And Now What We Do with Our Schoolchildren?

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Abstract. After training activities introducing computing, most teachers seem to ask themselves "And now: what do we do with our schoolchildren?". Once more we felt this could be the situation during the PP project promoted by our Municipality involving about 25 teachers from twelve primary and middle schools. Our commitment was to organize ten meetings to be attended by around two teachers for each school, half meetings during fall 2015 and half from March to April 2016. Previous experiences already proved that at the end of similar short courses many participants were unable to design structured activities suitable for their classes or were afraid of their isolation in creating activities for their schoolchildren not having nearby colleagues interested in sharing the experience. Consequently they often replicated some of the examples and exercises seen in training courses proposing activities normally not connected each other nor with the rest of the teaching. To avoid replying such situations, we decided to focus first five meetings on an introduction to programming and the remaining five meetings on the design and assistance in developing activities that teachers attending the course could immediately propose to their students. During the second half of the course, participants have therefore jointly designed and implemented activities suited to their students choosing from three patterns we proposed them: telling stories (about educational contents or not), designing group and class questions/answers, inventing and solving riddles modeled by linear equations. The latter activity, of course, is reserved for middle schools while former two are suitable to both primary and middle school. Here we describe this proposal highlighting that on the one hand the suggested patterns help teachers to overcome their apprehension in proposing a long and articulated activity, on the other hand, the activities are integrated with educational content specific of the classes in which they are proposed.

Keywords: teachers training, primary and middle school, new curricula, questioning, activity patterns.

1 Introduction

The PP project was promoted by our Municipality for introducing computing in twelve primary and middle schools. The request was to organize a course for about twenty five teachers of the schools involved in the project during the school-year 2015/2016. From our previous retraining experiences we knew to have several constraints: teachers have little time for retraining, most of them know little about com-

adfa, p. 1, 2011.

puting and almost all have only experienced digital literacy activities, i.e. they have been using the Internet and computer tools specific for an educational purpose [1]. Besides, the project had peculiar constraints: for example only few of the teachers were volunteers and during the interval December-February teachers could not attend training courses. This latter requirement meant that we should have half activities in autumn and the other half from beginning of March to the end of April.

In our country there is no mandatory neither commonly accepted curriculum for informatics in k-8 education: there are many formal and informal proposals going from educational robotics to programming (using different languages), from csunplugged to coderdojo and fablab type of activities, naming just some of the most popular ones. After having experienced different approaches, since years, in our projects for schools we support using suitable development environments for introducing programming integrated with unplugged activities of the type described in [2] for younger pupils. Our proposals are then in the line of the suggestions by C. Schulte in [3], M. Ben Ari in [4] and coming from the English National curriculum for primary school where we read: <<The role of programming in computer science is similar to that of practical work in the other sciences – it provides motivation, and a context within which ideas are brought to life>> [5]. According to Piaget's theory the “concrete operational” stage of children cognitive development is situated at the primary school age thus programming is a good choice both for pupils of schools involved in the PP project and for the teachers because practical experiences also help those who must be introduced to computing with short courses.

Since we have closely worked for years with teachers in schools we are quite respectful of the teachers competences in the pedagogical and methodological components of their activities. Also, we have in mind Martha Nussbaum’s concern on the contraction of the humanistic component in the educational contents: "More and more often we treat education as if its primary goal should be to teach students to be economically productive rather than to think critically and to become informed and empathetic citizens” [6].

With all the above in mind, our proposal for the PP project was to devote the first five meetings to introduce elements of programming and the remaining five to consider activities that the teachers attending the course could immediately begin with their pupils and implement while our lectures were continuing. Previous experiences had shown that at the end of retraining courses many of the participants had not felt able to design articulated activities adapted to their classes or not having colleagues in the same school to share the experience with, they had been afraid to tackle alone a first field activities. For this reason often we saw replicated some of the examples and exercises from a course with results not always connected to each other and with the rest of the teaching.

The PP project participants have been asked to design and implement one or two activities suited to their students choosing out of three patterns of activities proposed to them. The activities had to be held while the second part of the meetings was going on so that the problems encountered could be discussed in person among the attendees and the lecturer. After the end of the course, the virtual community environment of the course will still be available for discussions but a starting phase where problems

are discussed in persons is necessary, again from our past experiences. The three types of activities proposed are: a. storytelling, b. designing questions/answers on educational contents, c. inventing riddles modeled by linear equations. The latter activity, of course, is for middle schools.

