

## Draw Your Own Game

### Design Games with the RULER.game Collaborative Computational Thinking Tool

Alexander Repenning<sup>1</sup>

<sup>1</sup> PH FHNW, School of Education, Brugg-Windisch, Switzerland

#### Abstract

Imagine your students creating sophisticated games by combining hand-drawn art with AI – all while reducing their screen time. This workshop introduces RULER.game, where even programming novices such as first graders can build Pac-Man-like games with collaborating ghosts, bridging the gap between physical creativity and digital innovation. This workshop introduces Collaborative Computational Thinking Tools (CCTTs) through RULER.game, which combines off-screen activities like drawing game assets on paper with collaborative learning and AI-enabled programming. Participants will create a Pac-Man-like game and understand the distinction between contemporary block-based programming and CCTTs. The workshop examines how CCTTs address semantic and pragmatic programming concerns through prebugging, while Proxy-Based Programming blends block-based programming with programming by example to overcome semantic challenges. RULER.game is free, enabling students to create and play sophisticated games through collaborative creation and gameplay by combining hand-drawn assets with AI functions. Games can be programmed with RULER.game on tablets, laptops, smartphones and in VR environments.

*Tools, Skills and Materials: Tools -> RULER.game; Tools -> Collaborative Computational Thinking; Materials -> Paper and Pens.*

*Keywords and Phrases: computer science education research, block-based programming, programming by example.*

#### 1. Workshop Description

##### 1.1 Scope, Motivation, and Background

RULER.game is a Collaborative Computational Thinking Tool that transforms programming education. Running directly in web browsers without installation, it's accessible on any modern device – from laptops and tablets to smartphones, including support for virtual reality glasses and smartwatches. RULER.game introduces “prebugging,” an extension of block-based programming that incorporates programming by example, reducing logic bugs by a factor of ten (Repenning & Basawapatna,



2024). Through proxy-based programming, RULER.game enables users from first graders to advanced students to create games with AI-enhanced functionality (Repenning, 2024).

This workshop explores a theoretical framework addressing syntactic, semantic, and pragmatic challenges in programming education. While block-based programming has effectively eliminated syntax errors, novice programmers still struggle with semantic understanding (what code means) and pragmatic application (what code means in specific situations). The interdisciplinary nature of RULER.game bridges computer science with art, mathematics, and storytelling, allowing educators to integrate computational thinking across various subject areas. Workshop participants will create a complete Pac-Man game using proxy-based programming, implementing intelligent ghost behavior with AI blocks and experiencing firsthand how this approach represents a paradigm shift by “thinking outside the blocks,” using visual proxies as syntonic embodiments (Watt, 1998) of objects being programmed.

Our motivation draws from Pestalozzi’s “head, heart, and hands” educational philosophy (Lubis, 2021; Pestalozzi, 1932), which emphasizes cognitive understanding, emotional engagement, and physical interaction. The workshop demonstrates how this framework applies to computer science education through three complementary approaches: virtual embodiment via proxy-based programming (head), physical embodiment through hands-on creation of pen and paper designs (hands), and social embodiment through engaging collaborative game programming (heart). Participants will draw their own game characters on paper and scan them into their digital projects, making programming more accessible while addressing screen time concerns.

Our background includes pioneering work in block-based programming through AgentSheets (Repenning & Ambach, 1996) and AgentCubes platforms (Repenning & Ioannidou, 2006). As early innovators, we introduced tactile programming concepts that eliminated syntax errors, allowing focus on computational thinking. However, removing syntax barriers proved insufficient – students continued struggling with semantic and pragmatic challenges. This insight led to proxy-based programming in RULER.game, which proactively visualizes code execution consequences, significantly reducing logical errors (Ben-Yaacov & HersHKovitz, 2023). RULER.game emphasizes real-time, peer-to-peer collaboration where students learn to collaborate and collaborate to learn, and is currently being introduced to all School of Education FHNW (Switzerland) K-12 preservice teachers (400 per semester).

