SM4T: Scratch MOOC for Teens

A pioneer pilot experience in Uruguay

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***Abstract*— "SM4T: Scratch MOOC for Teens" represents a novel joint initiative developed by Universidad ORT Uruguay and Plan CEIBAL. CEIBAL is a governmental project of Uruguay which includes, among other projects, the distribution of free laptops and free access to Internet to students and teachers of primary and secondary public schools. We designed and implemented a Massive Open Online Course (MOOC), oriented to 1000+ teenagers students. This MOOC aims to promote the development of procedural thinking and problem-solving skills through learning the basics of computer programming building applications (videogames) using Scratch, a programming language designed for young people, developed by MIT's Media Lab. To be able to attend this course, no previous knowledge or background on computer programming, or use of the Scratch tool is required. The course is entirely implemented using Plan CEIBAL's CREA platform, offered to students through CEIBAL's computers via Internet. The first trial was conducted from October to November, 2013. In this article we present the characteristics of our MOOC in their context, the detailed course description, initial results, good practices, lessons learned, and some conclusions.**

Keywords*— *MOOC, Scratch, Computer Science 0, K-12

I. INTRODUCTION

Scratch MOOC – Massive Open Online Course- for Teens (SM4T) is a pioneering joint initiative launched by Universidad ORT Uruguay and Plan CEIBAL. Plan CEIBAL [1] develops various educational projects. Among them, there is a program based on the ideas of "one laptop per child" -and per teacher- for public schools (K-12) in Uruguay. A MOOC is a powerful tool to popularize access to education and democratize knowledge. We developed a trial pilot MOOC oriented to 1000+ teenager students. The project aims to promote the development of procedural thinking and problem-solving skills through learning the basics of computer programming building applications (videogames), using Scratch [2].

In this work, we detail the main characteristics of Plan CEIBAL, Scratch and MOOC. After that, we present the course organization and main topics, the experimentation, results, some lessons learned and best practices, and conclusions.

II. PLAN CEIBAL

Uruguay is a small country in South America. The population is 3.286.314 inhabitants [3]. In 2007, the government launched the "Basic Information Educational Program for Online Learning" ("CEIBAL") [1]. The project's immediate objective was to provide free laptops and Internet access to all public primary school students and teachers. CEIBAL's longer-term objective is to promote social justice by promoting equal access to information and communication tools for all our people [4]. It combines the distribution of computers with a program to train teachers in the cognitive skills needed to use information technology for maximum benefit [4]. The next step was to extend the distribution of computers and training of teachers to public secondary education centers [4].

M. Brechner (President of CEIBAL) explains that the current target of Plan CEIBAL for the next five years is to integrate technology and pedagogy [5]. In this context, the project includes the development of contents like SM4T.

III. SCRATCH

Scratch is a programming language that makes it easy to create interactive stories, games, and animations [2]. Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab. "As Scratchers program and share interactive projects, they learn important mathematical and computational concepts, as well as how to think creatively, reason systematically, and work collaboratively: all essential skills for the 21st century" [6].

Scratch has a collection of graphical "programming blocks" that children snap together to create programs [6]. It supports different types of projects like stories, games, animations, and simulations, so people with different interests are all able to work on projects they care about; and it is also easy to personalize the Scratch projects (for instance, including photos, music, recording voices, and creating graphics) [6]. These specific characteristics of Scratch were taken into account in the course design.

There are different versions of Scratch. We used Scratch 1.4 in this project due to a requirement of CEIBAL: that version is available in all the computers of the Plan and an Internet connection is not required to use it. Moreover, the new version of Scratch (2.0) was not completely available at the moment of the development of this course.

IV. MOOC

A MOOC is a "course of study made available over the Internet without charge to a very large number of people" [7]. "A MOOC integrates the connectivity of social networking, the

facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources". Also, "a MOOC builds on the active engagement of several hundred to several thousand 'students' who self-organize their participation according to learning goals, prior knowledge and skills, and common interests" [8]. The course is participatory and distributed. Each one works in an own space, with independence and creating networks [9].

For instance, renowned American universities, like Stanford, MIT and Harvard, are creating MOOCs. edX is an organization established by MIT and Harvard University that develops an open-source technology platform to deliver online courses [10]. "Topics include biology, business, chemistry, computer science, economics, finance, electronics, engineering, ... and more" [11]. Coursera is a social entrepreneurship company partnering with Stanford University, Yale and other universities and offers MOOCs [12]. In Europe there are also several institutions creating MOOCs. As an example, the University of Edinburgh offers a wide range of MOOCs in Coursera and Future Learn platforms [13].

V. Our Proposal: Scratch Mooc for Teens

To promote the problem-solving skills of the students, our proposal focuses in teaching the fundamental concepts of computer programming through designing, playing, creating and inventing in Scratch. Game development and their use is the main approach of the course. There are some options to teach and learn Scratch. In the MIT Scratch's site there are beginner tutorials and projects that may be used as samples or starting point [2]. Also the "Scratch Curriculum Guide Draft" [14] is useful in order to design a course based on Scratch. "Learn Scratch" is another site with plenty of material (also in Spanish). There are lesson plans and videos to help teachers and students [15]. In Eduteka's site there is material in Spanish [16]. Last year, when we started to develop our SM4T, we did not find any course of Scratch in MOOC format, neither in English nor Spanish.

