Using Scratch to Teach and Learn English as a Foreign Language in Elementary School

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Abstract: - English as a second language is introduced in the present school year (2015/2016) as a compulsory subject in the third grade of the Portuguese primary education. At the same time the elementary schools were also invited to enroll, at a small scale, in a preliminary project regarding the Introduction of Programming Languages. In Externato de S. Domingos, a primary private school in Fátima (Portugal), both efforts are being combined by the way of Scratch, a visual programming language, to teach and learn English on the third grade. This paper reports the approach followed and the first lessons taught and learnt from the practical experience acquired and on some preliminary conclusions of an ongoing study whose goal is to perceive if the students' satisfaction and receptivity, as well as their performance concerning linguistic acquisitions within the Common European Framework of Reference for Languages, can effectively be improved by exploring such innovative approach and assess to what extent computational thinking and programming can be used as partners in teaching and learning a foreign language.
For that purpose, two groups of students attending two Portuguese primary schools were studied and compared throughout the school year 2016/2017. While one of the groups had access to computer programming lessons and to the development of Scratch programming projects, this being the Test group, the control group had no access to programming, nor to the introduction of computational thinking in any other subject area, attending the so-called "traditional English classes", where the only resources were the teacher, the schoolbook and its assets. To assess both group academic and linguistic development, several written and oral tests were implemented, completed by the other skills demanded by the Common European Framework of Reference for Languages, regarding the students' abilities in spoken production and interaction, and listening comprehension and reading. Even though it is extremely difficult to get to a definite conclusion because more results and data should be considered and demanded, the students' tests scores of the test group show that programming might have had some influence in their academic and linguistic development.

Key-Words: - Scratch; English; Programming Languages; Learning Satisfaction; Linguistic Acquisitions; Computational Thinking.

1 Introduction

Information and Communication Technologies (ICT) entered into every field of everyday life, shaping the profile of today's as diverse areas as entertainment, communication, economics, health, research and education [1-2]. It is plausible to believe that new generations will require a renewed range of skills that includes, among others, fluency in Programming Languages (PL) [3]. However the gap between what school teaches and the twenty-first century social demands is noticeable [4]. Several countries, aware of the mentioned misalignment, have updated their curricula and among other initiatives have been introducing PL in recent years. [5-6]. Besides the enrichment of the digital literacy, there are more evidence that the Programming Languages, by stimulating the integrated training of decomposing activities into smaller and simpler ones, information representation, abstraction and (re)defining of strategies (algorithms), together referred to as "computational thinking" (CT) foster superior analytical skills, making the early learning of other skills (reading, writing, arithmetic,) easier, [7-8], that is the ultimate ability to think and solve problems [9]. This belief justifies the increasingly frequent, extensive and early adoption of the PL in the different education systems. The United

Kingdom stands out of this context by integrating PL in its curricula from five to sixteen years of age since 2014 [10-11].

Despite the inexistence of a systematic survey to support it, it can be said that Portugal is witnessing, similarly to what is happening in Europe and the rest of the world, the growing number of primary and secondary schools where, previously by local initiative and now with governmental support, computational thinking has been gradually introduced. It is in this context of enhancement of what Papert advocates since the 60s [12], that the Portuguese Ministry of Education and Science, opened the school year 2015/2016 to the introduction of Programming Languages in a pilot project for about 300 primary schools [13].

To support the training of computational thinking, several platforms emerged in the past decade and a half, mainly directed at the public whose mastery of the written language was effective, through which interactive applications, animations and games could be built [14]. These tools, of a remarkably constructionist nature, allow an easier engagement and motivation, providing both the students and educators with an intuitive development environment in which it is possible to create a myriad of projects only limited by the creativity and, therefore, easily usable by the different areas of knowledge [15].

By the number of registered users (over thirteen million), the number of shared projects (more than sixteen million), and the number of page views (more than one hundred and twenty-five million) Scratch, designed by Mitchel Resnick at MIT in 2003 [16], stands out. This tool is supported by a website devoted to the dissemination, discussion and sharing of related projects, which might be an extra motivation for their users by giving visibility to their individual work. More recently the Scratch website started offering the possibility of developing the projects online, allowing programmers to untie any particular device avoiding to install specific software.

