Chapter 6

COMPONENTS THAT CONTRIBUTE TO MATHEMATICS TEACHING SELF-EFFICACY DURING AN ALTERNATIVE CERTIFICATION PROGRAM

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ABSTRACT

Perceived self-efficacy for teaching has been linked to a variety of teacher and student outcomes, but research on the development of teaching efficacy during alternative certification programs is limited and mixed. The purpose of this chapter was to understand what particular components of an alternative certification program contributed to middle school teachers’ mathematics self-efficacy. We used interviews throughout the program and at the end of the first year of teaching to understand how self-efficacy development was impacted by the program. Findings suggest that knowledge of and experience with teaching are important for teachers throughout their training and first year of teaching, but in general, vicarious experiences, verbal persuasion, and stress reducers might be time-sensitive. Variation among individual cases is also discussed.

In a recent study (NCCTQ and Public Agenda, 2007) of nearly 700 first year teachers, 21% of middle and high school teachers stated that they anticipate staying a classroom teacher for less than 5 years; another report suggests that nearly 50% will actually leave during this time (Allen, 2005). Attrition rates are especially high for secondary mathematics and science teachers, as well as for teachers in low-income, low-performing schools, and in schools in urban settings (Guarino, Santibanan, and Daley, 2006). In a study of urban schools conducted by the Urban Teacher Collaborative (2000) approximately 80% of the school
districts surveyed stated that they had a shortage of math and science teachers with 60% anticipating shortages over the next 5 years.

Teacher shortages have contributed to increased interest in alternative certification programs. Research on the effectiveness of these programs is mixed, likely due to the wide range of program types that are considered to be alternative. When alternative education programs are high in quality, they are more likely to produce teachers who are similar to those from traditional certification routes in terms of confidence and performance (Wilson, Floden, and Ferrini-Mundy, 2001). High-quality features include high entrance and exit standards, extensive pedagogical training, substantial feedback and mentoring, and opportunities to plan and teach lessons "prior to taking on full responsibility as a teacher" (p. 30). However, the lack of detailed descriptions of program components in many studies makes it difficult to fully understand the effectiveness of alternative certification programs (Wilson et al., 2001).

One measure of effectiveness is whether the teachers remain in teaching beyond the problematic five years, and this outcome has been linked to self-efficacy for teaching. Teaching efficacy has also been linked to a variety of teacher behaviors and student outcomes (Czerniak and Schriver, 1994; Haney, Lumpe, Czerniak, and Egan, 2002; see Tschannen-Moran and Hoy, 2001, for an overview). Therefore, it is important to understand how to improve teaching efficacy early in order to minimize teacher attrition and improve outcomes. In this chapter, we describe components of an alternative certification program focused on middle school mathematics and science teachers in high needs areas, and we begin to identify those components that have an impact on teachers' views of their own teaching efficacy. In particular, two research questions guided our work. First, what components of an alternative certification program do teachers identify as being important in developing their self-efficacy for teaching? Second, what patterns exist for influences on self-efficacy over time, and how might these patterns vary across individuals?

**Theoretical Framework**

Self-efficacy was first described by Albert Bandura in 1977. Self-efficacy refers to a person's belief in his/her ability to perform specific tasks or processes (Bandura, 1977). Self-efficacy levels impact a person's effort, perseverance, level of stress when faced with difficulties, and even career interests (Bandura, 1997; Lopez and Lent, 1992). Thus, developing a high sense of self-efficacy in new teachers has the potential to give these teachers the resolve needed to see challenges, not obstacles, in difficult teaching situations and view teaching not as a stopgap but as a lifetime career.

Self-efficacy beliefs also have a direct impact on a person's outcome expectancies. According to Bandura, "perceived self-efficacy is a judgment of one's ability to organize and execute given types of performances, whereas an outcome expectation is a judgment of the likely consequences such performances will produce" (p.21). Specifically for teaching, personal self-efficacy can be described as a teacher's sense that he or she can teach the material, and outcome expectancy can be described as a teacher's sense that he or she can impact student outcomes positively. This latter aspect is particularly problematic for secondary teachers as the survey described above (NCCTQ and Public Agenda, 2007) found
that 37% of secondary teachers are either unsure or do not think that they can help all students learn. When a person believes there are factors beyond his or her control that impact performance (e.g., students' prior knowledge), self-efficacy beliefs will not fully explain outcome expectancies (Bandura, 1997). Hence, there has been a history of using both personal teaching efficacy and outcome expectancy for measuring teaching efficacy (Robert and Henson, 2000).

At the same time, researchers have hypothesized about other factors that might influence overall self-efficacy for teaching. Roberts and Henson (2000) argued that knowledge efficacy, or "a teachers' confidence in his or her mastery of content knowledge" (p. 13) is important to include in measures of teaching efficacy. According to Bandura (1997), when actual experiences with a task are missing, people draw on similar experiences as a source of information about how efficacious they will be with the new task. Because preservice teachers have little or no teaching experience, they might make efficacy judgments primarily based on themselves as learners (i.e., their content knowledge). Research supports this notion with evidence of a moderate, positive correlation between prior mathematical knowledge and personal teaching efficacy for preservice elementary teachers (Newton, Leonard, Evans, and Eastburn, in press). As teachers gain experience in the classroom, one might expect that they have more varied sources of information to judge their teaching efficacy.

