INVESTIGATING MATHEMATICS TEACHER EFFICACY BELIEFS IN PRIMARY INITIAL TEACHER EDUCATION

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INTRODUCTION

This paper will discuss the mathematics teacher efficacy beliefs (MTEB) of primary initial teacher education (ITE) students. We are interested in studying how ITE students' MTEBs are influenced (or not) by mathematics education modules undertaken as part of an undergraduate Bachelor of Education (BEd) programme. We will detail how approximations of practice (Grossman, Compton, Igra, Ronfeldt, Shahan, & Williamson, 2009) have been incorporated into mathematics education modules to create opportunities for the development of MTEBs and will report on focus group interviews which explored MTEBs of ITE students.

Self-efficacy concerns how we perceive our ability to accomplish certain levels of performance (Bandura, 1997). The related concept of teacher efficacy has been defined as "a teacher's sense of ability to organize and execute teaching that promotes learning" (Charalambous, Philippou, & Kyriakides, 2008, p. 126). The theoretical underpinnings of the concept are complex and there is ongoing debate about how it should be measured. Despite this, interest in teacher efficacy persists because outcomes such as teachers' persistence and instructional behaviour as well as student outcomes such as motivation and achievement have been shown to be related to efficacy beliefs (Morris, Usher, & Chen, 2017).

Teacher efficacy is considered to be both context and subject-matter specific (Bandura, 1997). This makes it highly relevant in primary education where (in Ireland) mathematics is taught for the most part by 'generalist' teachers, i.e., teachers who are qualified to teach the range of primary subjects with no specialized qualification in mathematics or mathematics teaching. Bandura suggests that efficacy beliefs are most malleable in their early stages of development however there is little consensus on how efficacy beliefs develop during ITE (Charalambous et al., 2008). The research on MTEBs within primary ITE tends to focus on school placement experience as a key site for the development of MTEBs. Our work adds a new dimension by considering the interplay between taught modules, school placement and MTEBs.

DEVELOPING MTEB IN INITIAL TEACHER EDUCATION

Tschannen-Moran et al. draw on the work of Skinner (1996) to suggest the following:

> Self-efficacy theory is one of the few conceptualizations of human control that describe a distinction between competence, or agent-means relationships (I can execute the actions), and contingency, or means-ends relationships (the actions will attain certain outcomes). (1998, p. 210)

Teacher education has a role in developing both 'agent-means relationships' and 'means-ends relationships'. Skinner (1996, p. 555) maintains that "control beliefs can be arrayed along a continuum from the extremely situation-specific to the extremely general or global". While

self-efficacy is generally focused at a specific behavioural level, teacher education must also aim to develop more global beliefs about means-ends relationships in mathematics education. In fact, we suggest that much of our work in the BEd taught modules involves interrogating the 'ends' or goals of mathematics education so that ITE students recognise the different domains of educational purpose (Biesta & Stengel, 2016) and understand how mathematics teaching contributes to the development of dispositions as well as content knowledge.

The focus module of this research study is the first mathematics education module on the BEd. It is designed to engage ITE students in problem-solving to build mathematical knowledge for teaching and to support them in interrogating their preconceptions of mathematics and teaching. All seminars also feature sample classroom activities and opportunities are created to experience multiple, progressive methods of supporting mathematics learning. Furthermore, opportunities are created to experience the four sources of efficacy described by Bandura (*mastery experience, vicarious experience, social persuasion,* and *physiological and affective states)* through the collaborative planning and teaching of a mathematics lesson to peers. This task can be understood as an approximation of practice (Grossman et al., 2009). In relation to *mastery experiences*, the planning element was purposely designed to simulate planning of a lesson for a primary class on school placement. It is an opportunity for authentic (ITE student) experience of planning. For the teaching component, ITE students effectively engage in a live role-play, a less authentic approximation of practice. *Vicarious experiences,* where other individuals are observed carrying out focus activities, are understood to have a more powerful impact on MTEBs if the observer identifies with the individual modelling the activity. Observing peers conduct these planning and teaching tasks is envisaged to hold potential for the development of MTEBs. Bandura described *social persuasion* as "social evaluations of capability" (1997, p. 102). Such feedback was another planned feature of the in-class peer-teaching activity. *Physiological and affective states* concerns how emotional reactions to events can influence efficacy beliefs. The ITE students generally appeared to find the peer-teaching activity challenging but enjoyable. For this reason, we contend that it presents an opportunity for the development of MTEBs.

