Chapter 10
Fostering Future Teachers' Competence in Computational Thinking in an Educational Technology Course

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ABSTRACT

Computational thinking is considered a necessary skill in the 21st century. However, few teacher-education programs offer training for pre-service teachers to learn how to integrate computational thinking into the classroom. Pre-service teachers need to gain the knowledge and experience of computational thinking so that they are confident about designing relevant instructions in the future. The purpose of this chapter is to show how a free elective course in the teacher education program provides learning opportunities for them to develop their computational thinking skills and knowledge through the use of tangible objects. Samples of their works were analysed at different stages of learning to illustrate the technological pedagogical content knowledge of computational thinking. Overall, the study demonstrates that pre-service teachers were able to develop knowledge and attitudes towards computational thinking with their experience in the teacher education course.

COMPUTATIONAL THINKING (CT) EDUCATION IN MACAO

Macao, a special administrative region of China, is a major gambling, tourist and resort city in the Asia Pacific region. The Macao government always wants to diversity its limited economy so it has put a lot of resources in education[1]. The educational authority in Macao also provides a series of seminars, training for teachers to know more about the technology and science. In Macao education system, there is a subject called Information Technology (IT) which every student has to learn in K-12. The ultimate goal of the course is to develop one's information literacy and thinking ability[2]. For children in K-6, the

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goal includes: (1) to foster a positive attitude towards IT; (2) to apply IT to enhance learning (3) to make appropriate use of IT in daily life[3]. Students have to learn one lesson per week about IT concepts and knowledge. Due to the limited instructional time allocated for IT, majority of the schools in Macao put lots of effort to foster students' attitude towards IT by providing students the application of IT in learning and daily life. They usually have the CT education after primary education depending on the choice of each school. There is a trend that CT education is emerging in primary education and extra curriculum activity. Schools also encourage students to join local and international competitions so that students have more practical experience of CT. Young children in kindergarten do not have any CT activity but more and more educational centers provide CT activities to attract young children to learn coding.

COMPUTATIONAL THINKING IN EDUCATION

Computational thinking (CT) is considered a necessary skill in the 21st century because computers and their related technology are ubiquitous. Wing (2006) argued that computational thinking is a fundamental skill, as important as reading, writing, and arithmetic skills. Computational thinking is a set of 'mental tools' to analyse and formulate automatic solutions to a given problem. It is a universally applicable aptitude and skill that can be utilised in daily life. Since everyone should be given the opportunity to develop it, the field of CT in education has been a hot research topic around the world. A meta-review of studies between 2006 and 2017 in this field showed that more and more countries were involved in the studies of CT (Hsu et al., 2018). The number of studies in this field increases a lot in the past 10 years.

In Tang et al.'s (2020) review of previous work in the field of CT studies, they found that the USA was the most productive country while China, Spain, Turkey and UK were keen to research in this area. This seems to imply that more and more countries recognize the importance of CT in education. Since CT is an important skill for new generations to acquire, many educational systems such as England and Japan setup computer science as a school subject where students start learning the basics of coding in primary (Hubwieser et al., 2015). For example, England setup the initiative for students to learn about algorithms and program design at the age of five (Waite et.al, 2020) while Japan has similar plan starting in 2020 (Kanemune et.al, 2017). In Singapore, the government has a clear goal to develop the nation's computational capability so programs are designed from preschool children to adults (Seow et.al, 2019).

In terms of the CT curriculum, the CT-infused courses were located in a wide range of disciplines stretching through music, languages, science, technology, engineering, and mathematics. CT activities usually appear in the form of competitions, extra-curriculum activities, and interdisciplinary learning. Commonly adopted pedagogy in CT literature include games-based learning, collaborative project-based learning, simulations and inquiry approaches. For example, Denner et al. (2012) found from their investigation that female middle school students benefited from an activity involving game construction. To develop CT skills, students have recently been introduced to visually based programming languages to solve authentic problems (Kalelioglu, & Gülbahar, 2014). Alternatively, some young learners are taught with board games to learn CT knowledge (Tsarava et al. 2018). Participants of CT studies ranged from kindergarten children to teacher educators while secondary students were the main target learners.