A person develops his or her self-efficacy primarily from four sources of information: mastery experiences, vicarious experiences, verbal persuasion, and affective states (Bandura, 1997). Mastery experiences refer to previous encounters with the content or skill. For example, if a person has previously been successful at building a campfire, this person is likely to feel confident he or she can do it in another situation. This is considered to be the strongest input into a person's self-efficacy. Second, not quite as strong as the mastery experiences are a person's vicarious experiences, which include watching a similar person having success at some task. Using the campfire example again, a person who sees a peer successfully build a campfire might feel more confidence that he or she can also build the campfire. Verbal persuasion occurs when someone more expert encourages a person and suggests that the novice can succeed. This person will have more confidence (i.e., a higher self-efficacy) in completing the task. Finally, if a person feels stress or anxiety at the thought of building a campfire, he or she will view their affective state as indicating a low ability to successfully complete the task.

**REVIEW OF LITERATURE**

Due to the important connections between teaching self-efficacy and teacher retention and effectiveness, researchers of several studies have attempted to understand the development of teachers' self-efficacy. These studies range in scope, with some focused on the impact of entire programs and others focused on the impact of particular courses or experiences. This research generally confirms Bandura's (1997) notion that mastery experiences are a key source of self-efficacy, but the studies have primarily involved traditional certification programs. In one study, 21% of teachers from non-traditional certification programs had no prior teaching experiences before entering the classroom (Zientek, 2007); in another study, the majority of participants in alternative certification...
programs trained while on the job (Humphrey, Wechsler, and Hough, 2008). Hence, research on how teaching efficacy can develop during alternative certification programs is warranted.

In comparing how traditional and non-traditional certification programs are linked to teachers' self-efficacy and feelings of preparedness to teach, Zientek (2007) surveyed 1,197 teachers in their first three years of teaching. She found that teachers with at least a year of teaching experience tended to have high ratings for teaching efficacy regardless of certification route, although new teacher mentoring of alternatively-certified teachers seemed to be especially important when student teaching was not included as part of the certification program. This study was conducted once teachers had experience in their own classrooms, as they reflected back on their training. On the other hand, Humphrey and colleagues (Humphrey et al., 2008) surveyed teachers at the beginning of their program and again at the end of their first year, in order to compare seven different alternative certification programs. Given that these teachers primarily learned on the job, the school context (e.g., leadership, resources) was a critical factor in the program's effectiveness. Neither of these studies made distinctions between teachers in different grade levels and content areas.

In several studies, researchers have sought to understand how teaching efficacy develops during traditional, undergraduate certification programs, particularly at the elementary level. For example, Utley, Mosley and Bryant (2005) surveyed 51 preservice elementary teachers about their efficacy for teaching mathematics and science, with surveys administered before and after their methods courses and after student teaching. They found a quadratic trend, indicating a significant increase during methods courses and a slight decrease during student teaching. Their findings suggest that methods courses are especially important for developing mathematics and science teaching efficacy, but the researchers only speculated as to why this might be the case.

The finding that methods courses are critical for impacting teaching efficacy has been echoed in the findings of other researchers (Cantrell, Young, and Moore, 2003; Morrell and Carroll, 2003). For example, Morrell and Carroll (2003) found a significant increase in self-efficacy for teaching science during a methods course for preservice elementary teachers, with no significant change during student teaching. These researchers also examined changes in science teaching efficacy as a result of science content courses. The se were not science content courses designed for preservice teachers and in fact the participants were scattered across several science courses. The researchers found no changes in self-efficacy during these courses, except for those with the lowest levels of teaching efficacy.

Findings from Cantrell et al. (2003) suggest that opportunities to prepare and teach lessons to actual children may explain why methods courses are so important for teaching efficacy; changes were more pronounced for those who spent more time engaged in these activities. Palmer (2006) found that opportunities to understand content and pedagogy are also important, given these are pre-requisites to successful mastery experiences with teaching. In their study, Brand and Wilkins (2007) asked 50 preservice elementary teachers to identify experiences from mathematics and science methods courses that impacted their teaching efficacy. For both content areas, written reflections indicated that mastery experiences and experiences that reduced stress were especially important. In both cases, preservice teachers frequently suggested that these experiences positively impacted their content knowledge, which was lacking. Newton et al. (in press) extended these findings by noting that initial content knowledge seemed to impact preservice teachers' attention to sources of efficacy
during a mathematics methods course; stress reducers were most relevant for those with lower content knowledge.

Other research suggests that student teaching can impact mathematics teaching efficacy. Swars and colleagues (Swards, Hart, Smith, Smith, and Tolar, 2007) surveyed 103 preservice elementary teachers three times and found that personal self-efficacy for teaching mathematics increased during each of two methods courses as well as during student teaching. A study by Charalambous, Philippou, and Kyriakides (2008) found that teaching efficacy increased during 12 weeks of supervised teaching, with the most pronounced changes occurring for those with the lowest levels of initial teaching efficacy.