In Portugal the number of initiatives and scientific studies on the use of Scratch in formal educational environments at the level of the primary/elementary school is still low, although in recent years it has gained expression. One of the great features of Scratch is that students are able to take over, try different solutions for the same problem, learn from their mistakes and improve their projects, which is truly the basis of constructionist learning [18, 19], allowing the students to broaden their abilities to problem solving in all areas of life and not only in the English curriculum plan.

2 Pedagogical proposal and methodology

The first step of a two-school-year project, in Externato de São Domingos, a private elementary school in Fátima, Portugal, was to introduce the students from kindergarden age to fourth graders to coding and to Scratch itself.

In order to have the elementary school teachers ready to later work with their students, the University of Coimbra and the Engineering Institute of Coimbra were and still are engaged in both training the teachers, monitoring and assessing the results of the project.

Still during the first school term, this same project joined an European consortium created to fostering computational thinking since early ages (GOTO STEM: http://kgblll.github.io/gotostem/), and developed the necessary detailed guidelines for various activities to be implemented in the different grades comprising the elementary education.

These detailed guidelines arose from the partnership between Externato de São Domingos, the University of Coimbra and the Institute of Engineering of Coimbra and aimed at the training of the teachers in charge of implementing the algorithms, in order to develop computational thinking, always regarding the different stages included, with students of several school years, through pre-thought activities that would allow to develop the so aimed computational thinking in a systematic way.

2.1 A. Introducing students to coding and Scratch

During the first three months of the first term, the students of the four different grades comprising Portuguese elementary school were introduced to Scratch, on a sixty-minute Algorithms and Programming lesson per week basis. This introduction was the result of the cooperation of the three different institutions and their experts in English, ICT, Coding and in the planning of different and effective Educational Pathways.

Meetings including all the involved personnel took place every fortnight in the first months, in order to

assess the evolution of the developing projects and defy teachers to be introduced to more complex projects and new strategies of using Scratch within the Algorithms and Programming lessons, but broadening the contents of the projects to specific topics of the several curricula of the different grades, and of the English subject in particular, for the students of the third grade.

After almost two months and a half of working with Scratch only within the Algorithms and Programming lessons, as can be seen in Fig. 1, students were taken to the development of the "Scratch Project 1". The students became fluent enough in the Scratch PL and it was then introduced in the English lessons, so that the students were able to use it to learn this target language, and the teacher could assess the impact of Scratch in both the students' receptivity to the teaching and learning of the English language and in their development of linguistic skills acquisitions. These activities targeted not only the consolidation of contents, but also finding different and personal or individual solutions to the presented problems within the course content.

At the same time all the students of the first, second and fourth grades were planning and developing other projects in the Algorithms and Programming lessons: "Scratch Project 2" and "Scratch Project 3", the third grade devoted its time to using Scratch within the English curricula (School Objects: "What's in my schoolbag today?" and "Getting to know my body!") to enable the development of "Scratch Project 2" and "Scratch Project 3". In both projects students were free to choose both the scenario and the main character, and the materials they had inside their schoolbags, so as the ones they didn't have, while referring to Project 2. In both projects they were then asked to present their undertakings to the class in order to develop their speaking skills and to get them engaged in sharing their ideas in the target language, to learn to listen to their classmates' opinions and imagine new ways of improving their works whenever they felt they could be enhanced.

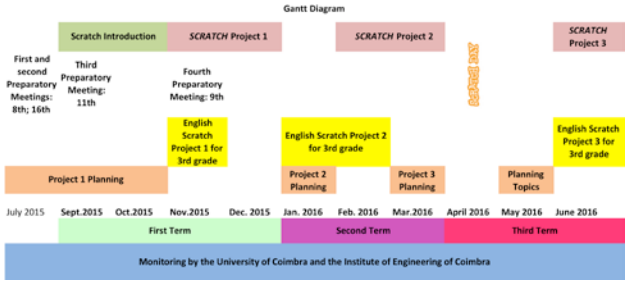

Fig. 1: Gantt Diagram of the development of the project

Two groups of 3rd grade students (8-10 years old) from two schools of Fatima (Externato de São Domingos, where the project is being implemented, and Centro Escolar Beato Nuno) are being tracked from the beginning of the project. It must be referred that despite not being a compulsory subject up to the present school year, the two groups were chosen because all the students including both groups studied English since they were 5 years old as an extra-curricular activity offered by both schools. As mentioned, these students belong to two different schools and they were consequently divided in a control group (Centro Escolar Beato Nuno) and a test group (Externato de São Domingos) with similar characteristics, concerning the students' demographics (age, gender distribution and academic results) and number of students (the control group includes 17 students, while the test group comprises 16 students).

