Programming at Pre-primary and Primary Levels: The Pipeline Can Start That Early

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Extended Abstract: In my panel address, I will summarize experience accumulated in our group in developing software interfaces for young and very young children to sustain the development of their computational thinking and problem solving skills. Our deep engagement in this field results from two intertwined facts: first, we believe that computational thinking supported through educational programming is a valid contribution to the *general primary and secondary education for all* – not because we want to attract young people into university Computer Science programmes, but because it constitutes important part of so-called *skills for the 21st century learning*. Second, in our department, we are for more than 20 years involved in designing national curricula for Informatics (this is how the subject is called in our country), and during all that time we are trying to develop new pedagogies – and software interfaces, which would be *developmentally appropriate* and yet would mediate the potential of programming to education.

In 2008, we managed to establish Informatics as a mandatory subject in Slovakia for every primary student (after establishing it in 2005 at the lower secondary level and in 1985 at the upper secondary level). Since the beginning of that process, we have considered programming to be the substance of the subject. Therefore, we continuously apply so-called *design-based research* to better understand what are the fundamental cognitive operations of such programming for young and very young children, what are appropriate cognitive requirements of elementary educational programming, what the primary and secondary students consider difficult and easy when solving programming tasks.

In my talk, I will solely focus on our research and development at the kindergarten level (working with children aged 4 to 6, corresponding to ISCED 0) and at the primary level (working with pupils aged 6 to 10 or

11, corresponding to ISCED 1). In both contexts, our activities always include working with the teachers, an interesting challenge in itself.

We explored what are the appropriate methods for developing productive and constructive *learning software interfaces*1 for pre-primary children and recently applied these findings for developing new software environment to support their early computational thinking and problem solving skills. Inspired by our older Thomas the Clown2 environment, we developed new application for collaborative work of a group of children playing in front of an IWB and *planning future behaviours* for Thomas, who is solving various tasks in the world of a ZOO, a town, a garden or a farm yard. While doing so, children apply direct manipulations to control the character, they read and interpret symbolic plans for his future behaviours, they build such plans by themselves and fill in their missing parts. While doing so, they have to cope with *dynamically changing constraints*. The whole activity is organized in a constructivist way, providing children with opportunities to discover the problems and build their own solutions – in an environment with rich social interactions.

In the primary level, we exploit a unique occasion we have gained due to running Slovak version of a famous international contest Bebras. In 2011, we initiated a new category of the contest for the primary students, with rapidly growing participation by itself – 12.448 children solving 12 tasks in November 2013. Each year, two to four of the tasks are programming tasks. While creating these tasks and then analyzing the actual scores achieved by the primary students, we have exceptional opportunity and motivation for further research, as far as we want to understand cognitive requirements and difficulty of the tasks. In my talk, I will present some of our findings and conclusions resulting from that research and development, which we are trying to exploit in developing our new pedagogy of early educational programming.

Keywords: Learning interfaces development, computational thinking, educational programming, primary level, pre-primary level

Endnotes

1 We presented our findings at the IFIP TC3 working conference in 2012, see Moravcik, Kalas (2012).

2 See our IFIP TC3/WG3.1 and WG3.5 conference paper from 1993, see Blaho, Kalas (1993).

References

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Biography

Ivan Kalas is a professor of Informatics Education. For more than 25 years, he concentrates on developing Informatics curricula for preschool, primary and secondary stages, developing textbooks and other teaching and learning materials for Informatics and ICT in education. Ivan is also interested in strategies for developing digital literacy of future and in-service teachers and enhancing learning processes through digital technologies.