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A TALE OF TWO CONTEXTS: MATHEMATICS SELF-EFFICACY DEVELOPMENT AMONG RURAL AND URBAN STUDENTS

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A TALE OF TWO CONTEXTS:

MATHEMATICS SELF-EFFICACY DEVELOPMENT

AMONG RURAL AND URBAN STUDENTS

THESIS

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By

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ABSTRACT OF THESIS

A TALE OF TWO CONTEXTS: MATHEMATICS SELF-EFFICACY DEVELOPMENT AMONG RURAL AND URBAN STUDENTS

Self-efficacy, or a belief in one's ability to complete a task, has been shown to predict student success and persistence. Rural students have a history of lower college enrollment and degree attainment than urban students. However, no studies have compared self-efficacy or its sources across rural and urban groups. The purpose of this study is to examine differences in how rural and urban middle school students develop self-efficacy and self-efficacy for self-regulated learning in the domain of math. Data were collected from 174 rural students and 1743 urban students in grades 6-8 in the southeastern United States. Measurement invariance analyses determined that rural and urban students respond to measures of self-efficacy and its sources similarly, but not identically. Comparison of latent means revealed that rural students reported more vicarious experiences than urban students. However, structural equation modeling showed that rural students relied solely on mastery experience when evaluating their self-efficacy. This differed from urban students who relied on mastery experience, vicarious experience, and negative physiological state when judging their self-efficacy. This study is the first to compare self-efficacy across rural and urban groups and extends research examining self-efficacy and its sources in understudied populations.

KEYWORDS: Self-Efficacy, Math, Sources of Self-Efficacy, Rural, Urban

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Dedicated to Jesse, my loving and patient husband, and to Luke, my source of joy always

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Chapter One: Introduction

Self-efficacy, or a belief in one's ability to complete a task, has been shown to be one of the most important motivational variables for predicting student success, persistence, and self-regulation in school (Bandura, 1997; Schunk & DiBenedetto, 2014). Personal achievements and failures, social influences, and a person's own internal state affect the development of efficacy beliefs, and these experiences play increasingly important roles as students navigate their home and school environments. Much of the research on self-efficacy and its sources has focused on university students, or primary and secondary schools in suburban or urban areas (Usher & Pajares, 2008; Usher & Weidner, 2018). Less research has been conducted with rural students, despite ample evidence of the ways in which rural contexts influence education (Hardré & Sullivan, 2008; Howley, 2003; Provasnik et al., 2007). Prior research on the motivation of rural youth has focused on the motivation profiles of high school students (Hardré, 2012), and few studies have directly compared rural students to their non-rural counterparts (Freeman & Anderman, 2005). Only one other study has examined self-efficacy and its sources in the unique rural context of Central Appalachia (Usher, Ford, Li, & Weidner, 2018). The purpose of this study is to examine the sources of middle school students' self-efficacy in rural and urban contexts in the core subject of mathematics. In addition to providing critical information about the development of students' self-efficacy in the understudied rural area of Central Appalachia, this study examines similarities and differences in the theoretical relationships between self-efficacy and its sources for rural and urban students.

I begin this paper with an explanation of the guiding theoretical framework. I then discuss self-efficacy development in middle school and review previous studies that highlight the important role efficacy beliefs play in students' academic outcomes. In addition, I discuss gaps in the current understanding of self-efficacy and its sources. I then define rurality and discuss math education and motivation in rural communities. Finally, I hypothesize how aspects of living in a rural environment may influence students' math self-efficacy and its sources.

Social Cognitive Theory and Environmental Influence

The guiding framework of this study is social cognitive theory, which posits that human motivation is determined by the interactions that occur between personal, environmental, and behavioral factors (Bandura, 1986). Within social cognitive theory, people are both influencers of and influenced by their environment. For example, a math student with high self-efficacy (a personal factor), may score higher on exams (behavior), and be placed in an advanced math class (environment). Faced with more difficult math problems and talented peers (environment), the student may feel less confident in her ability to succeed (personal factor) and participate less in class (behavior). In this way, the student's internal state, choices, and surrounding environment all play a role in her actions and motivation.

Self-efficacy, the focus of this study, is a personal factor and strong predictor of future behavior (Bandura, 1997). Within academic settings, self-efficacy can predict whether or not students succeed, how long they persist in the face of difficulty, and which college major or career path they choose (Schunk & DiBenedetto, 2014; Usher & Pajares, 2008). Self-efficacy is domain specific, meaning that it varies between skills and subject matter. For example, a young athlete may be very confident in his ability to play soccer, but much less confident in his ability to do well on a math test. However, in some cases self-efficacy for one skill may be related to the self-efficacy to perform other relevant skills. The ability to self-regulate, for example, is an important component of success in academic pursuits, and self-efficacy for self-regulation has a strong association with academic self-efficacy (Usher & Pajares, 2006; Zimmerman, Bandura, Martinez-Pons, 1992).

Bandura (1997) hypothesized that students' self-efficacy is shaped and informed by four sources: their own personal successes and failures (mastery experience), what they witness others doing (vicarious experience), what people tell them (social persuasion), and their physical and emotional arousal (physiological state). Self-efficacy is lifted or lowered by the interpretation of these experiences. Typically, successful mastery of a skill increases students' self-efficacy for that skill. However, what is interpreted as a successful mastery experience is dependent on the student and environment. Getting accepted into college may be considered a powerful mastery experience for a student who is the first to go to college in her family. Acceptance to the same college may be a less powerful experience for a student who witnessed his sibling's college graduation. Similarly, praise from a teacher may be more significant for one student, whereas watching a peer complete a difficult problem or the anxiety felt when taking a test may be most significant for another. The following review examines what is known about the sources of middle school students' self-efficacy and the environmental factors that influence how students interpret and evaluate efficacy-related experiences.

Self-Efficacy Development in Middle School

Early adolescence can be a particularly difficult time for students as they experience more challenges in their school environment and begin the emotional and physical changes associated with puberty. During this period of development, some children lose confidence as they cope with transitions to more difficult subject matter and begin preparations for high school (Schunk & Meece, 2005; Witherspoon & Ennett, 2011). Maintaining students' self-efficacy during early adolescence may be especially important, as it has been shown to predict students' grades, as well as their educational aspirations and general well-being (Pajares, 2006). Environmental factors such as the culture that surrounds a student can influence self-efficacy (Klasssen, 2004a). For example, middle school students in the more individualistic culture of the United States rated their self-efficacy higher than students from the more collectively-oriented countries of Korea and the Philippines (Ahn, Usher, Butz, & Bong, 2015).

Similarly, culture can also influence the ways students interpret and evaluate the sources of self-efficacy (Usher & Weidner, 2018). The value students place on socially-construed information, like vicarious experience and social persuasion, can vary depending on the culture in which they live and work. For example, students in collectivistic environments tend to place more value on socially-construed information from their families and peers than students in individualistic cultures, who focus more on their own experiences and feelings when determining their confidence (Ahn et al., 2015; Klassen, 2004a).