English classes with Scratch during the 1st, 2nd and 3rd terms, in which the control group worked in a traditional way and the test group held several programming activities, developing projects with Scratch.

During the school year, the students had fifty-two English sessions in which the test group performed several activities with Scratch, whereas the control group continued to work within the traditional class standards. The programming activities undergone by the test group are as follows:

a) During the first English Scratch project ("English Scratch Project 1") they were asked to answer the question: "What's in my schoolbag today?" and present the school material they normally carried in their schoolbags, as also as some other objects they don't usually take with them to school. The students were free to choose both the characters, the scenario, the having objects and the non-having objects. They were then asked to show their classmates the developed projects.

b) During the second English Scratch project ("English Scratch Project 2"), the students had to follow the guidelines of the computational thinking, and in groups of four, they were supposed to plan their project together by sharing ideas and perspectives, secondly they should imagine their story around the human body and its systems, create their Scratch project, test it and improve it. All the four students should have the opportunity to contribute effectively to find new solutions for emerging problems. When the groups found their projects concluded they had to show them to the

whole class that would also contribute to improve what was being shown.

c) The third English Scratch project ("English Scratch Project 3") was thought to be a theme-free work, based on the English Curriculum topics. The students worked in groups of 4 and they chose their topic of the project by themselves. They were also asked to define their whole project, which included following a plan that was then simplified not to be an obstacle instead of a help to the development of the whole project, making of it a real and effective way of following and using the Mitch Resnick's Spiral for Computational Thinking (Fig.2).

Fig. 2: *Learning Spiral from Media Labs MIT by Mitch Resnick*

They were asked to imagine a topic they were introduced to during the English lessons, and create a project where they could include several other topics to learn how to relate contents and use them in "real" contexts. Then they should create the project, present it to class, discuss the relevant problems the project might have and imagine new solutions or different perspectives to solve those problems, discuss the different and possible ways of improving their projects, getting into an agreement and enhance their projects so that they could please all the members of the group and get a good acceptance from the audience, comprised of both teachers (Enghish teacher and ICT teacher) and their classmates.

2.2. Monotoring and Assesssment Instruments

Both groups (control group and test group) were exposed to the same monitoring and assessment instruments.

2.1.1 Initial satisfaction questionnaires

These questionnaires served to measure students' motivation to learn English in school and their general view on the use of English language in everyday life.

Before starting the English classes, the students filled out an anonymous initial questionnaire intended to collect some information on their overview regarding the English language in everyday life, their preferred activities and major difficulties in the English lessons, their English subject grades, and their overall motivation and willingness to continue their English studies and learn new topics. These questionnaires were used to obtain interesting conclusions about students' preferences, and overall characterize both control and test groups concerning the student profiles they comprise.

Every lesson the students are assessed concerning their satisfaction on the strategies used to teach them the curricula contents. This assessment is based on naturalist observation before the lesson, during the lesson and after the lesson, and is highly dependent on the students' attitudes and comments towards the chosen strategies.

2.1.2 Initial placement tests

These tests served to assess students' English skills (listening, reading, speaking and writing). In order to assess students' English skills in all five components (listening, reading, writing, speaking and intercultural domain), all students took an initial placement tests designed for the purpose. The placement tests were used to make a diagnostic assessment of students' knowledge on general English contents and serve as a baseline to determine students' progress during the school year.

2.1.3 Progress Assessment (Language Acquisition) questionnaires

These questionnaires were written tests, where the listening, reading and writing skills were assessed. There was also one oral production/interaction activity per term to assess the students' speaking skills.

During the school year, both groups took four written tests to assess their understanding of the contents discussed in the classes. These tests focused on the listening, reading and writing skills, while an Oral Production/Interaction per term test was used to evaluate the students' speaking performance. The tests were the same for both groups, to allow a proper comparison between the groups' score results.