Much of the research on teaching efficacy has been conducted at the elementary level. It is unclear whether these findings would hold at the middle or high school level, as the content knowledge of preservice teachers at these levels is likely higher. Only a few of these studies asked students to reflect on program components that they perceived as significant in helping them become confident in teaching. In studies relying on Likert scale survey instruments, researchers must infer what aspect of a specific program component (e.g., of a methods course) caused the observed self-efficacy changes. Another weakness in the literature is the lack of studies that follow teachers during their programs and into the first year of teaching; studies have generally focused on one or the other but not both. Most importantly, there is little research on the development of teaching efficacy during alternative certification programs, which by definition include non-traditional components, modes of delivery, and/or timelines. In this chapter, we are focused on an alternative certification program for middle school math and science. All participants are switching from a career focused on math or science, indicating a comfort for these participants with those fields. Further, we used a semi-structured interview process to elicit data about the participants’ self-efficacy for teaching mathematics or science and their perceived sources of that self-efficacy. These interviews were conducted during the program as well as after one year of teaching.

**METHODS**

**Program Description**

Under Department of Education funding for five years, we have designed and are implementing an alternative certification program for middle years’ math and science. This program, now in its third year, is focusing on developing self-efficacy for teaching in high-needs urban schools. Qualified participants for the program have a strong academic preparation in science or mathematics and have several years of experience working in a related career. Thus, these applicants are “career changers”; content-based teacher certification exams are used to confirm that they have the needed content background indicated by their post-secondary education and career choice. Although other programs have intended to recruit teachers from the fields of mathematics and science, one study reported that only 5% of participants across seven programs were actually from those fields (Humphrey et al., 2008). Instead, participants in alternative certification programs most often had education backgrounds, with half of them having classroom experiences prior to beginning their programs.
Participants are admitted each year as a cohort in order to increase our ability to support the group as they progress. The four-semester program was designed for participants to continue with their current work positions during the first half of the program yet still have time in schools; this design allows them to confirm whether this career change is appropriate for them. The schedule is accomplished by minimizing weekday classes, meeting five full Fridays as well as five full Saturdays in each of the first two semesters. Participants are involved on a full-time basis once they begin student teaching in semester three. A tuition subsidy, with the requirement that participants complete the program and agree to teach in an urban school for three years, provides participants with financial support.

Coursework in this program begins by focusing on middle school students and their development, as well as the structures, curriculum and pedagogy of middle schools. The second semester emphasizes content-specific pedagogy and the diverse needs of middle school students, focusing particularly on English language learners and students with other special needs. During the third semester student teaching experience, participants are supported by an advanced methods course. Finally, in the fourth semester, participants complete a capstone course, designed to help them reflect on their practices and think about the first day and first year of teaching. Classroom management, technology, and issues related to urban settings were emphasized throughout the program.

A unique feature of this program is that it is field-based. Despite the importance of teaching experiences for new teacher self-efficacy, opportunities to teach are often minimal or lacking altogether in non-traditional certification routes (Zientek, 2007). For participants who hold full-time jobs as they learn to teach, arranging time to be in a classroom can be difficult. In the first two semesters of our program, students spend all day in the schools on five Fridays where they participate in extensive field experiences and some classes. Participants observe, assist, interview, and teach small groups during this day. Throughout the program, participants make connections between theory and practice in reflecting on each assignment. Saturday classes are held on the university campus and include unpacking the experiences of the previous day.

Partnerships with local schools have been vital for this design. For example, our host school allows us to hold classes in the school, and they allow participants to observe and teach small groups of students. They permit participants to interview teachers, students, and staff. In addition, they provide guest speakers, such as administration, guidance counselors, and master teachers to answer questions and provide insight into the teaching profession.

In order to bridge the time gap between classes in the first two semesters, participants are involved in online discussions where the initial work of reflection is begun. This forum also provides a support system for participants during their student teaching. Additionally, we conduct virtual meetings (e.g., classroom management seminars), and more recently, we have established an off-campus virtual site that allows both current and prior participants to come together for support and ideas.

In addition to regular assignments for each course, participants are also required to pass two performance assessments. These include an intermediate assessment prior to student teaching and a final assessment at the end of the program. Both are designed to assess students' understanding and ability to make instructional use of professional teaching standards. Once participants become teachers of record, we continue to provide support for three years, through face-to-face consultations, observations and feedback, as well as virtual
meetings described above. The visits to the teachers' classrooms occur on a regular basis (i.e., at least once per month) but vary depending on the needs of each teacher.

Participants

Participants were selected from a pool of highly qualified mid-career and retiree applicants. To qualify, applicants were required to have at least 15 credits of college-level math or 18 credits of science courses, as well as experience working in a mathematics or science-related career. As part of the application process, they submitted professional letters of recommendation and a personal statement, took the Haberman assessment test, and sat for an interview with program coordinators. The personal interview was based on the Haberman interview model, as recommended by the National Center for Alternative Certification (2008). The Haberman model predicts applicant potential and persistence for teaching, organizing, and cultivating student learning in impoverished communities with at-risk students. In addition, as part of the application process, applicants are required to pass state content exams required for teaching in middle school. University faculty and staff from the College of Education screened the application materials.

