Chapter 10
A System Thinking Approach to Pre-Service Teachers' Formation:
An Epistemological Perspective From Europe and USA

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ABSTRACT

It is acknowledged that it is necessary to introduce computing for a quality education starting from primary education. This can be accomplished by empowering pre-service teachers to become confident in teaching computing. The work will review the literature and compare teacher pre-service formation (PSF) activities in each author's country with an overview of the respective continents. Drawn from direct

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field experiences, this work will present, discuss, compare, and draw conclusions and best practices, through the lens of system thinking, on the complex process of pre-service computing teacher transformation. Similarities are acknowledged, while differences in approaches are highlighted. Using the lens of systems thinking, a review of research and theory to examine pre-service teacher (PST) formation will include Technological Pedagogical Content Knowledge (TPCK) in the realm of science, technology, engineering, arts, and mathematics (STEAM). Celia (Computer Educators Learning Inclusive Actor) will represent the teaching candidates' professional pathways in each country.

INTRODUCTION

For nearly a decade, there has been a worldwide resurgence to adopt compulsory P12 computing education. This revival shifted focus to computer science, coding and computational thinking to transition learners from consumers to creators of digital artefacts. Different countries are at different stages of adopting computing education with England regarded as an innovator, Italy within the early majority group, and USA as a late adopter. In the USA, the Department of Education can increase resources and guidance to enhance the quality of education through pre-service and leadership (Maiorana, 2022). However, the states remain independently reliant on the federal government's framework of policies and laws but are required to meet the diverse cultural dependencies within each state. By 2018, forty-four states adopted or are in the process of adopting standards in teaching computing education (CSTA K-12, 2017; National Standards, 2019; Richards & Turner, 2019; Code.org, 2018). Most states have blended two or more organizations' recommendations (CSTA K-12, 2017; National Standards, 2019; Richards & Turner, 2019; Code.org, 2018; Maiorana, Csizmadia, & Richards, 2020).

Recently researchers around the world have proposed a systemic approach (Fuller & Kim, 2022; Sengeh, 2022) as a way to achieve a holistic development of students (Datnow, 2022). Research (Maiorana & Cristaldi, 2023) has highlighted the importance of a system-thinking approach to transform schools (Fuller & Kim, 2022), supporting teachers, the mind and heart of the educational system around the world, through adequate policies supporting their continuing professional learning (Boeskens et al., 2020a; (OECD, 2021b; OECD, 2019b), advocating for upskilling and investing in people through bottom-up solutions and insights (Maiorana, 2023; (Maiorana, 2020b; OECD/OPSI, 2020).

A global perspective on teaching is needed for an ample and systemic reform of the educational system involving all the actors of the educational community and in this respect, a wise use of digital technologies can contribute towards a positive