Developing Teachers As Computational Participants

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ABSTRACT

This document briefly explains the context, motivations, background and research design of a PhD project titled *"Developing Teachers as Computational Participants"*. This PhD project will explore how Australian Primary School teachers learn and teach the *core CS skills* (*computational thinking*, *computer programming* and *systems thinking*), their experiences implementing lessons that impart these skills and the challenges they encounter when implementing these lessons.

CCS CONCEPTS

• **Social and professional topics → Computational thinking**; **K-12 education**;

KEYWORDS

constructionism; computational participation; teacher professional development; primary school

1 PROGRAM CONTEXT

I am a full-time student in the Doctor of Philosophy (Education) program in the School of Education at the University of Newcastle, Australia. As of June 2017, I have been in the program for a year and four months. I have just completed my confirmation and am planning to complete my dissertation over the next two years (Australian PhDs are typically three to three and a half years full-time).

2 CONTEXT AND MOTIVATION

Several countries, such as England and New Zealand, have recently begun to shift the focus of their ICT curricula from the teaching of software applications, to the teaching of skills that will allow students to create and implement their own digital solutions [6]. These skills include: *computer programming*, *computational thinking* and *systems thinking*, which are referred to as the *core CS skills* in this study. In Australia, the Digital Technologies subject area has recently been introduced as part of the national curriculum, which will involve the compulsory teaching of the *core CS skills* to all students from the first year of schooling (Foundation) to their tenth year (Year 10).

Introducing the compulsory teaching of the *core CS skills* presents a major challenge for teachers, particularly for those that teach at a primary school level. The majority of Australian primary school teachers are generalist teachers [5] and are unlikely to have learned about the *core CS skills* in their formal education. Professional development (PD) programs, such as face-to-face workshops and online courses, have been developed as one approach to address this challenge. However, there is currently limited research into the effect of these programs on teachers' knowledge of the *core CS skills*, their self-efficacy towards learning and teaching these skills, and the pedagogical practices teachers use to impart these skills, particularly in the Australian context.

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3 BACKGROUND & RELATED WORK

Computational participation is a frame for teaching and learning *computer programming*, which was introduced in the book *Connected Code* [3]. In *Connected Code*, Yasmin Kafai and Quinn Burke argue that students should not be taught *computer programming* solely with the aim to develop them as logical and rigorous *computational thinkers*, but instead with the aim to develop them as *computational participants* who understand the technical, social and cultural aspects of computing. The design of the *computational participation* frame has been influenced by the *Constructionism* learning theory [2], which underpins this project's theoretical framework. The central assumption of *Constructionism* is that students learn best when they construct physical and/or digital artefacts that can be shared with others.

There has been limited research conducted into PD programs that have been designed with a Constructionist lens on learning. Karen Brennan has developed a model of PD called *ScratchEd* [1], which is one example of a PD program designed in this way. The analysis conducted by Brennan has mainly been qualitative and has largely been concerned with how educators balance learners' structure and agency when teaching *computer programming*. However, in addition to qualitative analysis, this research project involves quantitative analysis of teachers' levels of knowledge of the *core CS skills*, self efficacy and pedagogical practices. The quality of pedagogical practices will be quantified by applying the *Quality Teaching Framework* [4], which is a validated model for examining teachers' practices.

4 STATEMENT OF THESIS/PROBLEM

The overall aim of this project is to understand how Australian primary school teachers learn and teach the *core CS skills*. It is intended that the model of PD developed in this project could be adapted by other PD providers and that the findings from the online survey will be available to policy makers, to help them design PD that is appropriate for teachers' current levels of knowledge of the *core CS skills*.

5 RESEARCH GOALS & METHODS

The goal of this research project is to answer four main research questions, which are listed later in this section. The project consists of three separate stages, which will be preceded by the design of a pilot survey. These stages, and the pilot survey design, are briefly described in the following paragraphs.