Morris et al. (2017, p. 819) propose a model showing how efficacy information is integrated and evaluated. The model details the relationship between a) sources, b) integrative and evaluative factors, and c) self-efficacy. In addition to the four sources of efficacy proposed by Bandura (outlined above), they include 'other sources of teacher knowledge' as a possible source of efficacy. This arises from a comprehensive literature review which shows that "knowing the material, and knowing how to teach it well, can improve teachers' sense of efficacy" (Morris et al., 2017, p. 817). Their model, like the earlier work of Tschannen-Moran et al. (1998), emphasizes the role of personal cognition in the formation of self-efficacy. Individuals are envisaged to combine information to make "general appraisals (e.g., of past success, of knowledge, of comparisons with others) that may, in turn, inform self-efficacy" (Morris et al., 2017, p. 820). They also highlight the moderating factors that inform these appraisals as information from various sources is combined and evaluated. An important factor in how a person might weigh information is in how closely (or not) he/she perceives it

to relate to the teaching task. As outlined above, the focus module includes mathematical problem solving and pedagogical content consisting of progressive approaches to the teaching of specific mathematics content. We contend that this content supports ITE students' "knowledge of the material" and begins to develop their understanding of "how to teach it well" (Morris et al., 2017, p. 817). The students are directed to draw from the module content to support their in-class enactment of teaching. A core objective of the module structure is thus to support both understanding and enactment of pedagogies that emphasise conceptual understanding, first within the in-class approximation of teaching and later when teaching in schools.

INVESTIGATING MTEB IN INITIAL TEACHER EDUCATION

Three focus group interviews were carried out with 16 ITE students who had completed the first year of the BEd (including the module described above and one teaching placement in a school). Based on the nature of their statements, the ITE students were assigned a place on a four-point MTEB continuum: low efficacy, mixed/low efficacy, mixed/high efficacy, high efficacy. On interrogation of the data, we noticed that some ITE students appeared to see many connections between the taught mathematics education module and their experiences in classrooms while others did not. We created another four-point continuum where the nature of students' statements was used to describe how flexibly they report applying module content to classroom practice. This continuum ranges from 'limited flexibility', where ITE students' statements show a strong focus on specific aspects of mathematics or teaching (e.g., expecting to receive exemplar lesson plans rather than generating their own) to 'Strong Flexibility', where ITE students' statements suggest that they are comfortable generalising theory about mathematics and/or teaching from module content to classroom practice

Looking across these two ways of categorising the ITE students, we found that highly efficacious ITE students appeared to show strong flexibility and professed competence in applying the module content to classroom practice. Less efficacious ITE students appeared to see fewer connections between the mathematics education module and their classroom practice. They appeared to be focused on the finer grained details of planning and teaching (e.g., the nature of planning templates or lesson content for particular class levels) and did not appear to be in a position to take the broader messages about mathematics pedagogy and apply them to the particular contexts of their school placement. Tschannen-Moran et al. (1998) contend that "judgments about the requirements of the teaching task, is an important factor in teacher efficacy" (1998, p. 210). From our data it appears that ITE students with different levels of efficacy may interpret the requirements of teaching tasks quite differently.

Our research design does not support interpretation of whether this connection between efficacy beliefs and flexibility in application of module content, is causal or correlated. We cannot say whether ITE students' strong self-efficacy beliefs support a flexibility of thinking, or vice versa, or indeed whether they are mutually supportive, or whether an additional external understanding or disposition contributes to both. Nevertheless, our findings point to a relationship between the two. Over the coming academic years, we intend to orchestrate

opportunities for ITE students to interrogate means-ends relationships (Skinner, 1996) at both broad and fine-grained levels of specificity and to make explicit the links between these two levels. In relation to the development of MTEBs, we theorize that if students consider the broad goals of mathematics education as shaping every teaching task, then particular pedagogies or 'means' aligned with those goals will be adapted or refined according to the specific mathematical content or context of any given situation. Adopting a design research approach (Borko, Liston, & Whitcomb, 2007), we will repeat the data collection and analysis cycles as conducted in the research phase outlined above, and aim to explore whether our modifications to the focus module support the developing efficacy beliefs of our ITE students.

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