In the domain of math, self-efficacy has been shown to be a strong predictor of middle school students' math achievement (Ramdass & Zimmerman, 2008). Multiple studies have demonstrated that mastery experience is the strongest predictor of students' math self-efficacy (Butz & Usher, 2015; Usher & Pajares, 2009). Physical and emotional states can also affect how capable students feel in math (Ahn, Bong, & Kim, 2017; Usher & Pajares, 2006). In a qualitative study of middle school students, Usher (2009) observed that students who had high math self-efficacy described heightened states of arousal in a positive light, whereas less confident students discussed heightened states of arousal in negative ways such as being stressful and anxiety-inducing. The influence of social models and feedback has been varied in the domain of math. Ahn et al. (2017) noted that social persuasion from teachers was a significant predictor of math self-efficacy, but that students did not value feedback or modeling from parents. Ahn et al. (2015) observed that students from different countries valued feedback and modeling in math differently depending on whether it came from parents, teachers, or peers. Students' age and the difficulty of subject matter may also affect who and what students pay attention to when determining their math self-efficacy (Ahn et al., 2015, 2017; Usher & Weidner, 2018).

Gender too may affect the ways students weigh and interpret information when evaluating their self-efficacy, especially in traditionally male dominated fields like math and science. Joët, Usher, and Bressoux (2011) found that girls in elementary school reported lower self-efficacy, lower self-efficacy for self-regulation, fewer mastery experiences, fewer positive social messages, and greater anxiety in math than did boys, but many of these differences disappeared when examining a language-based domain like French. Although quantitative results often show no significant differences in the sources of self-efficacy for boys and girls in math and science (Britner & Pajares, 2006; Kiran & Sungur, 2012), there is some qualitative evidence to suggest that girls may place greater importance on socially-conferred information than their male peers (Butz & Usher, 2015; Webb-Williams, 2017). Results from a mixed methods study of Central Appalachian students also followed this pattern. Quantitatively, there were few differences between boys' and girls' self-efficacy or the sources of self-efficacy in math and science. However, qualitative responses revealed that girls more often described socially-related information when describing what raised or lowered their confidence (Usher et al., 2018).

Despite calls for research into the ways other demographic variables, such as race and socioeconomic status, and environmental variables, like rurality, may affect self-efficacy and its sources, this area of research continues to be understudied (Usher & Pajares, 2008; Usher & Weidner, 2018). The aim of the current study is to examine the four hypothesized sources of math self-efficacy among students in urban and rural contexts. Although some studies have examined the self-efficacy of rural students, none have directly compared the development of self-efficacy across rural and urban contexts.

Findings and Limitations of Educational Research on Rural U.S. Samples

Academic achievement and college enrollment of rural youth. Rural education has been the subject of little systematic research as compared to education in suburban and urban areas (Hardré & Sullivan, 2008). Many scholars studying rural education have focused on the educational aspirations and expectations of rural high school students, as well as students' post-secondary enrollment and completion. For example, using data from the National Education Longitudinal Study (NELS), Byun et al. (2012) found that rural students fell behind their suburban and urban peers in college enrollment and attainment, and that this difference was largely attributable to socioeconomic factors. Other researchers have observed that although a high percentage of rural youth (51%)

had aspirations to enroll in and complete college, their aspirations were limited by family income, geographic isolation, and their desire to stay in their communities (Meece et al., 2013).

Despite evidence of lower rates of college enrollment, it is unclear if rural students have lower academic achievement than students in suburban or urban areas. Some studies have documented lower scores on standardized tests in rural areas (Roscigno & Crowley, 2001), but others have contended that this difference is largely dependent on the poverty rates and geographic isolation of some rural areas (Irvin et al., 2011). Researchers have also noted the positive characteristics of rural areas, such as strong social and community ties among rural inhabitants, may partially offset any negative effects of living in areas that are geographically isolated or lacking in resources (Byun et al., 2012; Irvin et al., 2011). The inconsistent findings regarding the effects of rurality on achievement may be largely attributed to the use of national datasets that mask the unique characteristics of rural communities (Hardré, Crowson, Debacker, & White, 2007). Some scholars have recommended examining education outcomes of rural students within states rather than nationally because of varying state policies regarding education (Hardré & Hennessey, 2010). Additional research is needed within states that focuses on the self-beliefs and motivation of rural students that lay the foundation for academic success or failure.

Motivation of rural students: What we know so far. Findings from previous research indicate that rurality plays a role in shaping students' self-beliefs and motivation. Of the few studies examining rural students' motivation, almost all focused on rural high school students. Some have compared the motivation of rural students across states (Hardré & Hennessey, 2010) and ethnicities (Hardré & Lieuanan, 2010). Results from one study indicated that rural students were similar across states in their perceived value, perceived competence, effort engagement, and success expectancies, but differed in their perceptions of teachers and the classroom environment (Hardré & Hennessey, 2010). In another study, rural Native American students favored learning-oriented achievement goals more than peers of other ethnicities (Hardré & Lieuanan, 2010). In a rare study directly comparing the motivation of rural and urban students, Freeman and Anderman (2005) found that rural middle school students showed a greater increase in mastery goals over time than did their urban counterparts. They also found that school location continued to predict students' mastery goals even when factors like GPA, gender, and classroom goal structure were taken into account (Freeman & Anderman, 2005).

Only a handful of studies have investigated self-efficacy or similar constructs in rural settings. For example, in their study of 414 high school students from 10 rural public schools, Hardré, Sullivan, and Crowson (2009) found that perceived competence (a combination of three scales measuring self-efficacy, perceived ability, and perceived competence) exhibited a strong, predictive relationship to achievement and intention to stay in school. Hardré and Hennessey (2010) similarly found that perceived competence predicted success and effort engagement for rural high school students in Indiana and Colorado. Hardré and Lieuanan (2010) reported that self-efficacy was significantly higher in math and science for rural students who identified as Native American; although they did not report how self-efficacy was measured. Only one study to date has focused on self-efficacy and its sources in a rural context. Usher et al. (2018) used mixed methods analyses to examine self-efficacy and its sources in the contexts of math and science in Central Appalachia. They discovered that students in Central Appalachia rely on mastery experiences and negative physiological state when determining self-efficacy for math and science, and that boys and girls differed in their qualitative descriptions of what raised and lowered confidence in these domains. Despite evidence that living in a rural setting may influence how students develop their confidence in domains such as math and science, no studies to date have directly compared self-efficacy development across rural and urban contexts.

Math self-efficacy development in rural settings. Many rural students report difficulty with and low motivation for math over other academic subjects. After examining rural students' motivation in multiple subject areas, Hardre et al. (2009) concluded that "rural students demonstrated a lower motivational profile for math than any other subject area, and for all other areas combined" (p. 14). Other researchers have found that math achievement in rural schools varies considerably from state to state (Lee & McIntire, 2000), and that many rural students have limited access to advanced math courses (Graham, 2009). Usher et al. (2018) observed that negative physiological states such as stress and anxiety influenced rural students' confidence in math. Scholars have also discussed the negative views some rural communities have come to exhibit toward formal education, and toward math education in particular, because of the tendency for rural students to leave their communities in order to pursue higher education and careers in math (Corbett, 2009; Greenwood, 2009; Howley, 2003). Others have discussed the additional obstacles faced by gifted rural math students who often have the difficult choice of pursuing a lucrative career or remaining a part of their communities (Howley, Showalter, Klein, Sturgill, & Smith, 2013).