The first cohort selected for the 2008-2009 academic year consisted of 30 applicants of which 10 (7 males and 3 females) accepted an invitation to join the program. Their admission process deviated slightly from the description above due to the late start in recruitment. While all students admitted met the academic and career requirements, some took the content exams during the program and not before. All but two passed the exams successfully on their first attempt, and ultimately, only one failed to pass all the exams (he was not allowed to complete the program as a result). The second cohort selected for the 2009-2010 academic year consisted of 50 applicants of which 18 (6 males and 12 females) accepted an offer to join the program. Of the 28 applicants accepted into the program during the first two years, 14 were in the mathematics track and 14 were in the science track. The participants were racially diverse (14 Caucasian, 10 African American, 4 other) ranging between 25-57 years of age (mean = 43 years).

To answer the research questions, we selected four participant that met several criteria. Selection criteria consisted of participants who completed the program, were currently teaching mathematics in high-needs urban schools, and provided all interview data. We opted to include mathematics only to reduce differences experienced within the program. At the same time, we wanted to capture differences that participants brought to the program (e.g., age, undergraduate degree, prior employment). The participants were also representative of the larger group in terms of levels of self-efficacy (see below for details). The four cases that met the selection criteria were Daniel, Ellen, Scott, and Darin (pseudonyms). Daniel and Scott were younger than the average program participant. Daniel earned a BS in accounting and was previously employed as a financial analyst. Scott earned a BS in chemical engineering and was previously employed as a process engineer. Ellen and Darin were representative of the average age of program participants. Ellen earned a BS in engineering and had a previous career in construction management. Darin earned a BS in mechanical engineering and had a previous career as a project engineer.
Measures

As part of a larger project, we surveyed all participants in the program about their perceived self-efficacy for teaching. Parallel surveys created for mathematics and science were based on the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) and the Science Teacher Efficacy Beliefs Instrument (STEBI) by Enochs and colleagues (Enochs and Riggs, 1990; Enochs, Smith, and Huinker, 2000), as well as the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST) by Roberts and Henson (2000). Collectively, these surveys measured teaching efficacy, outcome expectancy, and knowledge efficacy. The survey included 30 items that were answered using a 5-point scale, and we administered the surveys early in the first semester (time 1), before student teaching (time 2), and after student teaching (time 3). In general, teaching and knowledge efficacy levels increased throughout the program, with marked increases after the first methods course (Ketelhut and Newton, 2011). The four cases described in this chapter had mean scores similar to the larger group. For example, surveys indicated that the mean teaching efficacy scores for the four case studies were 2.961, 3.81, and 4.28, respectively for times 1, 2, and 3. For the larger group, mean teaching efficacy scores were 3.24, 3.85, and 4.22, respectively for times 1, 2 and 3.

Interviews based on the surveys helped to confirm and extend the findings for the four cases described above. Specifically, participants responded to three main questions. How confident do you feel to teach in your own classroom? How confident are you that your students will learn from your teaching? How confident are you that you know the content well enough to teach? For each of the three questions, we asked participants to comment on how this compared to when they began the program, as well as what parts of the program contributed to changes in confidence.

Procedures

Participants were individually interviewed on three separate occasions by the fourth author. Interviews were approximately 10 minutes in length and were audiotaped and later transcribed. The first two interviews took place at the university in a secluded room and occurred while participants were students. The first interview occurred during the second semester after the first methods course and the second interview occurred during the third semester at the end of student teaching. The third interview was conducted near the end of the first year of teaching at the school where the participant was employed.

Analyses

This investigation was a qualitative case study where codes were used to identify patterns that existed over time (Yin, 1994). To begin the analysis, two of the authors independently examined the same interview for factors related to teaching efficacy. This examination

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1 One of the four participants had some missing data points at the end of the first survey. The mean for this participant was estimated based on completed survey items.
involved compiling a list and then organizing the list into categories (Strauss and Corbin, 1990). The coders then met to compare and merge their findings. Using a merged list, they each independently coded a second interview, adding to it if necessary. The coders met again to compare their findings and reduce redundancies (Huberman and Miles, 1994). The resulting list of 22 codes fell into categories found to be consistent with the program design and also with Bandura's (1997) sources of self-efficacy. These categories included personal background, coursework, field experiences, feedback, and community. One coder coded the next interview and results were checked by a second coder. After several iterations demonstrated reliable results, one coder coded the remaining interviews. Coded data were then used to examine general and individual patterns.

**RESULTS**

Using data collected across participants' time in the program and at the end of their first year of teaching, we describe how each participant discussed his or her self-efficacy, including the program components identified as contributing to its development. As indicated above, Bandura's (1997) four sources of self-efficacy information—mastery experiences, vicarious experiences, verbal persuasion and affective states—were used as the framework for interpretation of participants' responses. Results from each participant are followed by general findings across cases.

