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Exploring Relationships between Personal Variables, Programmatic Variables, and Self-Efficacy in School-Based Agricultural Education

Aaron J. McKim[1], Jonathan J. Velez[2] & Haley Q. Clement[3]

Abstract

The educational importance of teacher self-efficacy necessitates research into variables presumed to significantly influence teacher self-efficacy. In the current study, the role of personal and programmatic variables on the self-efficacy of school-based agriculture teachers was explored. Self-efficacy was measured in five aspects of the agriculture teaching profession: (a) classroom management, (b) instructional strategies, (c) leadership, (d) science teaching, and (e) math teaching. Early career agriculture teachers in five western states were used as the population for the study. Backward deletion model selection was completed for each of the five self-efficacy areas and multiple linear regression was used to analyze final models. The number of teachers within an agriculture program, years of teaching experience, number of students in the agriculture program, science credit being offered, and CASE certification were all statistically significant, positive predictors of one or more of the five self-efficacy areas. Additionally, a significant, negative relationship between additional teachers and math teaching self-efficacy was discovered, suggesting predictors are influenced by positive or negative vicarious experiences and/or social persuasion. Findings are explored using concepts from broader self-efficacy literature.

Keywords: Self-efficacy; classroom management; instructional strategies; leadership teaching; science teaching; math teaching

Introduction

The self-efficacy of a teacher (i.e., teacher self-efficacy) is defined as his or her perceived ability to successfully accomplish a given task associated with teaching (Tschannen-Moran & Woolfolk-Hoy, 2001). Teacher self-efficacy has been identified as a vital component to successful classroom teaching. Research has linked teacher self-efficacy to the ability to motivate students, innovate within the classroom, adopt new innovations, evaluate effectiveness, manage the classroom, spend time on difficult tasks, and educate challenging students (Schunk, 1996; Tschannen-Moran & Woolfolk-Hoy, 2001; Woolfolk-Hoy, 2000). As a concept, teacher self-efficacy arose from broader self-efficacy research. Self-efficacy is defined as an individual's cognitive judgment of his or her own abilities to execute a given task (Schunk, 1995). Bandura, who authored the seminal works on self-efficacy, identified teachers with higher self-efficacy as typically more effective; as an example, efficacious teachers are more likely to provide students

[1] Aaron J. McKim is an Assistant Professor in the Department of Community Sustainability at Michigan State University, 480 Wilson Road Room 131, East Lansing, MI 48824, amckim@msu.edu.

[2] Jonathan J. Velez is an Associate Professor in the Department of Agricultural Education and Agricultural Sciences at Oregon State University, 108 Strand Agriculture Hall, Corvallis, OR 97331, jonathan.velez@oregonstate.edu.

[3] Haley Q. Clement is the Leadership Academy Coordinator and Graduate Teaching Assistant in the Department of Agricultural Education and Agricultural Sciences at Oregon State University, 108 Strand Agriculture Hall, Corvallis, OR 97331, haley.clement@oregonstate.edu.

with self-efficacy building experiences (Bandura, 1993). The current study sought to identify specific personal and programmatic variables contributing to early career agriculture teacher self-efficacy.

The connection between self-efficacy and early career retention (Kaiser, 2011) extends the importance of understanding self-efficacy to a national problem within school-based agricultural education (SBAE). As a discipline, SBAE has continued to struggle maintaining an adequate supply of teachers (Foster, Lawver, & Smith, 2014; Kantrovich, 2010), with many teachers leaving early in their career. Research within SBAE has identified teacher self-efficacy as a statistically significant predictor of career commitment (Blackburn & Robinson, 2008; Knobloch & Whittington, 2003; McKim & Velez, 2015, 2016; Swan, 2005; Wheeler & Knobloch, 2006; Whittington, McConnell, & Knobloch, 2006). While research linking teacher self-efficacy and career commitment is important, it is only the first step. To increase career commitment and teacher quality, SBAE must explore variables related to teacher self-efficacy. Within the current research, we explored the potential impact of 11 personal and programmatic variables on early career SBAE teacher self-efficacy with the goal of enhancing academic practices to support the continued growth of SBAE teacher self-efficacy.