Here we describe how the lectures of the PP project went on, giving examples of some of the activities developed by the attendees. We do not have an assessment of our experience but we have seen teachers curious of implementing something that on the one hand they feel near and useful for what they do every day, on the other hand new and fitting the direction schools shall go in the future. Also, our presentation of the narrative and the question/answer patterns as a continuation of each other was perceived as having an activity to develop with pupils lasting for several sessions and consequently not an occasional exercise. The second part meetings turned out to largely be a discussion time for solving implementation problems, for reciprocally showing the activities, exchanging ideas and pedagogical comments, acquiring new abilities from colleagues' suggestions. Besides, the general feeling was that the activities developed during the meetings helped overcoming the teachers fear of inventing something of their own. The integration of educational content specific to the class where an activity is proposed is an outcome of the active involvement of the teachers.

In Section 2 the general motivations are briefly resumed and then activities of story telling and riddles invention are described. The Section 3 is entirely dedicated to the activities of questions&answers whose proposal and materials have been methodically organized more recently than the others.

2 Activities for primary and middle school

In primary education activities count more for what children acquire during the process of developing the activity than for the result produced because the development process of the activity contributes to the overall growing of the child in its ethical, social and intellectual capabilities. Planning and offering digital activities also should take into account this methodological approach.

The PP project recommends teachers to consider programming as a new tool offered to pupils to express their imagination inventing a story or inventing places, participants, costumes, dialogues around a given content. In this way children can both gain in familiarity with the schools subjects and be introduced to computing.

The key principles supported by the activities suggested during PP are as follows:

- every action must have a specific educational goal and be connected to the pedagogical content of the grade it is proposed to,
- particularly in the early years, programming must be conceived as one of the "hundred" languages children shall use to express themselves, as from Malaguzzi of Reggio Emilia schools [7].

During the first part of the meetings we introduced attendees to the csunplugged activities presented in [2], shortly summarized in the first paragraph of this section. In

the second part of the meetings teachers have been asked to think what kind of activities could fit their students from the following ones:

- tell a fictional story or one that would gather the most relevant aspects of a topic covered in the classroom or that might be of interest to the schoolchild,
- choose a curriculum topic and decide a set of questions, some having multiple choice answers, better representing the topic,
- for middle schools, inventing riddles each modeled and solved by a linear equation.

Last paragraphs of this section focus on these activities.

2.1 Unplugged programming

Like many authors recommend, programming can be present in k-8 education using an environment suitable to the age of the students and to their previous experiences with computer [3], [4]. Lawrence Williams' visit to our department made us reconsider many of the activities in our introductory courses and consider to propose storytelling during first meetings .4[8]. In [2] three primary school teachers describe various types of computer-related activities they have created with their pupils. For kindergarten and the first grades in primary schools, they have experimented csunplugged activities, for example those moving a human-robot. The latter are activities on a school chessboard-like playground or similar where a pupil moves from one square to another one according to the instructions her/his mates give. Only four instructions are available at the beginning (forward, backward, turn-left and turn-right), then the instruction set is gradually enriched, for example with instructions for bringing something from a square to another one. Also pupils are requested to perform different activities such as:

- comparing the different paths obtained from different sequences of commands,
- comparing the length of the instruction sequences written by different groups.

The presence of an obstacle on the playground, for example a slide, enriches the possible activities since children must avoid the obstacle. Also: writing down first inside the school the instructions for a path, then verifying them on the playground makes teachers and pupils to concretely see the sequence of commands and better size the concept. Besides, having only few lines where writing the sequence might generate the idea of parameters, forward(n) for example or of repeat(n) if a number of commands must be repeated, and so on. Also, we shall find out that the human-robot written sequence of instructions correspond to the sequence of actions we perform in some real world situations, for example the sequence of actions written on the Fire Alarm Table, i.e. the actions we (must) perform when we hear the fire alarm in school.

Learning achievements during unplugged programming make easier the following activities.

2.2 First plugged in activities

Main objective of the second part of the PP meetings was to make attendees design and implement with their schoolchildren a programming activity of some complexity relying on the experience shared with the colleagues and the lecturer of the course. Obviously, the discussions during the five last meetings also gave way to enrich the knowledge and experience on programming acquired during the first meetings, in particular to solve the problems arising from the inventiveness of the schoolchildren (beginning with the typical problems related to formats for images and delete a figure background to create a new sprite). The PP meetings had the role of organize the different activities, define new steps, with colleagues suggestions, and receive help with respect to the problems found while developing such activities in the classroom.