2.1.4 Instruments for measuring Reactions

Students' reactions are a tool that allows the teacher to understand students' interest in learning more about the subject. When a strategy is presented, the students' reactions immediately give the teacher the feedback about the willingness of those same students to invest their time, attention and effort in

learning English through that strategy. Throughout the development of the projects the students were assessed concerning their:

- attitudes which included the students' assiduity, punctuality and general behaviour;
- effort or endeaver, concerning their interest during the lesson, after the lesson and their interest and effort to make more progress concerning both Scratch usage and English learning;
- time dedicated to each task, concerning the difficulty level of the task, the students were assessed according to an average time set/expected by the teachers, and they observed if the students were too slowly solving some tasks, if they took the right time, less time than previously thought or if they were much faster than expected;
- real part in the development of the project;
- ability to share ideas without conflicts;
- ability to accept suggestions without conflicts;
- interest on the whole development of the project;
- active contribution for the project;
- knowledge, concerning the Scratch environment;
- autonomy in using Scratch and solving problems without asking for help;
- reliabilty in their decisions;
- recognitions of mistakes and difficulties or obstacles;
- improvement of their projects;
- enhancement of their abilities and skills;
- progression, both in coding and in the English language;

This assessment was made using a Likert scale of 5 points, and at the end of each project an average assessment was defined and considered for both the teachers and the students being able to have a feedback of their work, concerning not only the Scratch projects, but also the spoken English language improvement the students showed throughout the whole project.

2.1.5 Instruments for results comparison

Both the instruments for satisfaction and progress assessment - on language acquisition - are being used in the two defined groups of students, in order to allow the comparison of results. This assessment and comparison is going to take place throughout the school year and this is going to last two school years. The end of the school years will be the high moments of this comparison and the publishing of official and more reliable results.

Despite the fact that a more detailed and accurate analysis of the results of using Scratch to teach and learn English as a foreign language will only be possible to obtain in the next stage of the whole project, the results and analysis already done, are able to present some slight evidence that allows the authors to weave some considerations.

3 Results and Conclusions

Apart from what has been published on the impacts of learning coding since early ages, little has been done to demonstrate the effectiveness of Programming Languages and Computational Thinking in the learning of foreign languages. With this project, it is intended to assess the benefits of using PLs and CT beyond the Programming, Mathematics or Science classrooms.

Scratch has been understood and accepted by the students as a highly motivating and interesting tool to work with. The teacher feels the students frustrated when the lessons have nothing to do with Scratch, despite the other interesting strategies the teacher may choose. By analyzing the students' reactions both to scratch lessons and non scratch lessons, it is not difficult to conclude that they have a very positive reaction to coding, specially when it includes the freedom to define the whole project and the "show and tell" strategy, that allows students to show their classmates the effort they have put on that same project, the results they have got and the improvements they will be able to do with the help of their classmates' opinions.

According to this, and through natural observation and the filling in of some instruments created for measuring and understanding the students' reactions, the teacher is able to identify which strategies they are more receptive to, and so will be more motivated to work and learn new contents, and the ones to avoid, because they promote lack of concentration effort, motivation and consequently a short learning span.

It is relevant to mention that the results gotten so far are not reliable enough to get to proven scientific data, besides the visible improvement in the results of the students comprising the test-group, several variables must be considered: the different teachers in the two different groups is something to be taken into account.

Besides being quite visible that the students' attitudes and satisfaction while Scratch projects are being developed are changing throughout the school year, the English teacher's motivation in both teaching English and using Scratch may also induce

the increase in the students enthusiasm for learning the English language.

Teamwork and sharing have also bought their own development, because while being a team that builds its own knowledge, students have been more aware of the importance of listening to each other and present their own opinions as a contribution that will be valuable for the work of a team, and not for individual profit.

However interesting these results may be, they aren't yet consistent enough, due to the short period of implementation and to the short number of developed projects.

Further work will be done concerning this project, but rearrangements must be considered. Devoting such young students to develop Scratch projects within the English lesson takes a long time, which is fundamental to teach the defined curricula for the third grade, which means that having an extra hour only dedicated to design projects within the English contents would definitely help solve the problem of lack of time to maximize both subjects and all the potential skills Computational Thinking is able to enhance.

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