Theoretical Framework

The concept of self-efficacy emerged from Bandura's (1977, 1986) social cognitive theory, which sought to explain human behavior (Schunk, 1995). Bandura posited four types of experiences increase self-efficacy: (a) mastery experiences, (b) vicarious experiences, (c) social persuasion, and (d) physiological and emotional states. Mastery experiences, the strongest predictors of self-efficacy, refer to past success accomplishing a task (Bandura, 1977). For example, an SBAE teacher who has successfully taught a lesson in the past would be more confident in his or her ability to teach the same lesson in the future. Within this study, mastery experiences included years of teaching experience and facilitating science labs, each of which provide additional opportunities to successfully teach agriculture.

Many novices have limited mastery experiences to augment self-efficacy. In the absence of mastery experiences, vicarious experiences are the strongest self-efficacy predictors. Vicarious experiences refer to an observer watching another individual model a specific behavior (Bandura, 1977). Observing another individual successfully complete a task, especially if you perceive the individual to have a similar skill set as you, can provide a template for how you could also find success. Additionally, observing others provides a comparative evaluation of your performance (Usher & Pajares, 2008). For individuals who do not have access to someone to compare themselves to or observe being successful (e.g., SBAE teachers in a single teacher program), vicarious experiences can be less abundant. Within this study, a number of variables were included (e.g., number of teachers in SBAE program, Curriculum for Agricultural Science Education [CASE] certification, and involvement in a high school SBAE program) which provide teachers access to individuals modeling SBAE teaching.

Mastery experiences and vicarious experiences have been identified as the two strongest predictors of self-efficacy (Schunk, 1995). However, individuals new to a task often rely on the appraisal of others, as opposed to their own evaluation, to help determine self-efficacy (Usher & Pajares, 2008). This feedback is identified as social persuasion, and has been found to be an important aspect of self-efficacy development (Bandura, 1977). Social persuasion and vicarious experiences are similar, as they both require proximity to individuals who can either demonstrate, or observe, performance. Therefore, we included the number of SBAE teachers in a program as a potential for vicarious experiences *and* social persuasion.

The final category of experiences linked to self-efficacy are physiological and emotional states, which include reactions (e.g., fear, anxiety, sweaty palms, nervous stomach) when considering a specific task. Bandura (1977) noted individuals internalize physiological and emotional states as evidence of potential success. In fact, many suggest individuals who have a negative reaction to a task (e.g., anxiety before the first day of teaching) perceive it as a sign they are unprepared, which decreases self-efficacy, making the individual more susceptible to failure (Usher & Pajares, 2008). The challenge of physiological and emotional states is measurement using social science research methods (Usher & Pajares, 2008). Therefore, we did not include specific personal and programmatic variables as indicators of physiological and emotional states. However, these states may be dictated by certain demographic and environmental characteristics (e.g., level of education, age, number of students in program), which are included in the study.

Literature Review

Starting with educational literature outside SBAE, we note important considerations for the development of self-efficacy among students and teachers. Throughout the literature, mastery experiences have been identified as the strongest predictors of self-efficacy for both teachers and students (Britner & Pajares, 2006), showcasing the importance of teachers experiencing success early in their career. However, the suggested link between vicarious experiences and increased self-efficacy has not been supported as consistently (Usher & Pajares, 2008), potentially due to variability in who an individual observes as a model and their internalization of modeled behavior. Within social persuasion, consensus supports a positive relationship with self-efficacy. However, studies note proximity between who is giving the feedback and who is receiving feedback as an essential element to positive social persuasion (Bates & Khasawneh, 2007). Finally, with regard to physiological and emotional states, consistent evidence supports negative reactions decreasing self-efficacy (Hampton & Mason, 2003).

Within SBAE, only a handful of studies have analyzed the role of personal and programmatic variables on teacher self-efficacy. The most commonly analyzed demographic is years of teaching experience. Rocca and Washburn (2006) identified a positive relationship between self-efficacy and years of experience among early career teachers. Additional research also found more teaching experience relates to increased self-efficacy (Burris, McLaughlin, McCulloch, Brashears, & Fraze, 2010; Wolf, 2008).