A story telling activity allows pupils to express their creativity whether using digital tools or not. Using development environments such as Scratch this activity can be done having very different levels of familiarity with the tool, see for example [8]. For this reason Scratch is often proposed in courses introducing computing. At the beginning attendees consider a story with only sequences of actions: they can start doing something of their own by changing images, dialogues, backgrounds. Then they continue with reviewing the synchronization among actions and so on according to the principle of remixing recommended by Resnick and the group of researchers who developed Scratch [9].

While developing narrations basic programming principles have been recalled from csunplugged activities or were newly introduced together with some achievements from using the tool such as:

1. Command sequence (with how to change backdrops and solve first practical problems for example how to get rid of the background for a new sprite image pupils have drawn);
2. very simple repeat (repeat n times), typically to move a sprite;
3. synchronization using both seconds and messages;
4. some interactions (often to ask user's name in order to personalize the execution of an activity).

During the interval between the first and the second part of the PP meetings, few teachers were able to develop csunplugged activities with their pupils. They recognized patterns of commands used in those activities within the Scratch scripts and were more confident than the other teachers in reading the scripts of the first Scratch stories.

The definition of new curricula with a satisfying coexistence among old and new contents is not easy. Those who propose to introduce the digital in education assume a great responsibility on the one hand with respect to the contents of the other disciplines that are declined to make way for new contents, on the other hand with respect to the resources, particularly time and money resources, that are diverted to the new activities. In choosing the types of activities to be proposed during our project one of our main intents was to conciliate the contents already present in k-8 education with the digital activities proposed to teachers and students.

The first two activity patterns allow to begin with very simple activities yet introducing some programming principles and then continue with exercises of gradually increased complexity. The "story telling " pattern is suitable for school children who can barely read and write and is interesting because it can smootly evolve into the second pattern and toward stories requiring a long time for the design, for planning the several activities to produce the story: i.e. the drawing of sprites and scenes, deciding the dialogues, and so on.
An example of how a story becomes an activity for an entire class is the "Red Riding Hood" tale produced in Scratch by fourth grade children. This activity had many educational components equally important as the acquisition of computer skills. Think of the design components, the planning, the collaborative work, the definition and organization of contributions, the timing and verification of the results, the children's feeling of responsibility for finishing in time the work assigned to them: all this next to the digital implementation of the story [2].

Beginning forms of interaction in story telling often lead to the idea of developing quiz activities. In this way we have a smooth transition from a basic type of storytelling and easy types of quiz activities. Which also means a smooth introduction of variables for keeping scores.

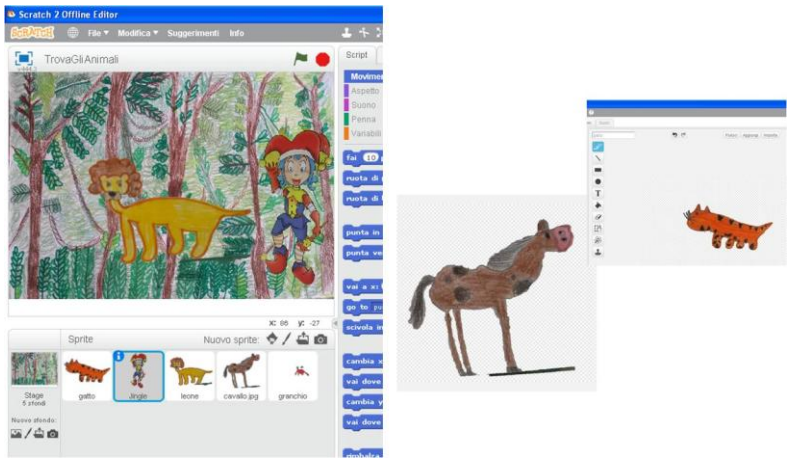

Fig. ;. "How is it called in English?"

