Name: Tony Knox **Degree:** Master of Science in Technology and Learning

Title: An Investigation into Bray's Heuristics for Mathematical Learning Activities as Applied to Functions

Supervisor: Professor Brendan Tangney **Year:** 2017

Abstract

Mathematics is an important activity for individuals and society (Hoyles, 2016, p. 225) with knowledge of mathematics and qualifications in it becoming ever more important gateways to life-skills, higher levels of education and to the success of economies (Norris, 2012, p. 22).

International evaluations of mathematics achievement have found that after finishing basic education many students' knowledge and competencies are below the expected level. There are many who see the subject as boring and irrelevant (Hoyles, 2016, p. 225) and these negative attitudes are a concern as it has been found that attitudes to the subject have a large bearing on the level of achievement of students (Boaler, 1993; Kislenko, Grevholm, & Lepik, 2005; Ma, 1999). This research focusses on the attitudes of student engagement with, and confidence in, mathematics.

Mathematics is vast in terms of choices of topics to be included in school curricula. Functions are included in all curricula internationally (Hodgen, Pepper, Sturman, & Ruddock, 2010; NCCA, 2013b, 2013c; NCTM, 2000) as they are seen as useful for consolidating students algebraic understanding, essential in preparing students for the topic of calculus (Lagrange, 2014) and important for helping students make sense of the world around them (Kalchman & Koedinger, 2005).

For this research, Bray's set of design heuristics (Bray, 2015) have been chosen as the basis for designing a rich learning experience in the topic of functions as these heuristics have been found to increase student engagement with, and confidence in, mathematics. Bray's interventions were conducted outside of the normal school timetable. This study builds upon Bray's work by using a web-based Toolkit[1] with social constructivism at the core of its design, to create a learning experience with a high level of technological integration within the confines of a normal school timetable. The research focus is how participation in a rich learning experience, designed in line with Bray's heuristics, improves student engagement and confidence when applied to the topic of functions within the confines of a normal school timetable.

The research methodology used was an exploratory case study. 24 students engaged in the learning experience over 8 hours and 40 minutes. Pre- and post- learning experience data on engagement and confidence was collected through the use of the Mathematics and Technology Attitudes Scale (MTAS) (Pierce, Stacey, & Barkatsas, 2007). Data was also collected via researcher observation, through analysing the data captured by the technology and a number of group interviews. The study found that the learning experience had a positive impact on the attitudes of participants, especially in their feelings about mathematics (affective engagement) and their attitude to learning mathematics with technology.

[1] A Toolkit describes technologies that are designed in accordance with a specific pedagogical approach, that provide support for the student and the teacher through tasks and lesson plans, and provide feedback for assessment (Bray & Tangney, under review, p. 10).