Research has also explored sex, age, high school SBAE involvement, level of education, and number of students in the SBAE program as potential influencers to teacher self-efficacy. This research suggests male and female SBAE teachers experience similar levels of self-efficacy (Rodriguez, 1997; Wolf, 2008). Research also suggests high school SBAE involvement and level of education have little to no impact on teacher self-efficacy (Wolf, 2008), yet the number of students enrolled in the SBAE program is positively associated with teacher self-efficacy (Wheeler & Knobloch, 2006; Whittington et al., 2006).

Self-efficacy is an essential element to teacher quality, student learning, and teacher career commitment (Kaiser, 2011; Schunk, 1996; Tschannen-Moran & Woolfolk-Hoy, 2001; Woolfolk-Hoy, 2000), making it an important variable for analysis. Although research has linked teacher self-efficacy to numerous variables, research in SBAE has lagged behind in (a) identifying personal and programmatic variables which consistently relate to higher levels of self-efficacy and (b) understanding the self-efficacy of teachers in a variety of areas. Within this research, we specifically attended to these two deficient areas of research by exploring the relationship between eleven personal and programmatic variables and five unique areas of self-efficacy (i.e., classroom management, instructional strategies, leadership, science, and math).

Purpose and Research Objectives

The purpose of this research was to explore the relationship between personal variables, programmatic variables, and the self-efficacy of early career SBAE teachers related to classroom management, instructional strategies, leadership, science teaching, and math teaching. The development and execution of this research was guided by the following objectives.

1. Identify the self-efficacy of early career SBAE teachers across personal and programmatic variables.
2. Determine the relationship between personal variables, programmatic variables, and the self-efficacy of early career SBAE teachers.

Methods and Procedures

The population included all early career SBAE teachers (i.e., teachers in the first five years of teaching) in California, Idaho, Oregon, Utah, and Washington during the 2012-2013 school year. A total of 295 names and contact information were collected via specialists in SBAE within each state. An electronic survey, developed through Qualtrics, was sent to all 295 early career teachers in the middle of the 2012-2013 school year. Four points of email contact were made in accordance with Dillman's (2000) tailored design method. A total of 150 useable responses (n = 150) were received, yielding a response rate of 51%. In an effort to test for non-response bias, on-time respondents (i.e., those who responded prior to the third point of contact) were compared to late respondents (i.e., those who responded after the third point of contact) using an independent samples t-test (Lindner, Murphy, & Briers, 2001; Miller & Smith, 1983). No statistically significant differences were found between on-time and late respondents in the five self-efficacy variables or demographic characteristics; therefore, the results may be generalized to the population of early career SBAE teachers in the five identified states during the 2012-2013 school year. Data collected were part of a larger research project.

The two elements of the survey critical to the current research were the personal and programmatic variables as well as self-efficacy constructs. Personal and programmatic variables were measured dichotomously (i.e., sex, involvement in high school SBAE program, CASE certification, availability of science credit), categorically (i.e., highest level of education), or continuously (i.e., years of teaching experience, age, number of students in program, length of classes, number of agricultural science laboratories facilitated, number of teachers in program) based on the nature of the data.

The five self-efficacy constructs originated from existing research. In an effort to increase consistency throughout the instrument, individual items were measured on a six-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*), with higher scores indicating higher self-efficacy.

The classroom management self-efficacy construct, which included seven-items and originated from the Teacher's Sense of Efficacy Scale (TSES) long form (Tschannen-Moran & Woolfolk Hoy, 2001), measured perceived ability establishing and enforcing student behavior expectations. An example item from the classroom management construct states "I can make my expectations clear about student behavior." The instructional strategies self-efficacy construct measured perceived ability identifying and implementing effective teaching methods to engage students in, and evaluate, learning. Instructional strategies self-efficacy was measured using eight-items, also originating from the TSES long form (Tschannen-Moran & Woolfolk Hoy, 2001). An example item from the instructional strategies construct states, "I can craft good questions for my students." The leadership self-efficacy construct measured perceived ability motivating and