In figure 1 we see some components of an activity a teacher has developed with the entire class of her second grade pupils to practice English.
When an animal appears, one of the children sitting in front of the screen, enters the animal English name. Actually for this first attempt children drew the scenes, the animals and decided the sentences the clown in figure 1 has to say to begin and while leading the activity. Thus the result is partially developed with children. But for the PP project we consider positive that a teacher who knew nothing of programming at the beginning of PP, after seven/eight meetings introducing her to computing had the initiative of proposing to her pupils this activity. She had to organize her schoolchil-

dren deciding with them four settings (the house, the country, the sea and the forest), and then divide pupils in groups, each group working on four animals one for each setting. This teacher's idea is to ask pupils to modify current year activity letting them digging into the code and producing something of their own beginning of the next year when they will be in their third grade.

Another PP attendee worked on a long story with different components developed each one by a different group of pupils. During our meetings we discussed about an easy way of putting together the components and together we found out the way. All these conquests came from working contemporarily in schools and with colleagues during the PP meetings.

Going toward a quiz activity, even if very simple like the one in figure 1, programming principles introduced are

2.1 selection: for verifying the answers

2.2 variables: introduced if we want to count the score

2.3 the "repeat until condition" is possibly introduced depending on the type of quiz, (in the case of the animals names is "repeat until the answer specifying the animal name is correct").

2.3 Inventing riddles

Retraining courses using Scratch are very well received by teachers because they appreciate the use of a simple tool through which you get rewarding results. Also teachers appreciate they are asked to work on activities fit to their students and with content that can be interesting for other disciplines and then for fellow teachers. Example of interdisciplinary activities are the programs "think a number (and I guess it)" in which each group of students invents its own riddle through an experimental activity on linear equations. The Scratch activity is very simple: it is a sequence of instructions as shown in Fig. 2. The valuable part of the activity is once again, but particularly in this case, the phase where the students use the teacher's riddle, try to understand the inner working till when they get that the proposed riddle can be modeled by an equation. And then they invent other riddles.

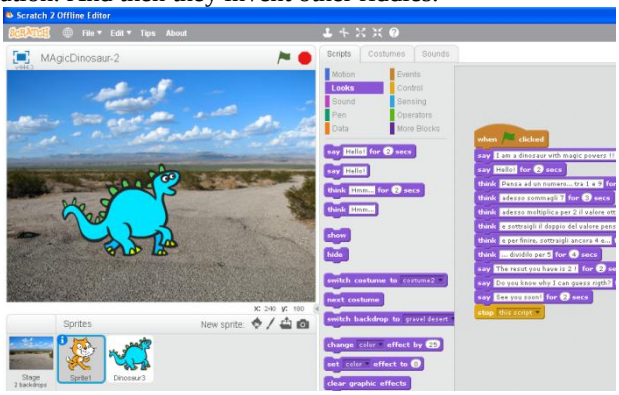

Fig. 2. "The magic dinosaur"

For the activity in figure 2 the equation is (2 (x + 7) -2x – 2)/ 5.

3 Questioning

This kind of activity has been suggested by various sources in the pedagogical literature where questioning techniques are largely discussed [10]. Not least the fact that a Scratch activity designed as an exercise to introduce the variables (in this case the "score" variable) in a quiz has been very well received in all courses in which it was proposed because considered appealing for schoolchildren. Discussions with teachers, involved in the PP project and outside, has also shown that a type of very simple exercise such as a quiz on one side can have computing value in introducing a gradual use of the variables but also propose original ways of learning: each group of students creates its own quiz where questions are proposed on the topics of a lesson that most affected the group. These are examples of the many activities that promote the involvement of teachers in other disciplines and thus the gradual upgrade of skills of these teachers also: involvement essential if you want to get to use the digital as a tool through which constructively learn various disciplines.

For the questioning activities will have two phases:

- work in group (two or three students per group): in which each group produces a quiz with 3 or 4 questions on a subject, generally a curricular one. During this phase the members of the group review the topic and decide which are its representative components candidate to become matter of a question. Similarly the relevant answers to the chosen questions are decided. The group-quiz is finished with images and sounds. We chose to suggest having multiple answers to increase the working by each pupil in the group;
- entire class work: at school the pupils show questions and answers present in their group-quiz. The goal is to produce a class-quiz from group-quiz with more questions. Questions and answers are chosen among those proposed in the group-quizzes, both can result from different formulation of what contained in group-quizzes to take account aspects deemed important by the children or according to teachers' suggestions.

The class-quiz can have various uses: for example, can be shared with another class having the same subject in curriculum. This will assess the pupils' ability both to answer questions and to evaluate possibly missing important aspects of the considered topic.

