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From Theory to Implementation: Examining EL Certification Requirements through the Lens of Local Context

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Abstract: With growing English learner (EL) populations enrolling in districts throughout the United States, educators must be trained to meet the needs of this culturally and linguistically diverse population. However, the approaches used to meet this growing teacher training need vary widely, with little available research on how different approaches impact student success. The current paper uses geospatial mapping to examine how states' EL teacher certification requirements are related to the academic success of English learners in those states. The results of this study suggest that state EL teacher certification requirements are related to student outcomes and that geographic location moderates those results. The geospatial mapping technique utilized in this study improves the accessibility of available data to the general population and policy makers.
Keywords: teacher certification; English learner; geospatial modeling; student achievement

De la teoría a la implementación: Examen de los requisitos de certificación de EL a través de la lente del contexto local

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Resumen: Con la creciente población de estudiantes de inglés (EL) que asisten a escuelas en todo Estados Unidos, los educadores deben estar capacitados para satisfacer las necesidades de esta población de diversidad cultural y lingüística. Sin embargo, los enfoques utilizados para satisfacer esta necesidad de capacitación docente varían ampliamente, con poca investigación disponible sobre cómo estos diferentes enfoques impactan el éxito de los estudiantes. Este artículo utiliza mapas geoespaciales para examinar cómo los requisitos de certificación de maestros EL de los estados se relacionan con el éxito académico de los estudiantes de inglés en esos estados. Los resultados de este estudio sugieren que los requisitos estatales de certificación de maestros EL están relacionados con los resultados de los estudiantes y que la ubicación geográfica modera esos resultados. La técnica de cartografía geoespacial utilizada en este estudio mejora la accesibilidad de los datos disponibles para la población en general y los responsables políticos.
Palabras-clave: certificación docente; aprendiz de inglés; modelado geoespacial; logro estudiantil

Da teoria à implementação: Examinando os requisitos de certificação EL através da lente do contexto local

Resumo: Com o crescimento da população de alunos de inglês (EL) que freqüentam escolas nos Estados Unidos, os educadores devem ser treinados para atender às necessidades dessa população cultural e linguisticamente diversa. No entanto, as abordagens usadas para atender a essa necessidade de treinamento de professores variam amplamente, com poucas pesquisas disponíveis sobre como essas diferentes abordagens afetam o sucesso dos alunos. Este artigo usa mapeamento geoespacial para examinar como os requisitos de certificação de professores de EL dos estados estão relacionados ao sucesso acadêmico dos alunos de inglês nesses estados. Os resultados deste estudo sugerem que os requisitos de certificação de professores de EL do estado estão relacionados aos resultados dos alunos e que a localização geográfica modera esses resultados. A técnica de mapeamento geoespacial utilizada neste estudo melhora a acessibilidade dos dados disponíveis para a população em geral e formuladores de políticas.
Palavras-chave: certificação de professores; aluno de inglês; modelagem geoespacial; realização do aluno

From Theory to Implementation: Examining EL Certification Requirements through the Lens of Local Context

Objective and Purpose

Teacher quality is consistently noted as a determining factor in predicting student achievement, particularly for populations such as English learners (ELs)[1] who have diverse

[1] The authors fully support additive approaches to language learning, which value students' diverse language backgrounds and support maintenance and development of students' native language(s) (e.g. Lambert, 1975; Cummings, 1986). As the language backgrounds of students can vary widely nationwide, terms such as English as a second language or emerging bilinguals do not accurately capture students for whom English may be a third or fourth language. Sadly, current educational practices in many local contexts do not support multilingual development. The term non-native English speaker unjustifiably privileges native speaker identity over more relevant measures of language proficiency (Lopez et al., 2013). Thus, the authors use the term English learner (EL) to broadly encompass a diverse demographic of students for whom English is not their native language and/or who meet the federal definition of English learners (U.S. Department of Education,

instructional needs (e.g. Ballantyne et. al., 2008; Loeb et al., 2014). As the public school populations in the United States become increasingly diverse, (NCES, 2020) and English learners' (ELs') academic progress in relation to native English speaking peers is closely monitored (e.g. Fry, 2007; Murphey, 2014; Spees et al., 2016), educators of the future must be well-prepared to provide the support needed to counter the opportunity gaps (e.g. Ladson-Billings, 2006) that culturally and linguistically diverse populations often encounter in school settings. However, states' approaches to addressing teacher preparation requirements, in response to changing student demographics vary, with little available research on how policies regulating teacher certification requirements impact student success. Requirements for educators to become state certified to teach English learners are particularly inconsistent both in terms of which teachers need specialized training to work with English learners and what competencies should be included in that teacher certification training (e.g., Ballantyne et al., 2008). The current paper aims to identify and describe relationships between states' EL teacher certification requirements and English learners' achievement in those states, as well as specifically examine the role that geospatial location plays in modifying those relationships. Given that specific EL demographics and teacher training needs are highly dependent on local context, the methodologies used in this study (i.e. Geographic Weighted Regression) represent an innovative approach to quantifying the correlations between such factors and EL achievement. Using geospatial mapping to represent these patterns and relationships also improves the accessibility of the data as compared to traditionally reported statistical analyses, thus leveraging the research to democratize the evidence.