inspiring students to achieve lofty goals. Leadership self-efficacy was measured using the eight-item self-efficacy construct, adapted for teachers, within the Individual Leadership Factors Inventory (Simonsen, Velez, Birkenholz, & McKim, 2013). An example item from the leadership construct states "I am able to bring out the strengths of my students." The science teaching self-efficacy construct measured perceived ability engaging students in science learning opportunities within SBAE. Science teaching self-efficacy was measured using the 13-item Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990). An example item from the science teaching construct states, "I know the steps necessary to teach science concepts effectively." The math teaching self-efficacy construct measured perceived ability teaching mathematics within SBAE. Math teaching self-efficacy was measured using the seven-item Ohio State University Teaching Confidence Scale for Math (Woolfolk Hoy, 2000). An example item from the math teaching self-efficacy construct states, "I can give students concrete experiences in learning mathematics."

Face and content validity of the instrument were evaluated using a panel of three faculty members and one graduate student with more than fifty years of combined teaching experience in SBAE and postsecondary teacher education. Additionally, reliabilities for the five self-efficacy constructs were estimated through a pilot test of 31 early career SBAE teachers in a Midwestern state. The self-efficacy constructs were reliable, with Cronbach's alpha ranging from .75 to .95. To accomplish research objective one, descriptive statistics were determined using the Statistical Package for the Social Sciences (SPSS). Research objective two was completed using backward deletion, multiple linear regression, a method used to systematically reduce a large number of independent variables to find the optimal regression model. In this study, all possible personal and programmatic variables were entered into the model with individual variables removed in a step-wise fashion based on model fit until a final model was determined. This regression method was selected because it permitted identification of the personal and programmatic elements most salient when considering the five self-efficacy variables. Other possible methods (e.g., correlations) did not allow for the systematic reduction of potential predictor variables and were, therefore, not used. Statistical significance (i.e., $\alpha < .05$) was established *a priori*.

Findings

Research objective one sought to evaluate the self-efficacy of early career SBAE teachers across personal and programmatic variables (see Table 1). Respondents were fairly equally distributed between first (n = 39), second (n = 32), and third (n = 35) year teachers with fewer respondents in their fourth (n = 25) or fifth (n = 19) year of teaching. Within four of the five self-efficacy variables, first year teachers responded with the lowest self-efficacy. For science teaching self-efficacy, the one variable in which first year teachers were not the lowest, second year teachers reported the lowest self-efficacy (M = 4.11). On the other end of the spectrum, the highest level of classroom management (M = 5.23) and instructional strategies (M = 5.05) self-efficacy was observed among fourth year teachers. Third year teachers exhibited the highest self-efficacy in leadership (M = 4.94) and science teaching (M = 4.28). The most experienced teachers (i.e., fifth year teachers) reported the highest level of self-efficacy within math teaching (M = 4.18).

With regard to sex, female respondents (n = 101) outnumbered male respondents (n = 48) more than two to one. Male teachers indicated higher self-efficacy in each of the five areas, with the largest difference between male (M = 4.18) and female (M = 3.97) respondents in math teaching self-efficacy. A majority of respondents (n = 125) indicated participating in a SBAE program during their high school careers. However, involvement in a high school program yielded lower self-efficacy in classroom management, instructional strategies, and math teaching. In fact, the only self-efficacy construct in which involvement in a SBAE program yielded a higher score was science teaching.

Some graduate coursework was the most common response (n = 68) when early career teachers were asked about highest level of education, followed by master's degree (n = 43) and bachelor's degree (n = 39). Teachers who reported completing a master's degree identified the highest instructional strategies (M = 5.03), leadership (M = 4.86), science teaching (M = 4.27), and math teaching (M = 4.31) self-efficacy. As for CASE certification, teachers who completed CASE training were the minority (n = 36); however, CASE certified teachers reported higher levels of instructional strategies (M = 4.97), leadership (M = 4.87), science teaching (M = 4.32), and math teaching (M = 4.22) self-efficacy. Finally, SBAE teachers who indicated offering science credit (n = 134) reported higher classroom management (M = 5.08), instructional strategies (M = 4.93), leadership (M = 4.82), and science teaching (M = 4.21) self-efficacy.

