Computational Thinking Integration Design Principles in Humanities

Secil Caskurlu
Michigan State University
East Lansing, MI, USA
caskurlu@msu.edu

Anne Drew Hu
Michigan State University
East Lansing, MI, USA
huandrew@msu.edu

Aman Yadav
Michigan State University
East Lansing, MI, USA
ayadav@msu.edu

Rafi Santo
Telos Learning
New York, NY, USA
rafi@teloslearning.net

ABSTRACT

In this poster, we will present approaches and associated design principles for integrating computational thinking (CT) into middle school Social Studies, Arts, and Language Arts instruction to enhance disciplinary learning. We used four steps to identify these approaches and design principles: (1) co-design with teachers and experts in computer science and CT education to ideate CT-integrated lessons; (2) research team meetings to identify initial design principles based on the ideated lessons; (3) consultation with subject matter experts; and (4) conducting a Delphi study with pedagogical experts (e.g., teachers, curriculum writers, teacher educators) to examine the clarity, feasibility and potential impact of the design principles. The process led to three broad approaches to integrate CT into Social Studies instruction that included 14 design principles, three for Arts with 16 design principles, and four for Language Arts with 13 design principles.

KEYWORDS

Computational Thinking; K-12; Social Studies, Arts, Language Arts; Design Principles

1 BACKGROUND

Computational thinking (CT) is a set of analytical skills that have been suggested as something computer scientists draw upon, but do not depend on using computational tools. Earlier efforts on CT integration into humanities mainly focused on either curriculum development or providing examples of how CT can be integrated into existing curriculum. Yet, there is no comprehensive articulation of the relationship between CT and these disciplines. Therefore, this study focuses on identifying underlying design principles for integrating CT into middle school Social Studies, Arts, and Language Arts in ways that enhance disciplinary learning.

2 OVERVIEW OF METHODS AND RESULTS

We followed the following four steps to develop CT integration approaches and associated design principles: (1) co-designing CT-integrated lessons with expert teachers; (2) identifying initial design principles based on CT-integrated lessons and relevant literature; (c) consultation with subject matter experts in focal disciplines and CT; and (4) conducting a Delphi study with pedagogical experts (e.g., teachers, curriculum writers, teacher educators) to examine the clarity, feasibility and potential impact of the design principles.

We identified three approaches to integrate CT into middle school Social Studies: (a) exploring, analyzing, representing social, historical, political, economic, or geographical phenomena using models; (b) data practices for social studies inquiry; and (c) algorithms and society. The approaches to integrate CT into middle school Arts instruction included (a) applying CT practices to create computationally enhanced/inspired artistic works; (b) applying computational practices, tools, or processes to analyze artistic works to explore or demonstrate art concepts and/or processes used by the artists and (c) using data to represent artistic works or as art to analyze artistic works. Finally, approaches to integrate CT into middle school Language Arts instruction included: (a) applying algorithmic exercises to analyze text; (b) applying computational practices to enhance writing process; (c) applying computational practices to compose interactive texts; and (d) critical analysis of computational texts.

The design principles under each of the approaches listed above could be found at [https://ctintegration.org].These design principles can support teachers, curriculum writers, and professional development providers who are interested in CT integration in K-12 and makes the connection between CT and these disciplines.

3 ACKNOWLEDGEMENTS