**Daniel**

Throughout the program, Daniel expressed a relatively high level of knowledge efficacy, based on his self-efficacy as a learner of mathematics (i.e., his own content knowledge). Further improvements to this aspect of teaching efficacy were due to increases in his knowledge of middle school students' understandings of mathematics. As stated in his first interview, "The only thing I learned really about content is misconceptions, learning about how students might view things."

On the other hand, Daniel expressed increases in his sense of personal teaching efficacy and outcome expectancy. "When I first started I hit that wall, sort of speak. I didn't know if I could do it. I was like, oh man, maybe this is not like what I pictured." By the end of the first methods course Daniel was feeling "very confident" in his ability to teach effectively, and after teaching in his own classroom, Daniel said "the confidence is way up." Changes for outcome expectancy were also notable. After the first methods course, he admitted that he was "a little shaky on this one." After student teaching, he was still somewhat uncertain about whether or not students would learn from his teaching. However, after a year of teaching in his own classroom, Daniel stated, "I feel very confident now."

After taking the first methods course, Daniel cited several contributors to his increased sense of teaching efficacy. A variety of sources informed his sense of self-efficacy at this time, and these sources seemed to be equally important to him. For example, he emphasized the knowledge of teaching strategies, knowledge of how students learn, and actual experience with teaching small groups of students. Daniel also attributed his increased self-efficacy to
modeled teaching behaviors and feedback about his teaching. Additionally, the fact that the program was cohort-based seemed to be a stress reducer. "The fact that I am with a group of people that are experiencing the same thing, that it's not just me" served to increase his self-efficacy for teaching.

At the end of student teaching, Daniel no longer cited vicarious experiences or verbal persuasion as sources of self-efficacy. Instead, knowledge and experience seemed to be most significant. Daniel cited "courses on lesson planning" and "differentiated instruction", but he also stated that the knowledge he had gained from "talking to the administrative people in the beginning" was helpful. Daniel was beginning to appreciate how knowledge of students, teaching, and schools are all important for being effective in the classroom. However, student teaching was clearly the most powerful experience for Daniel. In his words, "Nothing matches the exposure of what can happen and what can't happen." He especially emphasized "the very last part where my [co-operating] teacher decided to just let me go and make my own mistakes. That's probably the best way to learn, for me."

Daniel continued to cite knowledge and experience as contributors to self-efficacy near the end of his first year of teaching. In terms of program components, Daniel suggested that student teaching and writing/implementing detailed lesson plans were most helpful. Knowledge of how students learn was also cited; in particular, he appreciated "the fact that activity-based teaching helps the kids remember more than just direct instruction." Knowledge of early adolescent development was also important for Daniel, but its importance was as a stress reducer, or a way to "keep your own sanity" when trying to teach students who are experiencing significant developmental changes. Finally, talking with more experienced teachers who "have the same struggles" was also helpful for reducing stress. In particular, he learned from them that "every day is not going to be good and every day is not going to be bad so you just have to take it for what it is."

To conclude, Daniel cited experiences with teaching and knowledge of teaching in all three interviews. Especially important were the writing and implementing of detailed lesson plans, as well as coursework that focused on how students learn. Early in the program, modeling and feedback were important. Reducing stress was important in the first year of teaching. In particular, knowledge of students and support from fellow teachers were critical during this time.

**Ellen**

Ellen expressed confidence throughout the program that she knew the content well enough to teach it. As she stated in her first interview, "I think that is my strength, is that I don't have to struggle with the understanding of the lesson or the intent of the lesson or the objectives." Although Ellen seemed to experience increased self-efficacy in terms of personal teaching efficacy and outcome expectancy, the changes were slight after the first methods course, ranging from "pretty confident" to "very confident."

After a methods course but prior to student teaching, Ellen suggested that changes in self-efficacy were a result of primarily three things. First, experience with teaching was important. She cited writing and implementing detailed lesson plans with small groups of students, which she described as "complicated but necessary." She noted that they put her "in the position to know every single thing that I need to be thinking about, or just knowing that I
need to think about every single thing." Ellen also attributed changes to feedback from course instructors. Finally, knowledge of teaching was important. In particular, the course on diverse learners helped her "acknowledge the different types of learners and then come up with multiple strategies so that you can try to impact the larger group."

For Ellen, knowledge and experience seemed to be the most significant contributors to changed self-efficacy at the end of student teaching. Being able to "experience everything in real time" during student teaching was especially important. Knowledge of students gained through coursework and observations, "whether in the classroom or in the cafeteria setting," was emphasized as important for creating effective lesson plans. In addition, Ellen cited program components that helped her gain knowledge of pedagogy and schools, and an early appreciation for complexities around teaching. In her words, it was "the program giving us the inside scoop" that contributed to her confidence to teach. Briefly mentioned were vicarious experiences such as "seeing different teachers' styles". Verbal persuasion was something that Ellen noted was lacking and she needed more of.

