Programming to learn in Italian primary school

Martina Benvenuti†
Istituto Tecnologie Didattiche
Consiglio Nazionale Ricerche
Genova, Italy
benvenuti@itd.cnr.it

Augusto Chioccariello
Istituto Tecnologie Didattiche
Consiglio Nazionale Ricerche
Genova, Italy
augusto@itd.cnr.it

Giorgia Giammoro
Department of Educational Sciences
University of Genova
Genova, Italy
giorgiagiammoro@gmail.com

ABSTRACT

The Italian Ministry of Education is promoting the introduction of coding and computational thinking at compulsory school level. One of the research initiatives being taken in this regard is "Programming to Learn in Italian Primary School". The project's aim is to develop a vertical curriculum for the introduction of programming in Italian primary schools as a new expressive language for children. All the schoolchildren involved in the project attend a weekly computer lab class held throughout the school year. They work on individual projects during the first half of the year. Then, in the second half of the year, they work in small groups on a common theme that the teacher selects from those studied in class. In this poster, we report the work of a fifth-grade class (24 students – 7 females and 17 males, aged 10-11) in the 2017-2018 school year. Findings from individual and group Scratch programs produced, self-evaluation questionnaire and semi-structured interviews with the groups are presented.

CCS CONCEPTS

• Social and professional topics → K-12 education;

KEYWORDS

Primary school, Computational thinking, Programming

ACM Reference format:

Martina Benvenuti, Augusto Chioccariello and Giorgia Giammoro. 2019. Programming to learn in Italian primary school. In *Proceedings of the 14th Workshop in Primary and Secondary Computing Education (WIPSCE '19). October 23-25. 2019, Glasgow, Scotland. ACM, New York, NY, USA, 2 pages.* https://doi.org/10.1145/3361721.3361732

1 INTRODUCTION

In recent years, Computational Thinking (CT) has been widely recognized by educational stakeholders as a key competence for an informed citizen of today's digital age. Coding/programming provides a laboratory for teaching and learning CT – it makes CT concepts concrete. However, there is a general consensus that CT actually entails more than coding/programming [1]. In Europe, Computational Thinking is currently being introduced into formal education in many countries. Several countries embed CT across subject areas, particularly at primary level, while at secondary level CT is mostly included as a computing subject in its own right [2]. There is a general consensus on the importance of introducing CT concepts to children early on in school. This has stimulated research on how to introduce computational thinking and programming in primary school both across the curriculum [3] and as a subject [4].

On 12 March 2019, a unanimous vote in the Italian parliament committed the government to finalizing the introduction of computational thinking and coding in compulsory school by 2022 [5]. While it is still unclear exactly how the Ministry intends to reform the current curriculum guidelines to introduce computing, Italian schools have reached a record level of participation in international coding events (EU Code Week and Hour of Code initiatives). Here, we report the work of a 5th grade class at an Italian primary school.

2 METHOD

Programming to Learn in Italian Primary School is a three-year project aiming at developing a vertical curriculum for the introduction of programming in Italian primary school. The project follows Papert's Claim that children can learn to program and that learning to program can affect the way they learn everything else [6]. Children are introduced to programming with Scratch [7] in the computer lab, working on individual projects. Integration with other subjects is sought through project-based activities in small groups. These projects have a common theme, chosen by the teacher, with the goal of presenting it to an audience. Extended time is allocated (20 hours) to make room for: design, implementation, peer review, revision, and presentation. In the first year of the project (2017-18), we field-tested this scheme with one-5th grade class (24 students – 7 females and 17 males). The study involved two researchers, the two class teachers and another teacher acting as the computing lab coordinator.

All the productions that the participating students shared from their personal accounts are currently being analyzed and categorized according to both social and technical indicators. Collected data on the social aspects regard the use of instructions, notes and credits, as well as the number of likes, favorites,

WiPSCE'19, October 23–25, 2019, Glasgow, Scotland Uk

ACM ISBN 978-1-4503-7704-1/19/10.
https://doi.org/10.1145/3361721.3361732

remixes, and comments. The technical aspects considered were the number of sounds, sprites and stages implemented into each Scratch production, and the Scratch commands used. At the end of the year, each student completed a self-evaluation questionnaire[1]. Subsequently semi-structured interviews were carried out.

3 RESULTS

During the first half of the year the 24 children shared a total of 248 individual projects on the Scratch website [2]. The majority of children (15) shared between 5 and 15 projects; only three shared more than 15 projects (the maximum being 41), and six generated a limited production (the minimum being two). The majority of those projects could be classified as multimedia stories and animations, but there were also some games (14) and quizzes (3).

In the second half, the teacher created 6 groups of four students assigning each a theme related to their work on the European Union (EU). Since this was their first introduction to Scratch, we decided that inviting the children to create multimedia stories was an appropriate entry point for beginners. The process of making the stories was divided into five steps: 1) design (start with a text version to be converted into storyboards); 2) implementation in Scratch; 3) peer review by the whole class; 4) revision; and 5) presentation. The 6 groups created multimedia stories summarizing the body of information on the EU studied. In several projects, the narration is entrusted to fictional characters animated with Scratch.