Table 1

The Self-Efficacy of Early Career Teachers Across Personal and Programmatic Variables

		Self-Efficacy Area				
Demographic Variable	*f*	Classroom Management	Instructional Strategies	Leadership	Science Teaching	Math Teaching
Years of Experience						
First Year	39	4.77	4.79	4.60	4.22	3.98
Second Year	32	5.00	4.81	4.77	4.11	4.00
Third Year	35	5.13	5.02	4.94	4.28	4.01
Fourth Year	25	5.23	5.05	4.88	4.20	4.13
Fifth Year	19	5.05	4.88	4.87	4.22	4.18
Sex						
Male	48	5.13	5.01	4.88	4.27	4.18
Female	101	4.96	4.85	4.77	4.17	3.97
Involved in High School Program						
Yes	225	5.01	4.88	4.80	4.21	4.04
No	25	5.02	5.03	4.80	4.19	4.43

Table 1 (continued)

The Self-Efficacy of Early Career Teachers Across Personal and Programmatic Variables

Demographic Variable	*f*	Self-Efficacy Area				
		Classroom Management	Instructional Strategies	Leadership	Science Teaching	Math Teaching
Highest Level of Education						
Bachelor's Degree	39	4.88	4.80	4.72	4.19	3.83
Some Graduate Coursework	68	5.10	4.87	4.80	4.18	3.98
Master's Degree	43	5.00	5.03	4.86	4.27	4.31
CASE Certification						
Yes	36	4.98	4.97	4.87	4.32	4.22
No	107	5.03	4.87	4.77	4.16	3.97
Availability of Science Credit						
Yes	134	5.08	4.93	4.82	4.21	4.01
No	15	4.45	4.64	4.58	4.13	4.28

Note. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*).

The second research objective sought to determine the relationship between personal variables, programmatic variables, and the self-efficacy of SBAE teachers in classroom management, instructional strategies, leadership, science teaching, and math teaching. Backwards deletion, multiple linear regression was used to accomplish this objective with results being presented in the next five tables.

First, the model for classroom management self-efficacy was analyzed. Using model selection procedures, years of teaching experience, number of students in the SBAE program, availability of science credit, and class length comprised the strongest predictive model of classroom management self-efficacy (see Table 2). The final model was statistically significant ($F = 6.47$, p-value < .001). In combination, the four predictor variables explained 17% of the variance in classroom management self-efficacy ($R^2 = .17$). Three of the four variables were statistically significant predictors of classroom management self-efficacy. The standardized coefficients (β) indicate years of teaching experience was the strongest, positive predictor of classroom management self-efficacy ($\beta = .20$, p-value = .021) followed by number of students in the SBAE program ($\beta = .19$, p-value = .025) and availability of science credit ($\beta = .17$, p-value = .043).

Table 2

Final Model of Personal and Programmatic Variables and Classroom Management Self-Efficacy

Predictors	Zero-order correlation (*r*)	*p*-value	*B*	*SEB*	*β*	*p*-value
Years of Teaching Experience	.18	.024	.11	.05	.20	.021
Number of Students in Program	.27	.001	.00	.00	.19	.025
Availability of Science Credit	.28	.001	.39	.19	.17	.043
Class Length	.20	.019	.01	.00	.15	.071

Note. $R = .42$, $R^2 = .17$, $F = 6.47$, p-value $< .001$. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*).

Using the process described for classroom management, instructional strategies self-efficacy was analyzed. The final predictive model included sex, undergraduate degree in agricultural education, number of teachers in SBAE program, and an indicator variable for the highest level of education being a master's degree (see Table 3). The final model for instructional strategies self-efficacy was statistically significant ($F = 3.18$, p-value = .016). In total, 9% of the variance in instructional strategies self-efficacy was explained by the four independent variables ($R^2 = .09$). Number of teachers in the SBAE program was the only statistically significant, positive predictor ($\beta = .20$, p-value = .029) of instructional strategies self-efficacy.

