

Developing Computational Thinking in Early Childhood Education

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Abstract : Nowadays, in the digital era, the early acquisition of basic programming skills and knowledge is encouraged, as it facilitates students' exposure to computational thinking and empowers their creativity, problem-solving skills, and cognitive development. More and more researchers and educators investigate the introduction of computational thinking in K-12 since it is expected to be a fundamental skill for everyone by the middle of the 21st century, just like reading, writing and arithmetic are at the moment. In this paper, a doctoral research in the process is presented, which investigates the infusion of computational thinking into science curriculum in early childhood education. The whole attempt aims to develop young children's computational thinking by introducing them to the fundamental concepts of object-oriented programming in an enjoyable, yet educational framework. The backbone of the research is the digital environment PhysGramming (an abbreviation of Physical Science Programming), which provides children the opportunity to create their own digital games, turning them from passive consumers to active creators of technology. PhysGramming deploys an innovative hybrid schema of visual and text-based programming techniques, with emphasis on object-orientation. Through PhysGramming, young students are familiarized with basic object-oriented programming concepts, such as classes, objects, and attributes, while, at the same time, get a view of object-oriented programming syntax. Nevertheless, the most noteworthy feature of PhysGramming is that children create their own digital games within the context of physical science courses, in a way that provides familiarization with the basic principles of object-oriented programming and computational thinking, even though no specific reference is made to these principles. Attuned to the ethical guidelines of educational research, interventions were conducted in two classes of second grade. The interventions were designed with respect to the thematic units of the curriculum of physical science courses, as a part of the learning activities of the class. PhysGramming was integrated into the classroom, after short introductory sessions. During the interventions, 6-7 years old children worked in pairs on computers and created their own digital games (group games, matching games, and puzzles). The authors participated in these interventions as observers in order to achieve a realistic evaluation of the proposed educational framework concerning its applicability in the classroom and its educational and pedagogical perspectives. To better examine if the objectives of the research are met, the investigation was focused on six criteria; the educational value of PhysGramming, its engaging and enjoyable characteristics, its child-friendliness, its appropriateness for the purpose that is proposed, its ability to monitor the user's progress and its individualizing features. In this paper, the functionality of PhysGramming and the philosophy of its integration in the classroom are both described in detail. Information about the implemented interventions and the results obtained is also provided. Finally, several limitations of the research conducted that deserve attention are denoted.

Keywords : computational thinking, early childhood education, object-oriented programming, physical science courses

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