The complex relationship between math education and rural communities may lead rural students to develop different views and self-beliefs about math than students in urban or suburban areas. Previous work on math motivation and education in rural communities lays the foundation for hypotheses about how rurality could influence math self-efficacy and its development. Rural students who have limited exposure to advanced math content (Graham, 2009) or professionals in math-related fields (Howley, 2003) may have fewer mastery experiences and vicarious experiences with math, which in turn could lead to lower math self-efficacy than urban students. Scholars have emphasized the importance of family and community in rural areas (Barcus & Brunn, 2009; Howley, 2006). Previous researchers have also observed that students in community-oriented cultures place greater value on social persuasion and vicarious experience than students in individual-oriented cultures (Klassen, 2004b). Similarly, rural students who live in community-focused areas may be more influenced by socially-conveyed information than urban students who live in communities that are less connected. Rural students may also develop negative physiological arousal when dealing with math if the people around them hold and express negative attitudes toward math (Corbett, 2009; Greenwood, 2009; Howley, 2003).

Purpose of the Study

The purpose of this study is to examine differences in how rural and urban middle school students develop their math self-efficacy. Four research questions guided this investigation.

1. Do measures of general math self-efficacy, self-efficacy for self-regulated learning in math, and the sources of math self-efficacy function identically for students in rural and urban contexts?
2. Are there mean level differences in general math self-efficacy, self-efficacy for self-regulated learning in math, and the sources of math self-efficacy between rural and urban students?
3. Do data from rural and urban students fit Bandura's (1997) hypothesized model where the sources of self-efficacy predict self-efficacy?
4. Do the sources of math self-efficacy predict general math self-efficacy and self-efficacy for self-regulated learning similarly in rural and urban samples?

Chapter Two: Method

This study took place in one urban and one rural county in one state in the middle-southeastern U.S. The original sample included 196 rural students and 1882 urban students. Data from this study were taken at two time points, near the beginning and end of one school year, for both groups. After removing students who did not have data at both time points (22 rural students and 139 urban students), a total of 1917 middle school students were included in this study.

Definitions of Rurality

Multiple definitions of rurality exist within the United States that stem from various administrative, land-use, or economic guidelines (Cromartie & Buckholz, 2008). The U.S. Census (2015) classifies an area as *rural* if it has a population of less that 2,500, *urban* if the population is 50,000 or more or as an *urban cluster* if its population is between 2,500 and 50,000. The USDA Economic Research Service (2013a) defines the rurality of areas by their population density and classifies rural areas as those with densities of less than 500 people per square mile, or locations with fewer than 2,500 people. Rural Urban Commuting Area (RUCA) codes rank locations from 1 (*metropolitan)* to 10 (*rural*) and are determined by combining census data and levels of commuting to urbanized areas (USDA Economic Research Service, 2013b). In the present study, RUCA codes are used to define the rurality of the two student samples because they represent both population density and geographic isolation.

Central Appalachia: A Unique Rural Population

The Appalachian region of the United State is a 205,000-square-mile area that follows the span of the Appalachian Mountains and can be separated into distinct areas that vary in population, economic capital, and culture. Central Appalachia, encompassing 53 counties in Eastern Kentucky and surrounding states, is the poorest and most geographically isolated of these subregions (Appalachian Regional Commission, 2017; Pollard & Jacobsen, 2014). In this unique environment where there are limited job opportunities and few adults have attained college degrees, K-12 schools face challenges when preparing students for college and beyond. Despite these obstacles, a review of high school graduation rates and ACT scores showed that students in this region are performing as well or better than the rest of the nation (Kannapel & Flory, 2017). However, a cultural focus on family and community in addition to parents' uncertainty and lack of experience with higher education may negatively influence students' aspirations (Kannapel & Flory, 2017). In fact, many Appalachian students, especially women, have reported receiving discouraging messages about attending college (Wallace

& Diekroger, 2000). Scholars have emphasized the need for additional research focusing on K-12 schools in this area (Kannapel & Flory, 2017).

Rural Participants

Data from the rural sample were collected from one middle school within one school district in Central Appalachia. The county was given a RUCA code of 10. This rating represents the lowest population density and highest geographic isolation and classifies the area as “isolated rural.” In 2015, the total population of the rural county was around 7,000 with 97% of people identifying as White. Of people 25 and older, around 72% had completed high school and around 8% had completed a bachelor’s degree or higher. The median household income for this county was $23,000 and 32% of individuals in the county were considered below the poverty level (U.S. Census Bureau, 2015).

The rural sample consisted of 174 students, 89 girls (51.1%), 83 boys (47.7%), and two students who did not specify their gender (1.1%). Race/ethnicity was obtained from school report data. The sample was identified as 97.1% White, 1.7% Black, and 1.1% other or not reported. Students in the rural sample were similarly distributed among grade levels with 33.3% in sixth grade, 35.6% in seventh grade, and 31% in eighth grade. All of the students in the rural sample received free lunch at school.

Urban Participants

Data from the urban sample were collected from four schools within one school district. The district was located in a county with a RUCA code of 1, which is considered a core urban area. The county had a total population of around 296,000, with 76% of the population identifying as White, 14.5% as African American, and 9.5% identifying as a different or multiple races. Of people 25 and older, around 90% had completed high school and around 41% had completed a bachelor's degree or higher. In 2015, the median household income for this county was around $50,000 and 19% of individuals in the county were considered below the poverty level (U.S. Census Bureau, 2015).

The urban sample consisted of 1743 students from 4 middle schools, 856 girls (49.1%) and 887 boys (50.9%) whose school-reported race/ethnicity was 54.7% White, 30.3% Black, 8.5% Hispanic, 2.5% Asian, and 4% other or not reported. Students were distributed similarly among grade levels with 37.8% in sixth grade, 41% in seventh grade, and 21.2% in eighth grade, and 51.3% percent of the urban sample was eligible for free or reduced price lunch.

Procedure

Rural. Data from rural students were collected in two waves as part of a larger project investigating student motivation and achievement. Trained researchers visited four schools in one rural county and asked students to complete a survey during their math class. Each class of students was surveyed separately, with each school being surveyed over the course of two or three days. This study used data that were collected from in Fall 2013 (Wave 2) and Spring 2014 (Wave 3) near the beginning and end of one school year. Students were assured that their responses would remain confidential, and researchers were available to answer any questions. Passive consent was obtained from parents via a letter sent home with students describing the study and allowing parents to opt their children out of the survey. Student assent was obtained via student signature before students accessed surveys. Surveys were administered in school computer labs using Qualtrics, a computerized survey program.