Pilot Survey Design: Currently, a survey is being designed that will be piloted during Stage 1 of the project. This survey will collect information about teachers' demographics and the pedagogical practices they use when teaching the *core CS skills* to their students. The survey will also contain scales for measuring the teachers' self-efficacy towards computational thinking and their levels of knowledge of the *core CS skills*.

Stage 1 (PD Program): A PD program will be run as part of the project, designed with *computational participation* as a guiding framework. There will be 2 parts of the program, each of which will be 10 weeks in duration and that will involve weekly 2 hour after-school tutorial sessions.

Stage 2 (Interviews): Follow-up interviews with participants of the PD program will be conducted three months after the PD program has completed, in July 2018.

Stage 3 (Online Survey): The pilot survey will be reworked, and refined, as a result of analysis of the data collected in Stages 1 and 2 of the project. The reworked survey will be distributed nationally through an online survey platform in October 2018.

The following paragraphs state each of the project's research questions and briefly describe the methods of analysis that will be used on the data collected in the above three project stages, to answer each of the research questions.

Research Question 1: *"What are the levels of knowledge, self-efficacy and perceived pedagogical practices of Australian Primary School teachers, with respect to the Core CS Skills?"*

The first research question is an overarching research question. Answering this question will mainly involve quantitative analysis. Descriptive and inferential statistics will be performed on the responses to the online survey (Stage 3) to answer this question. Analysis conducted during Stages 1 and 2 will also inform the answer to this question.

Research Question 2: *"To what extent does Australian Primary School teachers' knowledge, self-efficacy and pedagogical practices, with respect to the Core CS Skills, change as a result of completing a professional development program developed with computational participation as a guiding framework?"*

This question will be answered by analysing collected data with a mixed methods approach. The survey responses and lesson plans, collected in Stage 1, will be analysed with descriptive and inferential statistics. Thematic analysis will be performed on the lessons and journal submissions collected in Stage 1. The results from the quantitative and qualitative analysis will be compared and contrasted, in order to answer the second research question.

Research Question 3: *"How do Australian Primary School teachers experience the elements of computational participation when taking part in the professional development program and when applying ideas from the program in their classrooms?"*

Answering the third research question will only involve qualitative analysis. Thematic analysis will be performed on the teachers' journal submissions (collected in part 2 of Stage 1) and interviews (conducted in Stage 2).

Research Question 4: *"What challenges do Australian Primary School teachers encounter in their classroom experiences of implementing the Digital Technologies curriculum?"*

This question will be answered by analysing data with a mixed methods approach. Thematic analysis will be performed on the journal submissions (collected in part 2 of Stage 1) and interviews (conducted in Stage 2). Descriptive and inferential statistics will be performed on the online survey responses, to discover the challenges teachers commonly encounter when implementing Digital Technologies subject lessons.

6 DISSERTATION STATUS

I am currently designing the pilot survey and will begin collecting data in October 2017. I am in the early stages of the project and have started writing the *Introduction*, *Literature Review* and *Methodology* sections.

7 EXPECTED CONTRIBUTIONS

The following four contributions will be able to used by computing education PD providers and teacher educators to adapt for their own programs. The first expected contribution is a model of PD, that will be designed with *computational participation* as a guiding framework. The second expected contribution is a validated instrument for measuring teachers' understanding of the *core CS skills*. The third expected contribution is an understanding of the challenges Australian primary teachers encounter when implementing Digital Technologies lessons. The fourth expected contribution will be an understanding of Australian primary school teachers' levels of knowledge, self efficacy and pedagogical practices, with respect to the *core CS skills*.

8 DOCTORAL CONSORTIUM

I am hoping that, by participating the ICER Doctoral Consortium, I will get feedback about my proposed methodology and suggestions for improving my pilot survey's design. I would also like to meet other doctoral students and discuss their research with them, as I rarely get the opportunity to discuss computing education with fellow doctoral students and faculty at my institution. These discussions could broaden my understanding of computing education and could also foster future, international collaborations in this research area.

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