Historical Perspective

The objective of a quality education for all students has been a national policy focus since the inception of the 1965 Elementary and Secondary Education Act (ESEA) and recent legislation (e.g. Every Student Succeeds Act, or ESSA, of 2015) has recognized the important role of teacher preparation programs, yet there is no nationally agreed upon policy for specific teacher certification requirements related to English learners. The initial versions of ESEA provided funding for schools with high concentrations of students from low income or special education backgrounds, as well as funding to help teacher preparation programs better prepare teachers to serve these students. As early as 1968, the law recognized the need for specialized training for teachers of ELs by providing funding specifically for these teachers, through the Bilingual Education Act. In 1974, Lau vs. Nichols determined that, in accordance with the Civil Rights Act of 1964, banning discrimination based on race, color, or national origin in any program or activity receiving federal financial assistance, districts had an obligation to provide meaningful education and language support to children who were acquiring English (*Lau v. Nichols*, 414 U.S. 563, 1974). As a result, schools and districts that receive federal funds under Title III of ESEA must submit a "Lau Plans" which outline, among other program components (identification, assessment, resources, transition criteria, and student performance), the school or district's plan to provide appropriate teachers and other personnel to serve the unique needs of language learners (U.S. Department of Education et al., 2000). The No Child Left Behind (NCLB) Act of 2001 required teachers who taught core academic subjects to English learners to be highly qualified in those academic subjects, but did not require training in or knowledge of English learner specific pedagogy. Rather, Title III of ESEA under NCLB only required that teachers of English learners be able to speak English and other languages

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2016), which refers to children who, among other criteria have "…difficulties in speaking, reading, writing, or understanding the English language [that] may be sufficient to deny the individual …. (i) the ability to meet the challenging State academic standards; (ii) the ability to successfully achieve in classrooms where the language of instruction is English; or (iii) the opportunity to participate fully in society." (p. 43)

of instruction fluently. The most recent ESEA reauthorization, the Every Student Succeeds Act (ESSA) of 2015, defers decisions related to minimum teacher certification requirements to the state level, while noting that programs must meet civil rights requirements defined under *Castañeda vs. Pickard* (1981) which, in part, requires that personnel be able to effectively implement a sound educational program for ELs. According to the U.S. Department of Education Office of Civil Rights' *Dear Colleague Letter* (2015), a sound educational program meets the following key three principles of the *Castañeda Test*:

> The educational theory underlying the language assistance program is recognized as sound by some experts in the field or is considered a legitimate experimental strategy; The program and practices used by the school system are reasonably calculated to implement effectively the educational theory adopted by the school; and The program succeeds, after a legitimate trial, in producing results indicating that students' language barriers are actually being overcome within a reasonable period of time. (p. 6)

While these principles are helpful in evaluating the structure of a program, they presume that trained and qualified educators are available to implement the program with fidelity. A lack of national certification requirements for teachers of English learners results in a vastly diverse set of requirements at the state level, causing variability in how EL programs and practices are implemented (e.g. Samson & Collins, 2012). States have alternately balanced producing high numbers of certified teachers very quickly via reduced requirements with requiring intense and lengthy coursework before certifying that a teacher is adequately prepared to teach English learners. This balancing act is the result of different policy approaches to addressing a well-documented need for more trained and certified EL teachers. In 2014-2015, 9.4% of public school students were English learners, with all but 15 states seeing an increase in EL population from 2004–05 to 2014–15 (U.S. Department of Education, 2017a, b). With this increase, a majority of states (39 in 2020-2021) and the District of Columbia report EL teacher shortages (U.S. Department of Education, 2020). The core question is how states' differing approaches to EL teacher certification impact student outcomes.

Quantitatively examining the academic performance of English learners as a specific subgroup is an emerging area of research that has been historically limited by both the definitions used to identify this subgroup and the availability of collected data that take into account the diversity of this subgroup (Saunders & Marcelletti, 2013; Thompson et al., 2017). The federal definition of English learners (U.S. Department of Education, 2016), refers to children who, among other criteria have

> …difficulties in speaking, reading, writing, or understanding the English language [that] may be sufficient to deny the individual …. (i) the ability to meet the challenging State academic standards; (ii) the ability to successfully achieve in classrooms where the language of instruction is English; or (iii) the opportunity to participate fully in society. (p. 43)

The U.S. Department of Education thus uses this definition when collecting data on the National Assessment of Educational Progress (NAEP) exam, which is the only comprehensive, standardized data currently available for valid analysis and consistent comparison of English learner

populations across the nation, despite some significant limitations[2]. The current study works within the limitations of the available data to highlight the need to examine the EL subgroup from a more nuanced perspective, looking in particular at the relationship between broad, statewide EL teacher certification requirements and EL academic achievement, while accounting for local, unique geographical context.

