Developing Comic-based Learning Toolkits for Teaching Computing to Elementary School Learners

Francisco Castro
francisco.castro@nyu.edu
New York University
New York, United States

Sangho Suh
sanghosuh@ucsd.edu
University of California, San Diego
San Diego, CA, United States

Jane L. E
je@ucsd.edu
University of California, San Diego
San Diego, CA, United States

Weena Naowaprateep
weena.naw@student.mahidol.edu
Mahidol University
Nakhon Pathom, Thailand

Yang Shi
yshi26@ncsu.edu
North Carolina State University
Raleigh, United States

ABSTRACT

We describe the use of comics to teach computing by having learners create, design, and arrange comic panels. We designed comic-based learning toolkits, guided by the following research question: *How do we support the informal learning of computing concepts for elementary school learners through a physical comic-based learning toolkit?* This question emerged as a result of our partnership with a community organization that teaches art to elementary school learners through the production and distribution of art *subscription boxes*. Subscription boxes contain art materials and instruction manuals that learners can use to create artistic artifacts at home. Partnering with the organization, we explored how to teach computing through art activities and designed a subscription box for comic creation activities that used materials such as paper comic panels, coloring pens, magnets, and activity manuals. Our learning toolkits guide learners to use computing concepts in the story-crafting process, for example: *decomposing* narratives with comic panels, *sequencing* comic panels to create a narrative flow, using *conditionals* (e.g., *if-else*) for character decision-making within the story, using *loops* to repeat comic story events, and *iterating* on or *refining* the comic to create and develop a cohesive narrative flow.

1 INTRODUCTION

Interest in opportunities for informal learning of computing is increasing, as evident in the rise of efforts and programs such as Hour of Code [3], Unplugged CS activities [4], and after school computing programs. Within this space, the use of block-based programming to create games or solve puzzles has been one of the most popular activities. Recently, *artistic computing* has been explored within informal learning settings as an avenue for teaching and learning about computing [1]. Our work explores the use of comics and comic creation activities to support the informal learning of computing concepts for elementary school learners.

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2 BACKGROUND AND RELATED WORK

While comic books such as *Hello Ruby* have been available for some time, research on how to design and use comics for computing education is relatively new. So far, research has found comics promising, with positive feedback from both students and teachers [6, 7]. There has also been progress in understanding how comics can illustrate programming concepts effectively: a prior study [7] proposed a design process and a set of design patterns for programming comics. Our work builds on these works by leveraging some of their comic design patterns for programming [5] to create learning toolkits[1] that enable learners to exercise computing concepts by creating, designing, and arranging comic panels in a physical format.

3 APPROACH: COMICS + COMPUTING

Our work is similar to tangible programming [2] in that learners work hands-on with physical pieces. Our work, however, differs in several ways. Rather than physical blocks with pre-defined commands (as in Horn and Jacob [2]), we use physical comic panels and art materials. Our work focuses on informal learning (e.g., outside of formal elementary school classrooms) with subscription boxes containing our art toolkits for comic creation. Our unique comic-based learning toolkits are designed to help learners exercise various computing concepts such as decomposition, sequencing, selection (e.g., *if-else*), loops, and iterative refinement, while creating, arranging, and designing comic panels.

REFERENCES

[1] Francisco Enrique Vicente Castro, Kayla DesPortes, William Payne, Yoav Bergner, and Kathleen McDermott. 2022. AI + Dance: Co-Designing Culturally Sustaining Curricular Resources for AI and Ethics Education Through Artistic Computing. In *ICER'22*. 26–27. https://doi.org/10.1145/3501709.3544275
[2] Michael S Horn and Robert JK Jacob. 2007. Tangible Programming in the Classroom with Tern. In *CHI'07 extended abstracts*. 1965–1970.
[3] Luis Morales-Navarro, Yasmin Kafai, Gayithri Jayathirtha, and Mia Shaw. 2021. Investigating Creative and Critical Engagement with Computing in the Hour of Code (Practical Report). In *WiPSCE'21*.
[4] Brandon Rodriguez, Stephen Kennicutt, Cyndi Rader, and Tracy Camp. 2017. Assessing Computational Thinking in CS Unplugged Activities. In *SIGCSE'17*.
[5] Sangho Suh. 2020. https://codingstrip.github.io. Accessed: 2022-08-16.
[6] Sangho Suh, Celine Latulipe, Ken Jen Lee, Bernadette Cheng, and Edith Law. 2021. Using Comics to Introduce and Reinforce Programming Concepts in CS1. In *SIGCSE'21*. https://doi.org/10.1145/3408877.3432465
[7] Sangho Suh, Martinet Lee, Gracie Xia, et al. 2020. Coding strip: A pedagogical tool for teaching and learning programming concepts through comics. In *VL/HCC'20*.

[1] Poster, prototypes, and materials for our comic-based learning toolkits are available at https://osf.io/uxm7p/