Table 3

Final Model of Personal and Programmatic Variables and Instructional Strategies Self-Efficacy

Predictors	Zero-order correlation (*r*)	*p*-value	*B*	*SEB*	*β*	*p*-value
Sex	-.12	.161	-.22	.18	-.16	.068
Undergraduate Degree in Agricultural Education	-.15	.071	-.26	.12	-.17	.061
Number of Teachers in Program	.10	.199	.15	.14	.20	.029
Master's Degree	.13	.102	.22	.13	.15	.089

Note. $R = .31$, $R^2 = .09$, $F = 3.18$, p-value = .016. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*). Sex variable coded 0 (*female*) 1 (*male*).

The third dependent variable analyzed was leadership self-efficacy. The final model included two predictors, years of teaching experience and the number of teachers in the SBAE program (see Table 4). The final model was statistically significant ($F = 6.60$, p-value = .002) and explained 10% of the variance in leadership self-efficacy ($R^2 = .10$). Both independent variables

were statistically significant, positive predictors of leadership self-efficacy, with number of teachers in the SBAE program being the strongest predictor (β = .21, p-value = .018) followed by years of teaching experience (β = .20, p-value = .020).

Table 4

Final Model of Personal and Programmatic Variables and Leadership Self-Efficacy

Predictors	Zero-order correlation (r)	p-value	B	SEB	β	p-value
Years of Experience	.15	.062	.10	.04	.20	.020
Number of Teachers in Program	.20	.014	.16	.07	.21	.018

Note. R = .31, R^2 = .10, F = 6.60, p-value = .002. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*).

Next, the relationship between personal variables, programmatic variables, and science teaching self-efficacy was analyzed. The final model included CASE certification, number of teachers in the SBAE program, and an indicator variable for teachers with a master's degree (see Table 5). The final model was statistically significant (F = 3.51, p-value = .017) and explained 8% of the variance in science teaching self-efficacy (R^2 = .08). Two of the independent variables were statistically significant; number of teachers in the SBAE program was the strongest, positive predictor of science teaching self-efficacy (β = .20, p-value = .026) followed by CASE certification (β = .18, p-value = .043).

Table 5

Final Model of Personal and Programmatic Variables and Science Teaching Self-Efficacy

Predictors	Zero-order correlation (r)	p-value	B	SEB	β	p-value
CASE Certified	.14	.088	.20	.10	.18	.043
Number of Teachers in Program	.10	.231	.11	.05	.20	.026
Master's Degree	.08	.334	.17	.09	.06	.075

Note. R = .28, R^2 = .08, F = 3.51, p-value = .017. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*).

In addition to self-efficacy in classroom management, instructional strategies, leadership, and science teaching, math teaching self-efficacy was considered. The final model of math teaching self-efficacy included high school involvement in an SBAE program, number of SBAE teachers in current program, and an indicator variable for master's degree (see Table 6). The final model was statistically significant (F = 4.94, p-value = .003) and explained 11% of the variance in math teaching self-efficacy (R^2 = .11). Only number of SBAE teachers in the current program was a

statistically significant, negative predictor of math teaching self-efficacy (β = -.18, p-value = .042), with no other variables being statistically significant.

Table 6

Final Model of Personal and Programmatic Variables and Math Teaching Self-Efficacy

Predictors	Zero-order correlation (r)	p-value	B	SEB	β	p-value
Involved in High School Program	-.18	.026	-.42	.23	-.16	.074
Number of Teachers in Program	-.22	.007	-.20	.10	-.18	.042
Master's Degree	.19	.024	.35	.18	.17	.058

Note. R = .33, R^2 = .11, F = 4.94, p-value = .003. Self-efficacy items scaled from 1 (*strongly disagree*) to 6 (*strongly agree*).