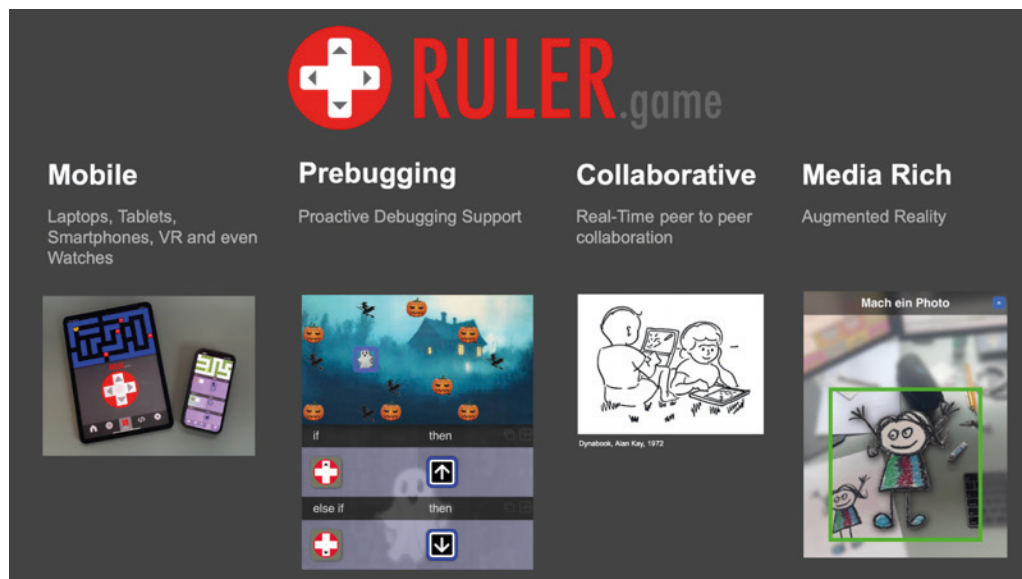


Figure 1: RULER.game: A mobile computational thinking tool that supports prebugging, collaboration, and integration of hand-drawn artwork.

## References

- Ben-Yaacov, A., & HersHKovitz, A. (2023). Types of Errors in Block Programming: Driven by Learner, Learning Environment. *Journal of Educational Computing Research*, 61(1), 178-207.
- Lubis, S. I. A. (2021). The Role Of School And Teaching Method Through Maria Montessori And Johann Heinrich PestalozziS View. *International Journal of Economic, Technology and Social Sciences (Injects)*, 2(1), 87-92.
- Pestalozzi, H. (1932). Wie Gertrud ihre Kinder lehrt, ein Versuch, den Müttern Anleitung zu geben, ihre Kinder selbst zu unterrichten in Briefen von Heinrich Pestalozzi. 1801. In *Band 13 Schriften aus der Zeit von 1799–1801* (pp. 181-359). Berlin, Boston: De Gruyter.
- Repenning, A. (2024). *Escaping the Turing Tar-Pit with AI Programming Blocks*. Paper presented at the The 19<sup>th</sup> WiPSCE Conference on Primary and Secondary Computing Education Research, Munich, Germany.
- Repenning, A., & Ambach, J. (1996). *Tactile Programming: A Unified Manipulation Paradigm Supporting Program Comprehension, Composition and Sharing*. Paper presented at the 1996 IEEE Symposium of Visual Languages, Boulder, CO.
- Repenning, A., & Basawapatna, A. (2024). *RULER: Prebugging with Proxy-Based Programming*. Paper presented at the IEEE Symposium on Visual Languages and Human-Centric Computing, Liverpool, UK.
- Repenning, A., & Ioannidou, A. (2006). *AgentCubes: Raising the Ceiling of End-User Development in Education through Incremental 3D*. Paper presented at the IEEE Symposium on Visual Languages and Human-Centric Computing 2006, Brighton, United Kingdom.
- Watt, S. (1998). *Syntonicity and the Psychology of Programming*. Paper presented at the Proceedings of the Tenth Annual Meeting of the Psychology of Programming Interest Group, Milton Keenes, UK.