



Computational thinking in kindergarten: Developing programming concepts with the programming environment ScratchJr

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Background

The digital literacy and the development of computational thinking constitutes the main subject of research concerning preschool and primary education (Komis, 2005). The development of modern digital literacy, as a basic skill of the 21st century, does not simply encompass the acquaintance of students with technologies, but it mainly concerns the development of abilities combining uses of digital tools and algorithmic based technologies such as robotics and programming environments (Manches & Plowman, 2015; Misirli, 2015). By using such environments students and especially preschoolers develop high order skills such as structured and critical thinking as well as problem-solving skills (Falloon, 2016; Papadaki et al., 2016; Brennan et al., 2012), which according to Wing (2006) contribute to the development of computational thinking. Consequently, the purpose of this study is to investigate if preschool children can actually obtain these kind of skills through programming and interacting with programming environments such as Scratch Jr, which according to Bers et al. (2013) is designed with a developmentally appropriate interface and methods of interaction for early childhood educators. However, in order to explore these skills we initially study whether children can effectively manipulate this environment and subsequently use its functions and commands to program it with simple programming structures such as sequence structure in order to solve open-ended problems.

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Theoretical framework

The programming environment “ScratchJr”

ScratchJr is a visual programming language based on Logo principles (Papert, 1996) which enables children to use and composite commands in a puzzle form, in order to make characters move, dance, speak and even sing (ScratchJr.org, 2015). Thus, it gives the opportunity to children to create interactive stories and games (Bers & Resnick, 2015) and at the same time enables them to get in touch with basic programming concepts.

Research Questions

In order to investigate if preschoolers can understand and manipulate the functions and the commands of the programming environment of ScratchJr, we posed the following research questions:

1. To what extent are preschool children able to use the interface of ScratchJr when programming?
2. To what extent can they understand and manipulate its programming commands when composing their code?

Method

A qualitative research and specifically a case study was conducted. The data was collected from a public kindergarten in Patras during the collaborative research program called “Dalie” that took place for two years (2015-2017) in five French universities and in the Department of Educational Sciences and Early Childhood Education of University of Patras. Under this research program, collaborative educational scenarios, using the programming environments of Bee Bot, Probot and ScratchJr, was designed and implemented by researchers and kindergarten teachers who participated. The aim of this program was to familiarize preschoolers with robotic tools, using basic programming concepts and problem solving skills and to educate teachers about the use of robotic tools and their inclusion in the curriculum. However, for our research we use the following data:

- an educational problem-solving scenario using the programming environment of ScratchJr that was designed and implemented by university professors, kindergarten teachers and postgraduate and doctoral students in Patra's public kindergartens that participated in the program. It contained four teaching activities, one consolidation activity and one evaluation activity.
- a video footage of its application and
- individual interviews of children with the form of pre-test and post-test

Results

In order to produce results we studied the video footage of educational scenario and we completed individual analysis grids that included the concepts and the skills of ScratchJr's interface and programming commands that children had to obtain per activity. Then we counted those that the children had fully acquired per activity in order to measure their average performance and we found out the following:

Average performance of students using the Scratch Jr interface

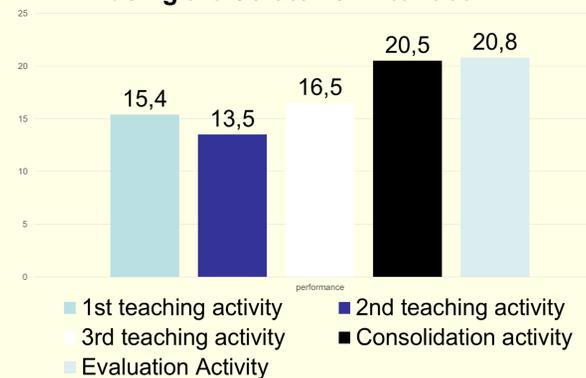


Chart1: The performance of students using the interface

Average performance of students using the Scratch Jr's programming commands

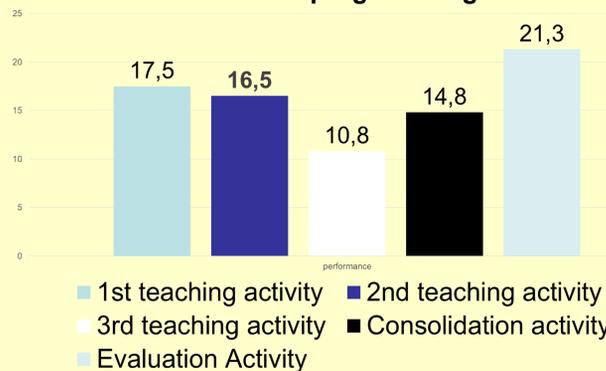


Chart 2: The performance of using the programming commands

As we can see in the two charts, most of the children had fully obtained the concepts and the skills concerning the interface and the programming commands of ScratchJr. For instance it was noticed that the children had completely understood the concept of application and its corresponding skill since the third teaching activity of the scenario. Regarding their course followed by the other concepts and skills, we observed that there were fluctuations, with a clear example of the skill of connection commands, which showed an upward course in the first and the second activity, decreased in the third teaching and consolidation activity, while increased again in the evaluation activity.

Discussion

Conclusions-Limitation

The purpose of this study was to investigate the concepts and the skills that preschool children develop when they use the interface and the commands of programming environment of Scratch Jr. So, we participated in a collaborative research program called Dalie and we had the opportunity to use and analyze data from a educational scenario that was designed and implemented by researchers of University of Patras and kindergarten teachers from public kindergartens of Patras. By analyzing them, we found that most children had fully acquired the concepts and the skills concerning the interface and the programming commands of ScratchJr. However, we observed that they faced some difficulties in some activities, which were attributed to the introduction of complex concepts and skills. However, there was a limitation for this study: Due to the small sample we couldn't not generalize the results, so a more extensive research is been proposed

Implications for future collaborations

Although the research program we have participated in has been completed, we recommend continuing our cooperation with the participants and even expand this cooperation with other universities and kindergartens and even other countries in order to have the chance to exchange experiences and data and create an effective educational and technological environment for preschool children.

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