Conclusions, Recommendations and Implications

The purpose of this study was to investigate the relationships between personal variables, programmatic variables, and the self-efficacy of early career SBAE teachers in classroom management, instructional strategies, leadership, science teaching, and math teaching. Research linking self-efficacy to positive attributes, like increasing student motivation and working with challenging students (Tschannen-Moran & Woolfolk-Hoy, 2001; Woolfolk-Hoy, 2000) along with the retention of SBAE teachers (Blackburn & Robinson, 2008; Knobloch & Whittington, 2003; McKim & Velez, 2015, 2016; Swan, 2005; Wheeler & Knobloch, 2006; Whittington et al., 2006) justified exploring how personal and programmatic variables relate to self-efficacy.

The first research objective sought to explore the mean scores of respondents within five self-efficacy areas across multiple personal and programmatic variables. The demographic distribution of responding early career teachers aligned with recent research showcasing an influx of female teachers (Foster et al., 2014). Additionally, the results provide a valuable snapshot of self-efficacy scores within classroom management, instructional strategies, leadership, science teaching, and math teaching. However, the recommendations and discussion of interest for this research emerge when considering the relationships between personal variables, programmatic variables, and the self-efficacy of SBAE teachers. Therefore, the focus of our conclusions is on research objective two.

Analyzing the relationships between personal variabes, programmatic variables, and self-efficacy yielded five unique predictors (i.e., number of SBAE teachers in the program, years of teaching experience, number of students in program, science credit being offered, and CASE certification) linked to self-efficacy. For discussion, we attend to these relationships, theoretical connections, and implications for SBAE.

Number of SBAE Teachers in the Program

Number of teachers within the SBAE program was a statistically significant, positive predictor of instructional strategies, leadership, and science teaching self-efficacy. We suggest the positive relationships were due to vicarious experiences and/or social persuasion, two of the four

self-efficacy building experiences identified by Bandura (1977, 1986). Vicarious experiences refer to a boost in self-efficacy (i.e., confidence in abilities to successfully accomplish a given task) when observing another individual successfully accomplish a given task. The positive relationships between additional SBAE teachers in a program and the self-efficacy of early career SBAE teachers may be explained by having additional opportunities to observe fellow SBAE teachers demonstrating successful instructional strategies, leadership, and science teaching. We recommend further research to investigate the relationship between number of SBAE teachers in a department and retention of early career SBAE teachers.

As an alternative, or compliment, to the potential for vicarious experiences to explain the significant, positive relationship between additional SBAE teachers and self-efficacy is the role of social persuasion. Social persuasion refers to an individual offering encouragement or support regarding performance on a specific task. The positive relationship between the number of SBAE teachers and self-efficacy may be explained by early career SBAE teachers in multi-teacher programs being encouraged more often by fellow SBAE teachers. This encouragement could come by way of formal and informal observations, affirmation of departmental tasks completed, or restating positive comments from students about the early career teacher. Unfortunately, limitations with the use of experimental methodology will likely preclude the profession from definitively attributing the observed positive relationships to vicarious experiences or social persuasion; however, we can still use this relationship to inform SBAE. The relationship between number of SBAE teachers and self-efficacy implies early career teachers need ready access to fellow SBAE teachers. Whether that access is created by encouraging early career teachers to work in multi-teacher programs, developing and maintaining a structured mentoring program, facilitating peer observations early in a career, or structuring peer teaching exercises during professional development, we recommend teacher educators consider ways to connect early career teachers to their peers in the profession.

In addition to multiple teachers relating to increased instructional strategies, leadership, and science teaching self-efficacy, a significant, *negative* relationship was identified between number of SBAE teachers and math teaching self-efficacy. Once again, we suggest this relationship can be explained by vicarious experiences and/or social persuasion (Bandura, 1977, 1986). However, unlike the aforementioned positive relationships, a negative relationship implies either negative observations of peers teaching math (e.g., observing a fellow SBAE teacher unsuccessfully engage students in math learning) or negative social persuasion regarding teaching math (e.g., hearing "we are agriculture teachers, not math teachers"). To better understand this negative relationship, we recommend qualitative research of early career teachers working in multi-teacher programs exploring what they observe and/or hear related to teaching math from peer teachers.