We decided to implement the SM4T as a basic five-week online course. To be able to attend this course, no previous knowledge or background on computer programming, or use of the Scratch tool, is required. At the end of the course the students should be able to: a) Identify and properly use the basic components of the Scratch tool: blocks, variables, stages and sprites, images, sounds, and program execution. b) Build basic programs through the use of simple variables, control structures and event handling by combining the many available components of the tool, and c) Compare, assess and review simple programs by using their critical judgment.

The course is divided into 5 units, plus an additional Unit 0 with the purpose of introducing the student to the e-learning platform and also contains an initial survey. The student must complete successfully (obtaining 70% or more points) the compulsory quizzes of one unit, before moving to the next one. There is a final survey in the last unit. Among other elements, the course includes: a) Learning while playing. Programming concepts are introduced as needed to improve games developing, b) Short videos (3-5 minutes) with complete transcription in PDF, c) Self-assessment exercises, d) Scratch downloadable code samples, and e) Multiple forums. In Figure 1 there is a snapshot of the course.

Fig. 1. Snapshot of the SM4T course

The students upload their projects to the MOOC platform making them available for peer assessment and learning. Through the use of discussion forums the students are able to share their opinions, evaluate peers and formulate questions.

In detail, the main topics and samples offered in the course are presented in Table 1.

TABLE I. Course Description

Week	Course	
	Topics	***Samples***
1	Algorithm notion	To change a bulb
	Scratch Interface and main blocks: move, change color, pencil, green flag. Event handling (key events)	To draw a square (sequentially and using repeat) To change the size of the cat and effects by pressing keys
	To update a program	Modification of a Scratch sample: "Aquarium"
	Use of sounds, costumes	To create an orchestra
	Stage. To create a movie	To create an animation to introduce himself/herself, including at least 2 sprites
2	"Divide and conquer"	To draw Olympic rings
	Event handling (mouse events). Debugging.	A drawing program using mouse
	Message passing	Animation: a car in a route
	Variable	To move a submarine through sea caves, to count crashes. "Zombie attack"
3	To analyze code and to update it. Use of boolean conditions	Scratch sample: Pong Penalty shot
4	User interaction. Random numbers.	To guess a random number
	Use of control structures	To draw geometrical figures and grids
5	Integration project: includes variables, sprites, key events, sounds, time	Video Game: the classic Frogger
	Evaluation of a program	Use of rubric

Students who finished the SM4T course and get a minimum of 70% in the assessments, obtained a certificate of completion, issued by Universidad ORT Uruguay and Plan CEIBAL.

The educational contents were designed and developed by Universidad ORT Uruguay. ORT's work team included a General Coordinator, three Computer Science teachers, two Platform Specialists, one Graphic Designer, one Audio Visual Producer, and one expert in Educational Evaluation. The work team of CEIBAL in this project was formed by a Coordinator, an Assistant Coordinator and two Platform Assistants. They were in charge of students' enrollment and platform technical support.

Although there are different platforms for MOOCs such as previously cited Coursera or edX, the course is entirely implemented using Plan CEIBAL's CREA platform as a requirement and offered to students through Plan CEIBAL's computers via Internet. The first trial was conducted from October to November 2013.

In this first pilot edition, CEIBAL decided to create different groups in order to better analyze the learning process in the MOOC, and also to have more options at the moment of the learning analytics process (see Table 2). In Group A and B, the students (12-17 years old) were invited by their own teachers. Those teachers helped and guided the students, as a "Local Teacher Assistant" (LTA). Students were enthused in class by the teachers. The teachers also promoted the activities. Due to their own timetables, LTA from Group A dedicated more time to these activities than LTA from Group B. Group C was composed by volunteer teachers only; most of them had no Scratch knowledge. They were invited to participate by CEIBAL through e-mail. Group D and E were the most "MOOC-like", because the enrollment was completely open by CEIBAL´s homepage and there was no external assistance. For organizational reasons they were divided into two groups (Group D, Group E). In all groups, two online teacher assistants (TA) gave forum support, answered questions, made suggestions to the participants and checked that all elements worked well during the five weeks of the course.

TABLE II. GROUPS AND NUMBERS

Groups	Course				
	Students enrolled	***Completed First activity***	***%***	***Completed Final Unit***	***%***
A -Teens with LTA	267	188	70.41 %	81	43.09 %
B- Teens with somewhat of LTA	256	148	57.81 %	26	17.57 %
C- Only Teachers	170	120	70.58 %	56	46.67 %
D- Teens without LTA	302	150	49.67 %	40	26.67 %
E- Teens without LTA	298	146	48.99 %	38	26.03 %
Total	1293	752	58.16 %	241	32.05 %

VI. INITIAL RESULTS AND LESSONS LEARNED

Though still in its results analysis phase, the SM4T pilot project achieved the following significant preliminary results (included in Table 2): more than 1290 participants enrolled (1100+ teens from public primary and secondary schools, 170 teachers) from almost all the country, 49%-51% male-female ratio. HarvardX and MITx refer 29% female students and age 26 as median [10]. Based on school location, we can infer that most of our students come from lower socioeconomic background.

