


Chapter 12

Student Learning of Computational Thinking and Coding: Synchronous vs. Bichronous Online Learning

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ABSTRACT

This paper reports a study that examined the development of teacher education students' computational thinking knowledge and coding skills in different online learning environments. The participants learned about computational thinking and coding over four consecutive weeks in an instructional technology class. One group of twenty-one participants attended weekly class meetings synchronously. The other group of eleven participants learned in a bichronous learning environment. The two groups did not demonstrate significant differences in performance and perceptions of integrating computational thinking and coding into teaching, except that the bichronous group had more positive perceptions of coding in education. The implications and recommendations were provided for future practice..

INTRODUCTION

In educationa, there has been an increasing recognition of the importance of providing avenues for computer science education, with a particular emphasis on involving students in computational thinking concepts and activities in the last

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decade (Kwon et al., 2021). According to Wing (2017), computational thinking is defined as “the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer -human or machine - can effectively carry out” (p.8). The common components of computational thinking that many researchers have used include abstraction, generalization, algorithms and decomposition (Cansu & Cansu, 2019).

In general, there are two pedagogies to foster computational thinking. One is the unplugged approach to teaching computational thinking knowledge and skills through hands-on activities that do not require computers. The other teaching method, widely adopted, focuses on developing CT through learning to code or program directly on computers (Huang & Looi, 2021; Kjällander et al., 2021; Tsortaanidou et al., 2021). Teachers play a pivotal role in developing students’ computational thinking and coding skills (Ray et al., 2020; Yadav et al., 2017). Ray et al. (2020) suggested that “before teachers can integrate coding into their instructional practice, they first must feel knowledgeable about and skilled, to some degree, in the concepts themselves” (p. 21). This poses an urgent need for teacher education programs to prepare teacher education students to teach computational thinking and coding in their future classrooms. During the COVID-19 pandemic, educators at all levels, including teacher educators, shifted to online delivery of instruction. There are three types of online learning: synchronous, asynchronous and bichronous online learning (Martin & Bolliger, 2023). Bichronous online learning blends synchronous and asynchronous online learning by leveraging the advantages of each format (Martin et al., 2020). In the post-COVID era, to empower students to become digital citizens and to help educators and students be prepared for emergent circumstances, it has been recommended that a bichronous mode of instruction be adopted (Brzezinska, 2022). This paper reports a study that compares teacher education students’ learning of computational thinking and coding in synchronous (Bai, 2024) and bichronous modes.

BACKGROUND

Wing (2006) argued that computational thinking is a fundamental skill for everyone in modern society and it should be in a child’s analytical ability. To ensure all students, including underrepresented groups, have the necessary skills to thrive in a technology-driven world and to address gender inequity issues in computer science and STEM fields, it has been recommended that teachers should integrate computational thinking and coding into the subjects that they already teach (Coenraad et al., 2020; Mills et al., 2021). Lloyd and Chandra (2020) pointed out that “The urgency of the requirement to teach coding and computational thinking means that

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