Urban. Data from urban students were part of a larger project called Motivation in Transition (MIT). MIT participants were surveyed in seven waves during the course of three years. This study used data collected from middle schools in Fall of 2011 (T1) and Spring of 2012 (T2). The procedure was identical to the collection of rural data, except that T1 surveys were administered in paper format rather than online. Paper surveys were entered and checked for accuracy by a trained research team.

Measures

Although numerous measures were used in both larger projects, this study focused on the Sources of Mathematics Self-Efficacy Scale administered in the fall and the General Mathematics Self-Efficacy Scale and Self-Efficacy for Self-Regulated Learning in Mathematics Scale administered in the spring of the same school year. By using data collected at two time points, I was able to observe the effects of efficacy-related experiences at the beginning of the school year on students' self-efficacy near the end of the same school year. A full list of items for each scale is included in Appendix A.

The *Sources of Mathematics Self-Efficacy Scale* contained 25 statements to which students responded using a 6-point Likert scale from 1 (*definitely false)* to 6 (*definitely true*) (Usher & Pajares, 2009). Six items measured mastery experience (α_{rural} = .90, α_{urban} = .86), such as "I do well on math assignments," 7 items measured vicarious experience (α_{rural} = .79, α_{urban} = .75), such as "Seeing adults do well in math helps me do better in math," 6 items measured exposure to social persuasion (α_{rural} = .90, α_{urban} = .87), such as "People have told me that I have a talent for math," and 6 items measured negative physiological state (α_{rural} = .88, α_{urban} = .87), such as "My whole body becomes tense when I have to do math."

The *General Mathematics Self-Efficacy Scale* was created using Bandura's (2006) scale construction guidelines and contained 7 items (α_{rural} = .95, α_{urban} = .93). Students responded on a 6-point Likert scale that ranged from 1 (*definitely false*) to 6 (*definitely true*) to questions such as, "How confident are you that you can learn math?"

The *Self-Efficacy for Self-Regulated Learning in Mathematics Scale* is an 11-item measure adapted from Zimmerman et al., (1992). Items were worded in a domain specific manner by changing the word "school" to "math." For example, "How well can you organize your school work?" became "How well can you organize your *math* work?" Students responded on a 6-point Likert scale that ranged from 1(*not very well at all*) to 6 (*very well*). Cronbach's alpha was .95 in the rural sample and .92 in the urban sample.

Analyses

A series of confirmatory factor analyses (CFAs) were used for each scale to test for measurement invariance across rural and urban samples (RQ1). First, rural and urban samples were separated and CFAs were run for each scale to determine if the scales showed good model fit in both groups individually. I considered recommended values of the comparative fit index (CFI) > .95 (Bentler, 1990), of the root-mean-square error of approximation (RMSEA) < .06 (Hu & Bentler, 1999), and of the standardized root mean square residual (SRMR) < .08 (Hu & Bentler, 1998) to be evidence of excellent model fit. I considered recommended values of the CFI > .90 (Bentler, 1990) and values of the RMSEA < .08 (Hu & Bentler, 1999) to be evidence of acceptable model fit. The samples were then combined, and CFAs with progressively more stringent model fit requirements were run to determine the level of measurement invariance between groups for each scale. I examined differences in latent means by school location for math self-efficacy, self-efficacy for self-regulation in math, and the sources of math self-efficacy (RQ2).

Structural equation modeling was used to examine the hypothesized relationships between general math self-efficacy, self-efficacy for self-regulation in math and the sources of self-efficacy for rural and urban students. I first examined the model's overall fit using the previously discussed recommended values of the CFI, RMSEA, and SRMR to determine if the data collected in each sample fit Bandura's (1997) hypothesis that the four sources of self-efficacy predict self-efficacy (RQ3). I then compared which of the sources were significant predictors of self-efficacy and self-efficacy for self-regulated learning among rural and urban students (RQ4). All analyses were conducted using SPSS and Mplus version 7 (Muthén & Muthén, 2012).

Students were nested within both teachers and schools. To account for the effects of classroom and school environment, each student was assigned a class code based on their reported teacher and class period throughout the school year. Codes were created that accounted for students who had multiple math teachers as well as students who changed math periods during the school year. Class codes were used to create clusters that represented the classroom environment for various groups of students. Due to the relatively small sample size at the cluster level (rural: $n = 32$ classes, urban: $n = 116$), and given that the research questions were focused on student-level outcomes, a design-based (versus a multilevel model-based) approach was applied (Stapleton, McNeish, & Yang, 2016) using the "type = complex" command in conjunction with the "cluster = Class" command and MLR estimator in Mplus.

Chapter Three: Results

Confirmatory Factor Analysis and Correlations Among Latent Variables

To determine if the measures used in this study function identically in rural and urban groups (RQ1), I performed separate CFAs with each group to examine scale performance and correlations among latent variables. The CFA models of the General Mathematics Self-Efficacy Scale and Self-Efficacy for Self-Regulated Learning in Mathematics scale showed that a one-factor structure had excellent fit for both rural and urban students (see Table 1). Factor loadings are presented in Table 2. For the General Mathematics Self-Efficacy Scale item loadings ranged from .76-.90 for the rural sample and .77-.87 for the urban sample. For the Self-Efficacy for Self-Regulated Learning in Mathematics Scale item loadings ranged from .75-.89 for the rural sample and .59-.84 for the urban sample.

The four-factor structure of the Sources of Self-Efficacy for Mathematics Scale did not initially show good model fit for either group. Model fit was improved to an acceptable level for both groups by removing three items. Item M4, "Even when I study very hard, I do badly in math," was removed because it cross loaded onto the latent variable representing negative physiological state. In addition, item M4 was the only item in the Mastery subscale that measured a failure experience and there is evidence to support measuring sources that raise and lower students' self-efficacy separately (Usher et al., 2018). Item V5, "I imagine myself working through challenging math problems successfully," was also removed because it cross-loaded onto the latent constructs that represent mastery experience and social persuasion. Item V7, "On math tests, I always try to do better than I have before," was removed because it cross-loaded onto the latent

Table 1

Global Fit Indices by Group for Confirmatory Factor Analyses of Study Variables

	Rural					Urban				
	n = 174					*n* = 1743				
Variable	χ^2	*df*	RMSEA	SRMR	CFI	χ^2	*df*	RMSEA	SRMR	CFI
General Math Self-Efficacy	14.91	14	.019	.016	.998	125.34	14	.068	.023	.975
Self-Efficacy for Self-Regulation	56.24	44	.040	.030	.986	262.72	44	.053	.030	.963
Sources of Self-Efficacy	302.56	203	.053	.048	.945	759.98	203	.040	.037	.958

Note. RMSEA = root mean square error of approximation; SRMR = standardized root mean residual; CFI = comparative fit index; Statistics presented are for the modified sources of math self-efficacy scale and sources of self-efficacy scale.