Positive aspects of this activity are

- discussions that are developed on the subject
- the active learning component
- the possibility to involve all students. In the digital implementation maybe you can choose to put in the class-quiz at least the figures of a group or of a student disappointed with respect to questions/answers, for example because the ones he has proposed have been discarded.

Working to build a quiz stimulates a series of reflections and activities that involve different learning areas. As in the story telling, the planning phase requires the choice of a subject and the definition of the objectives, the selection of materials and the definition of tasks and deadlines, then the organization of a scrum board. Later and during the development of the activity, critical comparisons are necessary and then, a

self evaluation test at the end of the activity on the strengths and critical points of the process and of the result.

Figure 3 shows a screenshot of one of the quiz on neurons (simplification of an activity by Carlotta Craveri, student of Educational Sciences of our university in the academic year 2014/2015). In figure 3 we have the question “How do neurons communicate?” Proposed answers are:

A. Smoke signals
B. Using WhatsApp
C. By means of the synapses

Fig. 3. “How do neurons communicate?”

This example has been shown in the meetings of the PP project with similar but much simpler activities. In fact for each activity type, because of the short time available, it was decided to start working on one or more canvases showing an example of the activity.

4 Conclusions

Activities described in this work have been carried out in various classes, and for each, in each class, the important part is not so much the Scratch final result but the preparation work during which the students discussed, designed, tested different formulations of questions and answers, decided for example a scrum board defining deadlines, distributing tasks, checking how the tasks were integrated and then urging one another to comply the deadlines of the several tasks.

The learning from the "Think a number" riddle is all in the care that the teacher puts in making the pupil, who shall invent and solve the riddle, discover that she/he is creating and solving a linear equation in one variable. For this the cooperation with the mathematics teacher is necessary.

The 17 primary school teachers attending PP meetings have all chosen to story telling activity that is in fact a feasible activity at very different levels of difficulty: one can start by modifying a given story. Teachers from middle schools were all mathematicians. They judged feasible in their classes all three kinds of activities even if, because of the short time available in this end of school year 15/16, they focused on stories and riddles (the latter also because more directly related to mathematics, their discipline) .

The operating mode we have chosen provided course attendees with a working simplified version of the chosen type of activity. According to the participants this method is proving to be very useful. Also useful, even mandatory after the end of the course, the Moodle community where participants can discuss problems and solutions.

An open question concerns the MOOC, with the same contents of the course here described, that the Municipality recently requested us. Our doubts on its effectiveness come from considering that the in person meetings have been a fundamental contribution to the success of this course.

5 References

1. W. Gander et all., Europe cannot afford to miss the boat, Report of the joint Informatics Europe & ACM Europe Working Group on Informatics Education, April 2013, http://europe.acm.org/iereport/index.html
2. F.Ferrari, F., Rabbone, A., Ruggieri, A., Experiences Conference, Ljubjana, September 2015.
3. C. Schulte, Reflections on the role of programming in primary and secondary computing education, Proceeding WiPSE '13 Proceedings of the 8th Workshop in Primary and Secondary Computing Education, ACM 2013
4. M.Ben-Ari, " In defense of programming", in ACM Inroads, March 2016
5. Miles Berry, “Computing in the National Curriculum. Guide for primary teachers”, Computing at school, 2013, http://www.computingatschool.org.uk/data/uploads/CASPrimaryComputing.pdf
6. M. C. Nussbaum, Not For Profit: Why Democracy Needs the Humanities, Princeton University Press, 2010
7. P. Cagliari, P. et all. (eds), Loris Malaguzzi and the Schools of Reggio Emilia, Routledge, London, 2016
8. Williams, L. and Cernochova, M. Literacy from Scratch. In Proceedings of the10th IFIP World Conference on Computers in Education (Torun, Poland, July 25, 2013) WCCE 2013. Copernicus University Publ, Torun, PL, 17-27.
9. Resnick, M., Maloney, J., Monroy-Hernandez, A., Rusk,N., Evelyn Eastmond, Karen Brennan, Amon Millner, Eric Rosenbaum, Jay Silver, Brian Silverman, Yasmin Kafai, Programming for all, Communications of the ACM, November 2009, vol. 52, no. 11, pp 60-67
10. Robasto, D. and Trinchero, R., (eds), Strategie per pensare. Attività evidence-based per migliorare la didattica e gli apprendimenti in aula, FrancoAngeli, Rome 2015.