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Development of Mathematics and Science Teacher Efficacy During an Alternative Middle Grades Certification Program

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Two connected factors contribute to teacher quality: preparation and retention. In the middle grades, quality teaching of mathematics and science requires knowledge of both content and pedagogy, but middle school teacher preparation programs generally provide weak preparation in both (Schmidt et al., 2007). One outcome of this weak preparation is that nearly 50% of all new teachers leave their initial assignments within the first 5 years (Allen, 2005). Understanding how to prepare new teachers to thrive in their schools is crucial.

One factor that has been linked to teacher retention is "self-efficacy." As it relates to teaching, "self-efficacy" has been conceptualized as a teacher's belief that he or she has mastered the content, has the ability to make the content understandable to students, can maintain classroom discipline and engage students, and can have a positive effect on learning (Enochs, Smith, & Huinker, 2000; Roberts & Henson, 2000; Tschannen-Moran & Hoy, 2001).

Teachers with lower self-efficacy for teaching are more likely to leave the profession than those with higher self-efficacy (Glickman & Tamashiro, 1982). Research has further indicated that teacher self-efficacy is linked to important teacher and student outcomes (see Tschannen-Moran & Hoy, 2001, for an overview). However, little is known about the longitudinal development of teacher self-efficacy. Teacher education programs seem to play an important role in the development of teacher self-efficacy in mathematics and science (Charalambous, Philippou, & Kyriakides, 2008; Palmer, 2006), but few studies have tracked self-efficacy throughout a preparation program.

Given the potential of alternative certification programs to address teacher shortages in mathematics and science and the importance of teacher efficacy in retaining these teachers, the current project focuses on design aspects of alternative certification programs to improve teacher retention.

Program Description

As part of a grant-funded project, we have designed an alternative certification program, $E = mc^2$, funded by U.S. Department of Education under its Transition to Teaching Program. Before beginning their student teaching, participants conduct observations, interviews, tutoring, small group instruction, and isolated whole group instruction. During student teaching, participants are enrolled in a second methods course to address the hypothesis of Utley, Moseley, and Bruamt (2005) that a lack of change of efficacy during student teaching is due to a lack of support.

Methods

To study the effect of $E = mc^2$ program on the development of self-efficacy among cohorts of content-strong preservice teachers, we borrowed constructs from two instruments measuring teacher self-efficacy in science and mathematics and two

constructs from another instrument that measures instructors' teaching efficacy and self-confidence in knowledge of content. This brief explores the relationship between those four constructs: outcome expectancy (OE), or the degree to which a teacher believes students can learn from his or her teaching; personal teaching efficacy (PTE), or the degree to which a teacher believes he or she can teach effectively; knowledge efficacy (KE), or teachers' confidence in their knowledge of content; and teaching efficacy (TE) across the program. Figures 1–4 show the trajectories of change of OE, PTE, TE and KE for this population

Results—RQ1

Cohort averages (the blue lines) increased significantly from the start to the end of the first methods course in all categories. However, during student teaching, KE and TE increased significantly. By the end of the program, all students on average have higher OE, TE, KE and PTE. Math teacher-students had a much steeper increase in their KE in the first part of the program than did their science counterparts.

Results—RQ2

Figures 1–4 provide evidence that knowledge efficacy and teaching efficacy are different as the trajectories of growth of each, OE/PTE/KE/TE, are different, with only KE showing differences between science and math trajectories. To investigate this further, we conducted correlations between the various self-efficacy measures at each time period, shown in Tables 1-3. Initially, all measures were highly correlated with each other (Table 1). However, after the methods courses (Table 2), OE is no longer correlated with PTE, KE or TE; KE and TE are still in correlation with each other and their parent construct, PTE. At the end of the program, while PTE is still correlated with its two derivatives, KE and TE no longer are correlated with each other, supporting the contention that these identify different aspects of a teacher's self-efficacy.

Conclusions

In this study, we have explored how self-efficacy changes over the course of an alternative certification program, particularly looking at the impact of methods courses and methods-supported student teaching, as impacted by content. We have discovered that while correlated with personal teaching efficacy, teaching self-efficacy and knowledge efficacy do appear to identify different constructs and have different trajectories of growth for students with higher content backgrounds than typical elementary education students. As Utley, Moseley, and Bryant (2005) conjectured, we are seeing, with our methods-supported student teaching, changes in self-efficacy but only by looking at the more specific teaching efficacy and knowledge efficacy of the SETAKIST. This is the first stage in our research; as we add more cohorts, we will investigate the trajectory of self-efficacy through the first 3 years of teaching and its impact on retention. §

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