Table 2

Factor Loadings and Residual Variance of Indicators on Latent Variables

Indicator	Rural		Urban	
	Loading	Residual Variance	Loading	Residual Variance
General Math Self-Efficacy				
GSE1	.89	.20	.87	.25
GSE2	.90	.19	.87	.25
GSE3	.84	.28	.78	.40
GSE4	.85	.27	.77	.40
GSETEST1	.89	.20	.85	.28
GSETEST2	.86	.27	.85	.28
GSETEST3	.76	.41	.77	.40
Self-Efficacy for Self-Regulation in Math				
REG1	.81	.33	.73	.47
REG2	.75	.44	.72	.49
REG3	.88	.23	.84	.36
REG4	.83	.33	.73	.50
REG5	.89	.20	.80	.53
REG6	.83	.28	.71	.57
REG7	.78	.38	.68	.65
REG8	.81	.32	.65	.46
REG9	.71	.48	.59	.44
REG10	.81	.34	.74	.57
REG11	.79	.37	.75	.63
Mastery Experience				
M1	.78	.40	.77	.41
M2	.84	.30	.79	.38
M3	.74	.44	.59	.66
M5	.74	.44	.73	.47
M6	.89	.21	.80	.37
Vicarious Experience				
V1	.70	.50	.57	.68
V2	.63	.60	.56	.69
V3	.65	.56	.64	.59
V4	.67	.53	.64	.60
V6	.47	.82	.49	.76
Social Persuasion				
SP1	.74	.46	.65	.58
SP2	.64	.58	.69	.53
SP3	.76	.43	.76	.42
SP4	.79	.37	.79	.37
SP5	.81	.33	.79	.38

Table 2 (continued)

Indicator	Rural		Urban	
	Loading	Residual Variance	Loading	Residual Variance
SP6	.83	.31	.71	.50
Physiological State				
PH1	.76	.41	.75	.45
PH2	.73	.48	.61	.63
PH3	.81	.35	.82	.33
PH4	.76	.43	.78	.39
PH5	.64	.60	.67	.56
PH6	.88	.23	.74	.45

Note. Full item descriptions located in Table A1.

constructs that represent mastery experience, social persuasion, and physiological state. The two removed vicarious experience items ask about vicarious learning by visualizing oneself completing a task and competing with oneself. These items may not be developmentally appropriate for middle school students, and more recent measures of vicarious experience do not include vicarious learning from oneself (Ahn et al., 2017). Removed items were not included in further analyses. Factor loadings for the Sources of Self-Efficacy for Mathematics Scale ranged from .47-89 for the rural sample and .49-.80 for the urban sample.

Correlations between latent variables for each group are presented in Table 3 and varied in strength ($.32 \leq r \leq .76$). Correlations between mastery experience, vicarious experience, social persuasion, general math self-efficacy, and self-efficacy for self-regulation in math were statistically significant and positive. Correlations between negative physiological state and all other latent variables were statistically significant and negative.

Measurement Invariance of Scales Across Rural and Urban Samples

After confirming successful measurement models for each scale, I tested measurement invariance to assure that scale items were interpreted in similar ways by rural and urban students. Data from rural and urban students were combined into one dataset. A new variable, "locality," was created wherein rural students were coded as "0" and urban students were coded as "1." Following the method recommended by Kline (2016), I conducted multi-group CFAs with increasingly restrictive hypotheses about invariance and applied the criterion of a ≤ .010 change in the value of the CFI and a nonsignificant change ($p < .01$) in the chi-square value, as recommended by Cheung and

Table 3

Within-Group Correlations of Latent Variables

Variable	1	2	3	4	5	6
1. General Math Self-Efficacy	-	.76	.68	.55	.57	-.67
2. Self-Efficacy for Self-Regulation	.75	-	.51	.49	.45	-.32
3. Mastery Experience	.58	.50	-	.58	.72	-.67
4. Vicarious Experience	.38	.42	.54	-	.63	-.36
5. Social Persuasion	.51	.48	.74	.61	-	-.45
6. Physiological State	-.45	-.45	-.65	-.38	-.49	-

Note. All correlations are significant at the .01 level (2-tailed). Correlations for rural sample appear above the diagonal; correlations for the urban sample appear below the diagonal.

Rensvold (2002). Model fit statistics for each level of invariance for each scale are reported in Table 4. The hypotheses for both configural and weak invariance were tenable for the General Mathematics Self-Efficacy Scale, the Self-Efficacy for Self-Regulated Learning in Mathematics Scale, and the Sources of Mathematics Self-Efficacy Scale meaning that the overall constructs measured by these scales are understood in the same way by both rural and urban students. However, the hypothesis for strong invariance, which holds when item intercepts are the same across groups, was not tenable for any scale. Rejection of the strong invariance hypothesis can occur if there is a misunderstanding of a word or phrase in an item that makes participants respond differently based on group membership. It can also occur because of a social desirability response bias among one of the groups (Cheung & Rensvold, 2000; Gregorich, 2006).

To determine which items were being interpreted differently by rural and urban students, I examined the unstandardized intercepts for items of all scales. The items GSETEST2, “How confident are you that you can do a good job on important math tests?” and GSETEST3, “How confident are you that you can do a good job on the math section of the state standardized test?” from the General Mathematics Self-Efficacy Scale had the largest changes in unstandardized intercepts across groups, indicating that rural and urban students had different interpretations of these items. This could mean that either (a) students in these groups have differing ideas about what constitutes an important math test and the difficulty of the math section of the state standardized test, or, (b) that students in one group may respond to these questions differently because it is socially desirable to do a good job on such tests in that group. I freed the intercepts of

Table 4

Summary of Measurement Invariance Tests of Study Variables

Model	χ^2	*df*	$\Delta\chi^2$	Δ*df*	$\Delta\chi^2$ ***p***	CFI	TLI	RMSEA	SRMR
General Math Self-Efficacy									
Configural	157.23	28	-	-	-	.974	.960	.069	.022
Weak	165.66	34	8.43	6	.829	.973	.967	.064	.027
Strong	195.85	40	30.19	6	<.001	.968	.967	.064	.031
Partial Strong	179.35	38	13.69	4	.051	.971	.968	.062	.030
Partial Strict	175.91	43	3.44	5	.255	.973	.974	.057	.034
Self-Efficacy for Self-Regulation in Math									
Configural	324.34	88	-	-	-	.965	.956	.053	.030
Weak	348.68	98	24.34	10	.161	.963	.959	.052	.035
Strong	381.55	109	32.87	11	.001	.960	.959	.051	.039
Partial Strong	368.19	106	19.51	8	.062	.961	.960	.051	.037
Partial Strict	398.77	114	30.58	8	<.001	.958	.959	.051	.048
Sources of Math Self-Efficacy									
Configural		406	-	-	-	.957	.951	.042	.038
Weak	1129.64	424	32.15	18	.036	.956	.952	.042	.041
Strong	1190.43	446	60.79	22	<.001	.953	.952	.042	.044
Partial Strong	1159.08	443	31.35	19	.041	.955	.953	.041	.042
Partial Strict	1188.52	462	29.44	19	.018	.954	.954	.041	.044

Note. In order to attain partial strong and partial strict invariance for General Math Self-Efficacy, two intercepts were freed. To attain partial strong and partial strict invariance for self-efficacy for self-regulation in math three intercepts were freed. To attain partial strong invariance for the sources of math self-efficacy, three intercepts were freed.