After her first year of teaching, Ellen attributed positive changes in self-efficacy to mastery experiences with teaching, knowledge of teaching strategies, and stress reducers. Mastery experiences included the actual experience of teaching in her own classroom and writing detailed lesson plans during the first methods course. Ellen's emphasis on teaching strategies was focused on diversity in the classroom. The course on early adolescent development reduced stress by allowing Ellen "to open the door and say, keep in mind you're dealing with a growing child and all of these things may be going on while you are trying to teach in a 90 minute period." The second methods course (designed to provide support during student teaching) also helped relieve stress, according to Ellen.

In summary, knowledge of teaching and experiences with teaching were emphasized by Ellen in all three of her interviews. In particular, knowledge of teaching strategies for reaching all students and practice with creating and implementing lesson plans contributed to her self-efficacy for teaching. Ellen attended to vicarious experiences less than other participants, but feedback was important throughout the program and first year. After teaching in her own classroom, affective states served as a source of self-efficacy; knowledge of students was a primary stress reducer during this time.

**Scott**

Scott described his sense of knowledge efficacy as high throughout the program, stating that he was "very confident" about knowing the content well enough to teach it. He did admit that "being able to bring it down to see where students have inconsistencies" was something he was working to develop, but he seemed to gain confidence in this during his first year of teaching. On the other hand, Scott described steady growth related to personal teaching efficacy. After the first methods course, he said, "I feel better than I did when I came in." After student teaching, he was "fairly confident" in his ability to teach effectively. After teaching in his own classroom, he was "very confident." For Scott, outcome expectancy was high and fairly stable by the end of the first methods course, based on student evidence of learning. He indicated this was an area of growth since the beginning of the program, stating "I just kind of figured that I would present the information. They would retain it all and that would be it. But that was far from the truth."
Mastery experiences with teaching small groups of students were a primary source of self-efficacy for Scott at the end of the first methods course. He noted that "being able to practice" is "how you can really, really get a handle on things." He was especially appreciative of the fact that he was "able to keep the same students every week." He also emphasized community as a stress reducer. In particular, the support of peers through online discussions and the general support of faculty were important. "You could always ask [the faculty] a question. They'd get back to you in a timely manner." Scott also mentioned the knowledge gained from coursework and being able to see how the ideas played out in schools.

Affective states were a source of self-efficacy at the end of student teaching. In particular, faculty support seemed to be an important stress reducer to Scott. "Every step of the way we've had someone there we can contact. 'Don't hesitate to call me.' Just a whole new level of teachers I've never had before in college." Knowledge of students was also important. The first methods course had a strong focus on students' misconceptions about mathematics, and Scott found this helpful during student teaching. "Like fractions. You think they've seen this before, they won't have a problem. Then all of a sudden, I never thought this would happen." Finally, Scott attended to verbal persuasion as a source of self-efficacy. Both praise and constructive criticism were important.

Support from community continued to be important to Scott during his first year of teaching. He said, "I've developed a community of teachers where I work." Knowledge of student misconceptions also continued to be important for Scott's sense of self-efficacy. Mastery experience in the form of "actual experience" in the classroom was also mentioned, and Scott again cited student evidence as a reason that he was confident students could learn from his teaching.

In brief, affective states were a source of self-efficacy throughout the program and during the first year of teaching for Scott. In particular, having support from peers and faculty helped reduce stress. This finding may be related to initial level of teaching efficacy, as Scott expressed somewhat low confidence early in the program. Experiences with teaching were also important, as was knowledge of students. Knowledge of misconceptions in mathematics was especially helpful for Scott's feelings of preparedness and confidence in the classroom.

Darin

Darin's self-efficacy increased somewhat over time, but changes were slight, with responses ranging from "confident" to "very confident." Knowledge efficacy was especially high, and he remarked that his knowledge of real-world connections was "really helping me as a teacher" during the student teaching experience. With regard to personal teaching efficacy, Darin commented at the end of his first year that he was "natural" at it. "I've always felt confident actually teaching."

Knowledge of schools, students, and pedagogy were all important to Darin's sense of self-efficacy after the first methods course. In particular, he noted that "it's been a long time since I was in middle school. It was good learning about the philosophy of middle school these days and how that program is designed to work." In addition, Darin cited coursework focused on how students learn and what strategies support learning as contributing positively to self-efficacy. He commented that when he was a student, "the teacher was in front of the
class talking the entire time" and he felt that worked fine for him. The methods course was helpful for "understanding that all kids don't learn that way." He noted that he was "more cognizant of using manipulatives or teaching them in different ways" than he was in the beginning of the program. Admittedly, he had initially thought manipulatives were a "waste of time." Darin attributed his new knowledge and increased confidence to the fact that the instructors in the program were "all very good" and to his observations of teachers in the classrooms (vicarious experiences). Interestingly, he did not find the course on early adolescent development particularly helpful. Although he admitted it was an important part of the program. In general, he said the information was "pretty obvious" to him as a father of middle grades children. Darin did not seem to attend to mastery experiences or verbal persuasion prior to student teaching.