752 participants formally started our course (they completed at least the initial survey), and 32.05% of them finished the course. This average completion rate is a particularly high value. The rate for MOOCs is less than 7 percent [17]. "Across all Coursera courses, average retention measured overall is approximately 4%." [18].

In the initial survey, 90% of the students answered that they did not have previous expertise with Scratch. 92% answered that they have their own computer from Plan CEIBAL and 8% used computers of their schools. 34.5% accessed to the platform from the schools, 34% from home, 19% from both places and 12.5% in other places. Among other topics, in the final survey we asked the students about their perception of the course. It was really high perceived: 96.97% rated it as "Very Good" or "Good", while only 3.03% rated it "Not Good". The videos and the downloadable Scratch files were the most highlighted elements of the course. Regarding the knowledge obtained, 94.5% of the participants stated that they learned "a lot" or "enough", 4.5 % answered they learned "not so much" and only 1% answered that they learned nothing.

At the end, we have also interviewed some students and teachers to know their feelings about the experience. Some comments from students were:

- "In class I helped many of my classmates. I also learned about using the microphone, is very cool. I think the course is very good."
- "Before I knew a little about Scratch. In Scratch to create games you have to think a lot. To think and to find the correct tools are the most difficult. I would recommend to other people to try the course"
- "The videos were useful. I could go back and forth anytime. I did the exercises looking at the same time the videos and programming in the Scratch interface".

Teachers expressed:

- "Congratulations. Now I have really learned Scratch programming. Before, it was quite hard to understand. It comes very handy and I am using it in my classes. Congratulations again and let's have more courses like this."
- "I loved the course, I knew nothing of Scratch and finished learning a lot. Thanks to the tutors for always being willing to answer questions, and also thanks to the colleagues for sharing their work, an inspiration to me in many cases."

After the course ended, the work team of Universidad ORT reviewed all the processes and results. We include here some of the lessons learned and best practices. Related to choosing

the MOOC Platform, there are some useful functions to take into account. For instance, to personalize students tracking, choose one that warns of new mail messages in forums (in CREA you must check yourself the forums). If a student does not enter in the MOOC in certain time, automatically send him/her an email. Other important elements to consider are to include forums with votes, tags, multiple search forms (to locate messages, questions, etc.), and an easy way to download data and statistics. Additionally, try to make the course easy from an information and communications technology point of view.

In order to smooth the creation of videos, the script should be written down in detail before recording them. This helps to film the videos faster. It is also useful the use of a "prompter", as in the TV news. The stage should be comfortable and allow the teachers to move and walk, not only to sit. The make-up should also be taken into account. It is convenient to check the videos in the same moment, and to correct them as many times as necessary. Another point is to pay careful attention to the technical vocabulary and its explanations. For instance, we detected in the forums a lot of questions related to the term "debugging", which was included with little detail in only one video.

Related to the topics included, some teachers told us that the examples related exclusively to geometry were difficult, because some students did not know that theme deeply. So, we should consider this issue for the new version of the SM4T.

Based on this pilot experience, we think that is useful to have an initial MOOC with few participants (1000+), in order to evaluate and do the "fine-tuning". This course was launched in October 2013 (and a second version will be launched in second semester of 2014). We suggest checking the starting date with the corresponding activities of the students. For instance, during November in Uruguay there are a lot of final exams, so the students may not have enough time for the MOOC. The peer evaluation and the forum use should be mandatory to assure a minimum participation (CREA platform do not allow those options in a "mandatory" form). In this edition, we configured the platform to allow trying each quiz as many times as the student wished. Some interviewed students told us that they prefer a limited number of tries. Each day, each TA dedicates about an hour to check the forums and answers pending questions. Considering the interviews with the students, whenever possible, try to promote local "study groups" (fighting against the isolation feeling). Also, wherever possible, try to have a fully available "local support facilitator", like the LTA (see Table 2, Group A). In the experimentation, partial teacher support seems to be discouraging (Group B). Make it enjoyable, from a life experience point of view for teachers and students.

VII. Conclusions and Future Work

While an experimental approach to teach programming to teenagers in a MOOC format, the SM4T pilot allowed Uruguayans public school young people have access to computer programming teaching as taught by University professors. In addition, it allows for further inclusion and equality of opportunities, in a format scalable to all school students in the country in the immediate future. At the end of the first trial, almost 200 teenager students from all over the country and different social and economic areas, learned and created Scratch programs, and completed the course successfully. The course was perceived highly satisfactory. Based on our experimentation, we could infer that this MOOC proposal to teenagers appears as a valid option to promote the development of procedural thinking and problem-solving skills using Scratch.

More conclusions are due to be drawn shortly. Using the Learning Analytics process, sociologists and researchers in education from our Institute of Education will conduct further in-depth analysis of the results obtained. In turn, these findings will represent an invaluable input for model adjustment, for launching a SM4T course open to the entire country's population in this year (2014), and for sharing with the academic community.

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