GSETEST2 and GSETEST3 in the model, and found that the hypothesis for partial strong invariance was tenable (see Table 4).

After I examined the unstandardized intercepts of the Self-Efficacy for Self-Regulation in Mathematics Scale, I found that the item REG4, "How well can you remember information that is presented in math class and in your math textbooks?" and the item REG5, "How well can you get yourself to do math?" had the largest changes in unstandardized intercepts across groups. It is possible that REG4 was not interpreted equally between groups because the students use different textbooks and are presented with different material in their classes. REG5 could have been answered differently because of a social desirability bias or because of varying interpretations of what it means to "do math." Once the item intercepts of REG4 and REG5 were freed, the hypothesis for partial strong invariance was tenable.

The Sources of Mathematics Self-Efficacy Scale had three item intercepts that were freed in order to attain a tenable hypothesis for partial strong invariance. I freed the intercepts for item M1, "I do well on even the most difficult math assignments," item V4, "When I see how my math teacher solves a math problem, I can see myself solving the problem in the same way," and item V6, "I compete with myself in math," because they had largest differences in unstandardized intercepts from weak to strong invariance testing. Item M1 could have been answered differently across groups because of a difference in difficulty of math assignments between rural and urban students. Item V4 could have been answered differently because of a variation in teacher style between rural and urban schools. It is possible that item V6 was not interpreted in a similar manner because of a social desirability bias in either context that made students more likely to endorse competing with themselves.

The hypothesis for partial strict invariance was tenable for the General Mathematics Self-Efficacy Scale with items GSETEST2 and GSETEST3 freed, allowing for comparison of observed means across groups. However, partial strict invariance was not tenable for the Self-Efficacy for Self-Regulated Learning in Mathematics Scale or the Sources of Mathematics Self-Efficacy Scale. Because the strict invariance hypothesis was not tenable for all scales, latent means are compared in place of observed means.

Mean Differences Between Groups

Latent mean differences, standard errors, *p* values, and effect sizes are presented in Table 5. Rural and urban students had similar scores for all latent variables except for the Vicarious Experience subscale of the Sources of Mathematics Self-Efficacy Scale. Urban students scored 0.331 Likert scale points lower than did rural students on this subscale, indicating that urban students reported fewer instances of vicarious experience in math than did rural students. The effect size for this difference was .301. Although typically classified as "small," this effect size falls within the normal range in educational research due to the large variability in the larger populations (Coe, 2002).

Structural Equation Modeling

The primary aim of this study was to examine how the four hypothesized sources of self-efficacy were related to rural and urban students' math self-efficacy and self-efficacy for self-regulation in math. The hypothesized SEM model in which self-efficacy and self-efficacy for self-regulated learning in math were regressed on the four hypothesized sources showed acceptable model fit for rural students, $\chi^2(725) = 1141.44$,

Table 5

Latent Mean Differences

Variable	Mean Difference	Standard Error	Two-Tailed P-Value	Cohen's *d*
General Math Self-Efficacy	.051	.118	.669	.045
SE for Self-Regulation in Math	-.195	.128	.128	.189
Mastery Experience	-.211	.146	.149	.192
Vicarious Experience	-.331**	.118	.005	.301
Social Persuasion	-.082	.115	.474	.075
Physiological State	.095	.155	.540	.086

Note. Values use urban sample as reference group. For example, on average, urban students scored .051 points higher in general math self-efficacy than did rural students.
** $p < .01$.

CFI = .911, RMSEA = .057, RMSEA 90% CI: (.051, .064), SRMR = .054; and good model fit for urban students χ^2 (725) = 2174.71, CFI = .952, RMSEA = .034, RMSEA 90% CI: (.032, .036), SRMR = .034. All correlations, beta coefficients, and R^2 values are presented in Figure 1. Factor loadings and residual variances of items are presented in Table 2. For urban students, mastery experience (β = .538, p < .001) and negative physiological state (β = -.098, p = .019) were significant predictors of general math self-efficacy, and mastery experience (β = -.247, p = .003), vicarious experience (β = .138, p < .001), and negative physiological state (β = -.219, p < .001) were significant predictors of self-efficacy for self-regulated learning. For rural students, only mastery experience was a significant predictor of general math self-efficacy (β = .651, p = .001), and none of the sources were significant predictors of self-efficacy for self-regulated learning. However, the influence of other sources may have been muted by the small sample size of the rural group, and a few sources had large beta values and were approaching significance as predictors of self-efficacy. Vicarious experience was approaching significance as a predictor of general math self-efficacy (β = .294, p = .08) and mastery experience (β = .443, p = .058) and vicarious experience (β = .353, p = .064) were approaching significance as predictors of self-efficacy for self-regulated learning in math. Social persuasion was not a significant predictor of either math self-efficacy variable for rural or urban students.

Chapter Four: Discussion

The purpose of this study was to examine the development of students' math self-efficacy in rural and urban contexts. Three main findings emerged from this study. First, scales developed to measure motivation constructs may not carry equal meaning for