At the end of student teaching, Darin primarily attributed changes in self-efficacy to knowledge of teaching and experience with teaching, or in his words, "Again, just practice and coursework. I think everything was brought in there." He also continued to attribute changes to vicarious experiences. By observing his co-operating teacher, he "realized a lot of the things she did were subtle" and that they were similar to things he learned in coursework. In addition, he suggested that feedback from the supervisor was important for increasing his confidence.

Darin's responses were similar after teaching in his own classroom. Knowledge of teaching, experience with teaching, vicarious experiences, and verbal persuasion were sources of information for his self-efficacy for teaching. In terms of program components, Darin cited student teaching, practice with lesson planning, and coursework focused on teaching strategies as contributors to self-efficacy. Although he showed high confidence in his knowledge of content and ability to teach, he admitted to struggling somewhat with classroom management. About this struggle, he said, "I tried to see the teachers that do well with students, so I have learned a little bit from them." He also appreciated feedback from the university supervisor and a teaching coach, who "tells me that I'm doing better every time and getting to the students." When asked about whether or not students can learn from his teaching, Darin did say that "some of the students, they really aren't learning and I don't know where that comes from. With some of the kids I do have to teach the same things every day and then they say it's gone and I have to do the same thing." He suspected there may be "psychology behind that" but he was not certain.

Affective states did not seem to be a source of self-efficacy for Darin; he never mentioned feeling stressed, perhaps because of his high confidence level. Most important for Darin with building confidence in his own ability to teach was observing practicing teachers. These vicarious experiences were mentioned in all three interviews. Verbal persuasion seemed to remain important during the first year of teaching. His struggles with classroom management and with reaching all students may help explain this finding.

Cross-Case Analysis

All four teachers began the program with a high sense of knowledge efficacy, and they cited their content knowledge as a positive contributor. This is not surprising; given their lack of experiences with actual teaching, these teachers seemed to draw on their experiences as learners and users of mathematics. As one teacher stated, "I've been in math class since I was
in kindergarten up until graduate school. And it's been beaten into me through the years. I can reproduce math like, like nothing." Because strong content knowledge was required for acceptance into the program, all of the teachers were able to draw on these experiences in a positive way. This finding contrasts with teacher candidates at the elementary level, who are more likely to draw on these experiences in a negative way (Brand and Wilkins, 2007; Newton et al., in press).

At the end of their first year of teaching, all four teachers cited experience teaching in their own classroom as a primary and positive contributor to their personal teaching efficacy. This is also not surprising, since enactive mastery experiences "provide the most authentic evidence of whether one can muster whatever it takes to succeed" (Bandura, 1997, p. 80).

Several trends were noted in teachers' responses about program components contributing to changes in teaching efficacy. For example, vicarious experiences seemed to be most important early in the program, especially prior to student teaching. After the first methods course, three teachers identified such experiences as contributing to increased self-efficacy. These experiences included being in the schools from the beginning of the program, modeling from co-operating teachers, and modeling from instructors. For instructors, what seemed important was not only the modeling but also the explicit discussion of what was modeled. According to that teacher, "that whole putting a pause on things and the instructors telling us why they are doing it definitely contributed a lot to my confidence level and to my knowledge base."

Verbal persuasion was also important early in the program, but it seemed to be especially important during student teaching. Two teachers suggested that feedback, constructive criticism, and praise during this time were helpful for increasing feelings of self-efficacy for teaching. One said, "Just having the constructive criticism, and having the praise. And even being yelled at a couple of times. It worked." A third teacher lamented its absence, wishing she had "more support along the way."

According to Bandura (1997), reducing stress is one way to change self-efficacy beliefs that are negatively impacted by affective states. After the first year of teaching, stress reducers were emphasized by three teachers. For two of them, community was important. In particular, support and reassurance from more veteran teachers helped reduce stress and, subsequently, increase self-efficacy. When asked about program components that contributed to increased self-efficacy, two teachers cited the course on adolescent development as a stress reducer. In particular, it helped them to understand more broadly what middle school students are experiencing, including out-of-school influences on learning. One said that "you can't drive yourself crazy as a teacher trying to put knowledge into this kid when he's really thinking about his next meal...you know, the psychology I think was a great help." Another teacher recalled having immediate feedback from an instructor during student teaching, but she referred to it as a stress reducer. Being able to immediately discuss how a lesson went helped her to "feel relaxed about the flaws, like it's okay...and that it's so very possible to tweak and make a change. Start out fresh the next day."

Throughout the program, teachers cited mastery experiences as contributing positively to their self-efficacy. Creating and implementing lessons plans prior to and during student teaching were frequently mentioned. Even after the first year of teaching, three of the teachers recalled writing long, detailed lesson plans during the program. As one teacher noted, "It was exhausting, and now even if I do a shorter version of the lesson plan I still have those ideas in
my head, knowing that I need to communicate that to them. So I think that would be the glue to the program.”

In order for mastery experiences to contribute to personal self-efficacy, one must have the relevant knowledge for effectively performing a task (Bandura, 1997). Participants frequently cited knowledge of teaching (i.e., knowledge of students, pedagogy, and schools) throughout the program as a contributor to increased self-efficacy. Additionally, teachers cited being in the schools as a way to make the knowledge meaningful. "I could actually learn the theory and then immediately apply it and see how it actually works. So I guess that's why it worked better for me." This latter perspective contrasts with findings of Humphrey et al. (2008), which suggested that participants in alternative certification programs generally did not see the relevance of theoretical coursework.