The groups' projects are more complex than the individual projects, both in terms of narrative and programming. The computational concepts used in those projects involve sequences, loops, parallelism, and events; conditionals, data and operators are absent [8]. However, variables and conditionals are used in games and quizzes in the individual projects. Kafai and Burke [9] argue that writing stories favors the generation of linear structures rather than the more complex branching conditionals present in game design. The choice of multimedia stories for group work, fostered children fluency in orchestrating the media components of their stories via parallelism and events.

To gather qualitative data, the children responded to a self-evaluation questionnaire. Their overall perception was of a positive experience; they learned to design and program multimedia stories with Scratch, and to work in groups.

At the end of the project, we interviewed the six groups of children (the four members together) to gather their viewpoints on the collaborative project work. Results show that, while they acknowledged that working in groups allows for the production of a better story and improved their knowledge of Scratch, it also created problems. Group work generates conflict that needs to be solved. Individual work, instead, was perceived as freer and more creative compared to the constraints of the group. Furthermore, the storyboard phase was central to organize the story but did not become a tool for detailed design. The story evolved with the production of the multimedia components and the animations with Scratch.

4 CONCLUSIONS AND FUTURE RESEARCH

The poster describes the work done in the first year of the "Programming to Learn in Italian Primary School" project. The approach of combining work on individual projects during the first half of the year, with work in small groups on a common theme selected by the teacher has been replicated in the 2018-19 school year in two 5th grade classes. The weekly one-hour programming lab involves all students from grade 3 through 5. While our approach to the introduction of programming is spreading in this primary school, further research is need to monitor the programming concepts that are used at each school grade to better define the kind of activities that are best carried out at each age range. We are also planning for evaluating children learning of programming and the contribution of our approach to the learners' performance on curricular activities with those classes involved in the project for at least three consecutive years.

ACKNOWLEDGMENTS

Special thanks go to the children and teachers of the "A. De Scalzi - F.lli Polacco" primary school in Genoa for their participation in this study.

REFERENCES

[1] Shuchi Grover and Roy Pea. 2018. Computational Thinking: A competency whose time has come. In *Computer Science Education: Perspectives on Teaching and Learning in School* (1st ed.), Sue Sentance, Erik Barendsen and Schulte Carsten (eds.). Bloomsbury, 19–38.

[2] Stefania Bocconi, Augusto Chioccariello, Giuliana Dettori, Katja Engelhardt, and Anusca Ferrari. 2016. Developing computational thinking in compulsory education – Implications for policy and practice. EUR 28295 EN, DOI: https://doi.org/10.2791/792158

[3] José-Manuel Sáez-López, Marcos Román-González, and Esteban Vázquez-Cano. 2016. Visual programming languages integrated across the curriculum in elementary school: A two year case study using "Scratch" in five schools. Computers & Education 97, (June 2016), 129–141. DOI: https://doi.org/10.1016/j.compedu.2016.03.003

[4] Katharina Geldreich, Alexandra Simon, and Peter Hubwieser. 2019. A Design-Based Research Approach for introducing Algorithmics and Programming to Bavarian Primary Schools. MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung 33, (2019), 53–75. DOI: https://doi.org/10.21240/mpaed/33/2019.02.15.X

[5] Chamber of Deputies of the Italian Parliament. 2019. MOZIONE 1/00117, https://aic.camera.it/aic/scheda.html?numero=1/00117&ramo=C&leg=18

[6] Seymour Papert. 2000. What's the big idea? Toward a pedagogy of idea power. IBM Systems Journal 39, 3.4 (2000), 720–729. DOI: https://doi.org/10.1147/sj.393.0720

[7] Mitchel Resnick, John Maloney, Andrés Monroy-Hernández, Natalie Rusk, Evelyn Eastmond, Karen Brennan, Amon Millner, Eric Rosenbaum, Jay Silver, Brian Silverman, and Yasmin Kafai. 2009. Scratch: Programming for All. *Communications of the ACM* 52, 60–67.

[8] Karen Brennan and Mitchel Resnick. 2012. New frameworks for studying and assessing the development of computational thinking. In AERA2012 - annual meeting of the American Educational Research Association.

[9] Quinn Burke and Yasmin B. Kafai. 2012. The Writers' Workshop for Youth Programmers: Digital Storytelling with Scratch in Middle School Classrooms. In Proceedings of the 43rd ACM Technical Symposium on Computer Science Education (SIGCSE '12), 433–438. DOI: https://doi.org/10.1145/2157136.2157264

[1] The questionnaire was created specifically for this study.

[2] The Scratch class page (https://scratch.mit.edu/classes/57500/) allows access to students' accounts and to published projects.