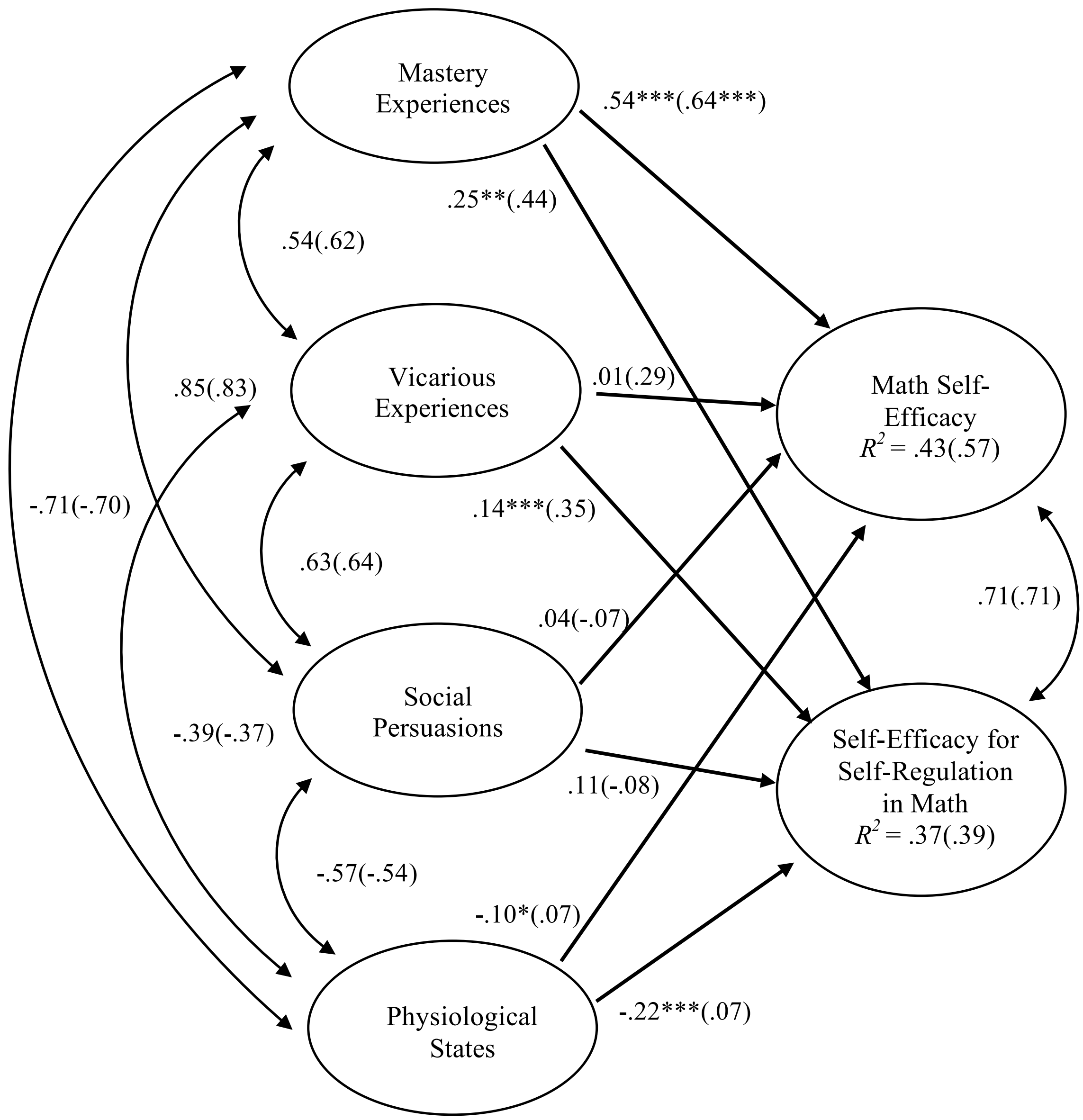

Figure 1. Modeled relationships between latent variables. Results for the urban sample are presented first, followed by results for the rural sample in parentheses. Factor loadings for items are presented in Table 2. All correlations and R^2 values are significant at the p ≤ .001 level.
**p* ≤ .05, ***p* ≤ .01, ****p* ≤ .001

students in rural and urban areas. Second, rural students appear to report greater exposure to vicarious experience than do urban students. Third, rural and urban students may rely on different experiences when developing their self-efficacy and self-efficacy for self-regulated learning in the domain of math. I discuss these main findings below.

Interpretation of Scales Across Groups

This study, through the use of measurement invariance, was able to show that rural and urban students interpret measures of self-efficacy and its sources similarly, but not identically. Hypotheses for partial-strong invariance were tenable for all measures in this study, and the hypothesis for partial-strict invariance was tenable for the General Mathematics Self-Efficacy Scale. This means that rural and urban students both conceptualize self-efficacy and its sources in similar ways, and that students in each group who are equally confident or who have similar experiences with the sources should score similarly using the response scale. However, because the strict invariance hypothesis was not tenable, un-modeled systematic effects on observed scores may still influence one group more than another (Kline, 2016). This finding signifies that the latent means of rural and urban students should be compared rather than the observed scores that remain subject to unknown systematic error. To my knowledge, this is the first study that used measurement invariance testing across rural and urban samples on measures of motivation. Future researchers examining motivation variables across rural and urban groups should exercise caution when determining whether it is appropriate to compare observed scores.

The Role of Vicarious Experience and Social Persuasion

After comparing latent means across groups, rural and urban students reported similar levels of math self-efficacy and self-efficacy for self-regulated learning in math. Reported mastery experience, social persuasion, and negative physiological state were also similar across groups. However, rural students, on average, scored significantly higher on measures of vicarious experience than did their urban peers. This finding is surprising considering some evidence that indicates rural students have fewer opportunities to encounter successful math models, such as proficient math teachers or professionals in math-related fields (Howley, 2003; Provasnik et al., 2007). Although rural students reported more exposure to vicarious experience than urban students, SEM analysis revealed that despite large beta values ($.294 \leq \beta \leq .353$) vicarious experience was not a significant predictor of students' self-efficacy or self-efficacy for self-regulated learning. This finding could be influenced by the small rural sample size or gender differences. Mixed methods research examining a larger sample from the same investigation of Central Appalachian students found that girls often reported social comparisons as something that made them feel less confident in math (Usher et al., 2018). Additional work is needed to determine if certain vicarious models are more influential than others in this unique rural context and if this influence varies based on gender.

Surprisingly, vicarious experience was a significant predictor of self-efficacy for self-regulated learning for urban students. This means that although urban students reported fewer vicarious experiences overall, those experiences played an important role in the development of their self-efficacy for self-regulated learning. This study provides preliminary evidence that exposure to self-regulated models could be an important component for the self-regulated learning of urban students.

Previous work has shown the important role of teacher support for rural students (Hardré, 2012). Central Appalachian students often report social persuasions when asked what makes them feel more or less confident in math (Usher et al., 2018). Surprisingly, rural students did not report significantly more social persuasions than their urban peers, and social persuasion was not a significant predictor of rural students' self-efficacy. As discussed in previous reviews (Usher & Weidner, 2018), more nuanced measures may be needed to identify the social models that students are referencing when they report social persuasion and vicarious experience. When provided with such measures, students have differentiated in how they interpret vicarious experience and social persuasion from parents, peers, and teachers (Ahn et al., 2015, 2017). Future studies may reveal that vicarious experiences and social persuasions from certain social models may be more influential than others for rural students.

Diverging Paths to Developing Confidence

Although rural and urban students reported similar levels of self-efficacy and self-efficacy for self-regulated learning in the domain of math, the sources of these beliefs varied across groups. Both rural and urban students relied heavily on mastery experiences to guide and shape their general math self-efficacy; this comes as no surprise considering the extensive body of work showing the power and salience of mastery experiences (Usher & Pajares, 2008; Usher & Weidner, 2018). As Bandura (1997) explained, few experiences have the ability to boost a student's belief in his abilities as gaining mastery over a difficult task. In study after study, mastery experiences continue to be the strongest predictors of students' self-efficacy across domains and age groups.

What is surprising, however, is the finding that neither mastery experience nor the other sources were significant predictors of rural students' self-regulatory self-efficacy. This finding could be a result of smaller sample size for the rural group or it could indicate that rural students rely on other, unmeasured influences when determining their self-efficacy for self-regulated learning. For example, qualitative work has revealed that in addition to direct experience and performance evaluation, factors such as teaching style and help availability can make Central Appalachian students feel more confident in math (Usher et al., 2018). The current study also did not account for possible combinatory influences from the sources. Perhaps because self-regulated learning is a complex process involving multiple skills, students rely on multiple sources simultaneously when deciding how capable they feel. This is evidenced by the fact that although the sources individually are not significant predictors, they account for almost 40% of the variance in self-efficacy for self-regulated learning.

