Design of an Agent-Based Visual Programming Tool for Elementary Ecosystem Science Learning

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ABSTRACT

Computational thinking and scientific modeling are essential STEM education practices, and visual block-based programming interfaces offer new opportunities to make coding accessible in elementary school science. The EcoMOD research project blends computational modeling and ecosystem science learning through a 3D virtual forest ecosystem combined with a 2D visual block-based programming tool, for 3rd and 4th grade students (ages 8–10). During a 14-day curriculum, students explore an immersive virtual forest ecosystem, and program agent-based computational models of a beaver building a dam. As students run their program and watch their beaver agent go through the steps of building a dam, they observe the emergent outcomes as their programmed model impacts other elements of the ecosystem. The final curriculum was implemented with 7 teachers and approximately 150 students.

A scaffolded coding interface provides domain-specific programming primitives, such as “move toward tree,” “bite tree,” and “pick up log.” Conditional expressions include “if,” “if/otherwise,” and “repeat until,” and can be nested. The interface provides a virtual 2D sandbox to test and edit programs, visual feedback during code execution, and debugging supports. Using design-based research methods, different sets of primitives and functionality were tested with students. Analysis of computational models constructed by students uses logfile

data of programming activities over multiple class periods, as well as screen capture video of focus students. The poster will include design insights for the agent-based modeling language, including choices of primitives, conditionals, and scaffolding.

CCS CONCEPTS

• Social and professional topics~Children • Social and professional topics~Computational thinking • Social and professional topics~Computer science education • Applied computing~Interactive learning environments • Software and its engineering~Domain specific languages • Software and its engineering~Visual languages

KEYWORDS

Introductory Visual Programming Environments; Elementary Computer Science Education; Ecosystem Science Education; Block-based Programming; Agent-Based Programming

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