Chapter 10
Introducing Computer Science Education Through Robotics Education in Community-Engaged Contexts:
Reflecting on Good Practice

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ABSTRACT

The introduction of computer science education (CSE) in schools is required to prepare the learners for future work and develop the required 21st century skills. However, for competent and confident learners, the educators need to be upskilled and trained to develop CSE teaching capacity and skills. The use of robotics education (RE) provides a more concrete (less abstract) environment for the introduction of CSE. Although CSE is introduced at schools, concern relates to the required access to quality training, required equipment and support from gatekeepers that delay or hinder the advancement of CSE. The good practices for the informal option of CE at higher education institutions (HEI), through engagement with and within a community of practice (COP), to provide access to quality CSE training and skills development to educators, visionary community leaders and learners is presented in terms of the balanced scorecard (BSC) perspectives of strategy, process, people, resources and growth and sustainability.

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INTRODUCTION

Computer science (CS), especially through computational thinking (CT), is significant in the context of 21st century skills. The elements of CT related to the thinking methods of a computer scientist, such as analysis, and algorithmic approaches to problem solving, are considered as core 21st century skills (Bocconi et al., 2016). Teaching of CS and the development of related skills, including the teaching of programming, is considered challenging (Robins, 2015). The equipping and empowering of educators (despite limited resources, limited exposure to technology, and limited CS backgrounds) to teach the CS curriculum is a hinderance in the teaching and learning of CS.

The intuitive link between CSE and RE has been described as reciprocal (El-Hamamsy *et al.*, 2021). Efforts have been made in the context of formal education to include RE as a method to teach CS. In science, technology, engineering, and mathematics (STEM), RE is considered a practical vehicle to engage and develop 21st century skills for learners.

Within South African tertiary institutions, emphasis is placed on more informal engagement with communities. Community engagement (CE), and communities of practice (COP) entails engagement with communities around skills development and knowledge transfer. An academic responsibility is the pursuit of CE within tertiary institutions, to address knowledge mobilization and the addressing of social injustices.

Within South African schools, the Department of Basic Education (DBE) introduced a coding and robotics curriculum. The Department of Science and Innovation (DSI) promotes Science Olympiads and Competitions. Significant resources are made available for science engagement to advance science (Department of Science and Technology, 2015). Recently, DSI introduced a focussed approach, ensuring that robotics and coding have a focussed segment of implementation.

This chapter proposes that equipping, supporting, and development of educators, mentors, and coaches through CE provides a less formal engagement context. The combination of good practices related to the elements of CE, RE and CSE (which is the focus of this paper) allows for equipping educators, mentors, and coaches to teach and mentor CSE fundamentals through practical content and the domain of RE. To ensure competent and confident RE and CSE learners, community leaders can be equipped and supported to be competent and confident. Although not the focus of this paper, the structure within which this support and equipping would occur would typically be a Community of Practice (COP). The establishment of COPs in this context is an extensive topic which would warrant a paper on its own.

The chapter proposes a comprehensive literature-founded framework for good practices of RE with a specific focus for the development and support of CSE through and in the context of CE. The contribution makes CSE through RE a more explicit endeavour, specifically in less formal engagement with communities. This approach will complement and strengthen the existing literature on using RE to support CSE in more formal CE contexts.

Community Engagement (CE) Context

The elements that enhance CE include the definition of role players and partners, the use of infrastructure, the understanding the complexities of engaging with communities, conducting research to support best practices, understanding the history and social context of the community, respectful engagement and power sharing, and the inclusion of the community in all aspects of the engagement, and networking (Michener *et al.*, 2012). The aim is for engagement practices to be sustainable and in the best interests