To summarize, the cross-case analysis suggests that knowledge of teaching and experience with teaching are important throughout their training and first year of teaching, but it suggests that in general, vicarious experiences, verbal persuasion, and stress reducers might be time-sensitive. Generally speaking, these participants seemed to first need to see others teach, then be reassured they can be successful at it, and then be equipped with ways to handle the stress of teaching.

**DISCUSSION**

Alternative certification programs have had mixed results in terms of successfully producing high quality teachers; wide variations in program design is likely contributing to this phenomenon. In particular, there are mixed findings in terms of alternatively certified teachers' confidence and sense of self-efficacy (Wilson et al., 2001). The purpose of this chapter was to describe how various components of an alternative certification program contributed to changes in mathematics teaching efficacy over time. The particular alternative certification program described in this chapter lasted four semesters and was designed to be field-based. Field experiences included interviewing, observing, assisting, teaching small groups, and student teaching. Coursework focused on understanding middle level students, diversity, pedagogy, and schools. Participants were also involved in an online community.

When participants described what parts of the program contributed to changes in self-efficacy, responses fell into five general categories: personal background, coursework, field experiences, feedback, and community. These categories are well-supported by self-efficacy theory (Bandura, 1997). In other words, participants came into the program with some sense that they could be effective at teaching because they had been effective at learning mathematics in the past. Coursework provided knowledge needed for mastery experiences. Field experiences offered vicarious and mastery experiences. Feedback from supervisors, cooperating teachers, and faculty provided verbal persuasion needed to support growth. Faculty and peer support helped reduce stress.

Knowledge of and experience with teaching were especially important to these teachers' sense of teaching efficacy. One of the most frequently cited components was the writing and delivery of detailed lesson plans during the first methods course. These lesson plans required that participants write out key questions, anticipate what difficulties students will have, and plan how to respond to anticipated difficulties. In other words, the level of detail necessitated
that participants integrate their knowledge of students and of teaching. Student teaching was also an important mastery experience for these teachers. In terms of knowledge that helped participants be prepared for teaching experiences, coursework emphasizing how students learn, what misconceptions they hold, and what impacts their learning were critical to teachers' sense of self-efficacy. That teachers perceived coursework as valuable is important because such perceptions are linked to teaching efficacy, teachers self-reports of growth, and intentions to teach long term (Humphrey et al., 2008). Finally, knowledge of teaching strategies for reaching all students was important. Palmer (2006) also noted that understanding of pedagogy contributed to self-efficacy for teaching, but the current work extends his findings to include knowledge of students and schools.

Findings described in this chapter are consistent with the findings of Wilson et al. (2001), which suggested that high quality alternative certification programs include training in pedagogy, extensive feedback, and opportunities to teach. We extend these findings in at least two ways. First, our work suggests that vicarious experiences and affective states are also important and should be considered when designing such programs. Classroom observations and development of community addressed these needs in our program. Second, the timing of experiences may be important. Vicarious experiences and verbal persuasion seemed most important early in the development of self-efficacy whereas affective states were a significant source of information during the first year of teaching. This latter finding may be related to the fact that these teachers did not have the initial feelings of anxiety and stress that elementary preservice teachers have about teaching mathematics (Brand and Wilkins, 2007; Newton et al., in press). Variations across individuals may be related to persistent struggles (e.g., classroom management) and initial levels of teaching efficacy.

More research is needed to understand how particular components of alternative certification programs impact the development of self-efficacy for teaching, particularly at the middle school and secondary levels. For example, given the importance of opportunities for mastery experiences, what factors contribute to the development of teaching efficacy when these are missing from a certification program? Zientek (2007) suggested that new teacher mentoring may accommodate for lack of teaching experiences in terms of teaching efficacy, but the degree and type of mentoring varies considerably across alternative certification programs (Humphrey et al., 2008). It seems teaching experiences are particularly important for "career changers", who are less likely to have these experiences prior to entering the certification program. According to Humphrey and colleagues, teaching experiences prior to entering a program can provide a significant advantage for teaching efficacy that persists through the first year. Future studies are also needed to understand whether the current findings hold across content areas. For example, science teachers must have a breadth of knowledge for teaching in middle school (e.g., life science, physical science), but their own knowledge may be focused on a particular branch of science.

Results from this chapter suggest that field-based, alternative teaching certification programs have the potential to increase teaching efficacy for novice teachers. Given their lack of experiences in the classroom, it may be especially important for career-changers not only to have opportunities to teach but also to have specific opportunities to carefully consider how to integrate knowledge of students and pedagogy (e.g., by addressing student misconceptions within lesson plans).
This increased level of self-efficacy coupled with the accelerated pace suggests such programs could potentially serve as a viable resource for creating a pool of highly qualified teachers to address the demanding teacher shortage plaguing many urban school districts.

REFERENCES


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