Also surprising is the role of negative physiological state in predicting urban students' math self-efficacy and self-efficacy for self-regulation in math. Contrary to the hypothesis that rural students would be more affected by negative physiological state because of a broader negative attitude towards math seen in some rural communities (Corbett, 2009; Greenwood, 2009; Howley, 2003), physiological state did not predict rural students' self-efficacy. This contradicts findings from a larger study of Central Appalachian students which found that negative physiological state was a significant predictor of students' math self-efficacy (Usher et al., 2018). Other studies comparing rural and urban students have noted that urban students are more likely to have performance-oriented rather than mastery-oriented achievement goals (Freeman & Anderman, 2005). Freeman and Anderman (2005) hypothesized that this focus on performance could be driven by larger school funding structures, which increase competition between urban schools, but not rural schools. Some researchers have noted that competition in a classroom environment can alter the way students interpret the sources of self-efficacy (Lin, Fong, & Wang, 2017). It is possible that in a more competitive urban environment, anxiety and stress may play a larger role in determining students' self-beliefs in math. However, future research is needed to examine competition in rural and urban classroom contexts and its potential mediating effect on the sources of self-efficacy.

Conclusions and Implications for Teachers

The goal of this study was to begin to unravel the effects of one aspect of place, rurality, on the development of math self-efficacy. The results of this study provide preliminary evidence that living in a rural or urban place can influence the ways that students view their own abilities and how they interpret and value different experiences. Rural and urban students were similar in the ways they interpreted and responded to measures of self-efficacy and self-efficacy for self-regulation in math. However, there were some differences in how the sources influenced the development of their self-efficacy and self-efficacy for self-regulated learning in math. Urban students reported more sources as significant predictors of their self-efficacy including vicarious experience and negative physiological state. Rural students reported more vicarious experiences, but these experiences did not seem to play a role in predicting their self-efficacy. Teachers in both urban and rural contexts should focus on providing a classroom environment ripe with direct mastery experiences. Exposing students in rural and urban contexts to proficient math models through mentoring and field trips may provide valuable vicarious experiences that boost students' confidence in their ability. In urban contexts, teachers should also focus on reducing stress and anxiety in math classrooms that may negatively affect what students believe they can accomplish.

Overall, this study is an important addition to research in both social cognitive theory and rural education. It lays the groundwork for future studies examining environmental influence on self-efficacy development, as well as studies designed to assess the needs of rural and urban students.

Limitations and Future Directions

One major limitation of this study is the difference in sample size between the rural and urban samples. The urban sample in this study was almost ten times larger than the rural sample. Although it is reasonable to have smaller rural samples due to smaller rural populations, researchers should seek to gather larger samples of rural data when making comparisons across rural and urban groups. In addition, more research is needed to identify whether rural students across states and regions share this pattern of math self-efficacy development, or whether these differences vary based on the culture and characteristics of each rural community. Previous studies have noted that suburban students vary in their responses as compared to both urban and rural students (Provasnik et al., 2007). Researchers should consider adding suburban students as another comparison group.

Many demographic variables were not accounted for in this study such as gender, race/ethnicity, and socioeconomic status. Interactions between these variables and rurality could partially explain differences between rural and urban students. Researchers should continue to examine the influence of understudied demographic variables on self-efficacy development.

Previous scholars have called for qualitative work that clarifies and further explains quantitative findings on the sources of self-efficacy (Butz & Usher, 2015; Usher, 2009; Webb-Williams, 2017). Giving students a voice in explaining and expressing how they perceive their environment and efficacy-related experiences is an important next step for researchers in this area.

Finally, this study did not examine how the self-efficacy of rural students affected additional outcomes like student achievement or educational aspirations. Future researchers should build upon the model presented in this study and identify ways in which student self-efficacy and its sources influence the matriculation and success of rural students through high school and beyond.

Appendix A

Table A1

Full List of Scale Items

	Item	Code
General Math Self-Efficacy Scale		
	In general, how confident are you in your abilities in math?	GSE1
	How confident are you that you will do well in math this year?	GSE2
	How confident are you than you can learn math?	GSE3
	How confident are you that you will get an A in math this year?	GSE4
	How confident are you that you can do well on standardized tests in math?	GSETEST1
	How confident are you that you can do a good job on important math tests?	GSETEST2
	How confident are you that you can do a good job on the math section of the state standardized test?*	GSETEST3
Self-Efficacy for Self-Regulation in Mathematics		
	How well can you finish your math homework on time?	REG1
	How well can you finish your math homework on time?	REG2
	How well can you do math work in there are other interesting things to do?	REG3
	How well can you remember information that is presented in math class and in your math textbooks?	REG4
	How well can you get yourself to do math?	REG5
	How well can you participate in math class?	REG6
	How well can you arrange a place to do math at home where you won't get distracted?	REG7
	How well can you organize your math work?	REG8
	How well can you get help with math work if you need it?	REG9
	How well can you check over your math work to make sure it's correct?	REG10
	How well can you get back on track with your math work if you are distracted?	REG11
Sources of Mathematics Self-Efficacy		
Mastery Experience	I do well on even the most difficult math assignments.	M1

Table A1 (Continued)

	Item	Code
	I do well on math assignments.	M2
	I got good grades in math on my last report card.	M3
	Even when I study very hard, I do badly in math. [Removed]	M4
	I have always been successful with math.	M5
	I make excellent grades on math tests.	M6
Vicarious Experience	Seeing adults do well in math helps me do better in math.	V1
	Seeing kids do better than me in math helps me do better in math.	V2
	When I see how another student solves a math problem, I can see myself solving the problem in the same way.	V3
	When I see how my math teacher solves a math problem, I can see myself solving the problem in the same way.	V4
	I imagine myself working through challenging math problems successfully. [Removed]	V5
	I compete with myself in math.	V6
	On math tests I always try to do better than I have before. [Removed]	V7
Social Persuasion	My math teachers have told me that I am good at learning math.	SP1
	Adults in my family have told me what a good math student I am.	SP2
	Other students have told me that I'm good at learning math.	SP3
	People have told me that I have a talent for math.	SP4
	I have been complimented for my ability in math.	SP5
	My classmates like to work with me in math because they think I'm good at it.	SP6
Physiological State	Just being in math class makes me feel stressed and nervous.	PH1
	Doing math work takes all of my energy.	PH2
	I start to feel stressed-out as soon as I begin my math work.	PH3
	My mind goes blank and I am unable to think clearly when doing math work.	PH4
	I get sad when I think about learning math.	PH5

Table A1 (Continued)

	Item	Code
	My whole body becomes tense when I have to do math.	PH6

Note. * Name of standardized test removed for confidentiality.

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