Years of Teaching Experience

Additional years of teaching experience was a significant, positive predictor of classroom management and leadership self-efficacy. This finding corroborates existing research linking years of teaching experience and self-efficacy (Burris et al., 2010; Rocca & Washburn, 2006; Wolf, 2008). From a theoretical perspective, we suggest this relationship is attributed to mastery experiences, defined as an individual successfully accomplishing a given task (Bandura, 1977, 1986). In other words, more years in the SBAE teaching profession provides additional opportunities for teachers to experience success managing the classroom and leading students.

The unique aspect of the relationship between years of teaching experience and self-efficacy was it not being seen in the other self-efficacy areas (i.e., instructional strategies, math

teaching, and science teaching). Based on the theoretical foundations of self-efficacy, we could confidently assume more years of teaching experience would yield additional opportunities to experience success in instructional strategies, teaching math, and teaching science (Bandura, 1986; McKim & Velez, 2016). One unique difference between the teaching areas found to relate to years of teaching experience (i.e., leading students and classroom management) and the teaching areas not found to relate (i.e., instructional strategies, math teaching, science teaching) is the emphasis on content. Uniquely, the two areas not directly associated with content were significantly related to years of experience. Potentially, this suggests areas of teacher self-efficacy which emphasize interpersonal responsiveness (i.e., leading and managing) can only be developed through authentic, sustained engagement in a classroom.

Number of Students in the Program

The number of students in the SBAE program was significantly related to increased classroom management self-efficacy. From a theoretical standpoint, it is difficult to connect additional students within an SBAE program to one of the four areas of self-efficacy development. However, we suggest the explanation is more pragmatic. Early career teachers who are able to form a safe and welcoming environment for students are, potentially, more confident in their ability to manage a classroom; additionally, these teachers are more likely to attract a broader pool of students due to the positive learning environment. Additional research is recommended exploring the development of, and outcomes associated with, a safe and welcoming environment within SBAE classrooms. We fully acknowledge challenges exist in measuring such a construct; however, the potential to enhance both classroom management and recruitment of students warrants further consideration.

Science Credit Offered

Science credit being offered through SBAE courses was a significant, positive predictor of classroom management self-efficacy. As was the case with number of students, we suggest this relationship is a product of the classroom environment. Specifically, this relationship suggests classrooms where science credit is offered are (a) more rigorous and engaging and (b) attracting students who are less likely to engage in classroom discipline problems; thus, increasing the classroom management self-efficacy of the early career teacher. In either case, the finding emphasizes a need for SBAE teachers to adapt or enhance curriculum to meet science credit expectations, not only to benefit student learning, but to help establish a desired classroom culture. Research is recommended addressing variables which illuminate differences among classroom demographics; specifically, science credit classrooms and non-science credit classrooms and teacher self-efficacy.

CASE Certification

The final statistically significant predictor was CASE certification, identified as a positive predictor of science teaching self-efficacy. It is important to recognize the identified relationship does not imply causation. In fact, it is very possible early career teachers with a higher self-efficacy for teaching science would self-select into a professional development opportunity associated with illuminating science through SBAE curriculum. However, past research has evaluated the self-efficacy of SBAE teachers before and after a CASE institute and found an increase in science teaching self-efficacy (Ulmer, Velez, Lambert, Thompson, Burris, & Witt, 2013). Researchers attributed self-efficacy growth to engagement in vicarious (i.e., observing lead teachers teach science) and mastery (i.e., engaging in science lessons) experiences during the CASE experience (ibid.). Whether CASE is an opportunity for already efficacious teachers to sharpen their science

teaching self-efficacy or a transformative experience for non-efficacious teachers, evidence suggests CASE is valuable for the science teaching self-efficacy of early career teachers. Continued evaluation of the CASE experience and how it impacts teachers across the science teaching self-efficacy spectrum is recommended.

Self-efficacy is a powerful construct within SBAE due to its connections to teacher effectiveness and retention (McKim & Velez, 2016). Within this study, we sought to identify personal and programmatic variables related to the self-efficacy of early career SBAE teachers. Through our research, a number of important variables were identified that can inform practice and help focus self-efficacy research within SBAE. As research and practice progress, we look forward to teachers and researchers intentionally offering and exploring self-efficacy building experiences to support the continued growth and impact of SBAE.

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