solution.

To facilitate the distribution of missions, was created an online repository to provide challenges created by the APIN development team, teachers and students. However, it is not currently possible to automatically attach the challenges in the repository, because, although the framework has a mission analytic system designed to prevent the creation of missions impossible to solve, this is limited once an important part of the challenges is the explanation of the problem and the providing of tips and logic puzzles with which is possible to infer what the correct order of actions to be made. The student has freedom to express instructions of the missions as they want, and for this reason it is not computationally possible to verify if the provided premises are sufficient to reach a conclusion. Thus, the student or teacher who wants to provide their missions in the repository should send them to our team to be done an analysis of each mission.

This is a problem that to be solved it would be necessary to considerably restrict the student's creativity in expressing their ideas, because would be used static phrases as premises, for example: "To be activated, the Device X need the Item Y" or "The Device 1 can only be triggered if the Device 2 is turned on".

6. Conclusion

The APIN tool was developed to assist in the process of logical-mathematical base development in high school students in an attempt to minimize the learning problems faced by academic at courses in computing. It was used in two schools and the results were satisfactory.

In order to improve the APIN tool, it was developed APIN+, an extension module that consists of a framework for creating missions in high-level. The addition of this framework increases the range of the tool's features to achieve its goal of facilitating the development of a logical-mathematical that support the computing learning, and as one of this framework's objective is encouraging competition, it gives more emphasis to the APIN's recreational characteristics, which can raise students' interest at the tool. Another benefit of the framework is the possibility of teachers to create missions according to their educational and pedagogical needs, instead of using only static missions in the APIN tool.

One problem in the framework is the impossibility of computational analysis to the fully validate the created missions. The analytic algorithms made are restricted to check if the mission can be completed, not checking the validity of information that helps the student to complete the mission without "trial and error". This problem is a challenge for a future work: To computationally analyze the validity of mission's information without limiting the student's creativity in the design and organization of this information.

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