Framework for EL Teacher Skills and Knowledge

Extensive reviews of extant research have led to the development of research-supported guidelines for effectively educating English learners (e.g. Lucas et al., 2008; Markos, 2011; Menken & Antunez, 2001). Lucas and Villegas (2013) outline how pre-service teacher preparation programs can align a linguistically responsive teaching (LRT) framework (Lucas & Villegas, 2011; Lucas, Villegas, & Freedson-Gonzalez, 2008) to foundational tasks shown to prepare preservice teachers to become effective teachers over time (Feiman-Nemser, 2001). High impact tasks, such as a language immersion or 'shock' experience (i.e. Gort, Glenn, & Settlage, 2011), help preservice teachers develop the sociolinguistic consciousness that is needed to effectively teach culturally and linguistically diverse (CLD) students (Lucas & Villegas, 2013). As the authors state, these frameworks provide teacher preparation programs a guide for "...developing a coherent plan for preparing linguistically responsive teachers" (106). However, Lucas & Villegas (2013) also highlight the need for policies that support "...coherent, integrated systems of teacher preparation and development" (106). As the courses and content offered by teacher preparation programs are designed to meet state requirements for teacher certification, the first step to creating this coherent system is to examine how minimum state requirements for EL certification align with frameworks for linguistically responsive teaching. Building on the linguistically responsive teaching (LRT) framework outlined by Lucas and colleagues (Lucas & Villegas, 2011; Lucas et al. , 2008), the following section provides an overview of factors believed to impact teacher preparation and EL academic success.

Teaching Skills

High quality teachers can greatly impact student success. For a highly effective EL teacher, distinguishing between the effects of that teacher's EL specific training and their skills as an effective teacher in general, is a challenge. Some research suggests that specific EL certification and EL

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[2] Data collected by NAEP has a number of limitations, particularly in how the data collection process defines "English learners." NAEP uses the federal definition for English learners, which means that only English learners who are reported by districts as needing English language support services are labeled as such. Those English learners who have been able to exit from EL services because they have achieved high levels of English proficiency are grouped with native English speakers. This process effectively creates a subgroup of English learners whose academic skills may be masked by their developing English language proficiency. Recent efforts have examined the performance of "ever-ELs" (i.e. those students who have been classified as English learners at some point even if they have since been reclassified as former ELs), in comparison to their native English speaking or "never EL" peers (e.g., Kieffer & Thompson 2018; Wilde, 2010). Such studies find that this change in definition is important in examining differences in academic performance on NAEP and other measures because any differences in performance narrow or even becomes statistically non-existent for students who are former ELs, in comparison to their never-EL peers. This method of classifying English learners is currently not available in NAEP data, nor is it available in any other data collected consistently across all states, nationwide, an issue that merits additional attention in the field. Importantly, NAEP scores measure academic achievement regardless of language proficiency and the current study does not purport to make comparisons between native English speakers and "Ever-ELs." The current study compares the performance of ELs who are currently classified as requiring language support across different states.

teaching skills may not be as predictive of teacher effectiveness as other, more general teaching skills (e.g. Loeb et al., 2014). However, other researchers caution against assuming that "just good teaching" or general knowledge and skills are sufficient for EL teaching effectiveness (e.g., Bueno et al., 2010; de Jong & Harper, 2005). Lucas and Villegas' (2013) theoretical framework provides an example of how a more general framework of essential tasks for preservice teachers (Frieman-Nemser, 2001) are applicable to the EL teacher, though a targeted focus on developing sociolinguistic consciousness, language analysis skills, and scaffolding strategies specific to the needs of ELs is needed to successfully support EL learning. Thus, previous research suggests that adding specialized training in EL specific methodologies to a strong foundational preparation in general teaching methodologies is necessary to maximize EL potential success.

Teacher Attitudes and Advocacy Tendencies

There is a large body of evidence supporting the impact of teacher training on teacher beliefs and attitudes about students, specifically finding that teachers who lack training related to working with diverse students have more negative opinions about them and less confidence in their abilities to effectively teach such students (e.g., Gandara et al. 2005; Harper & de Jong, 2009; Olson & Jimenez-Silva, 2008; Sugimoto et al., 2017; Tran, 2015). Teachers' beliefs and attitudes about students' potential can, in turn, affect student attitudes and performance, with more negative beliefs and less confidence in teachers' own abilities resulting in lower student performance (e.g., de Boer et al., 2010; Goddard et al. 2000; Ulug et al., 2011). Lucas and colleagues (2008, 2011) specifically cite the importance of teachers' awareness of their need to advocate for their students and willingness to actively pursue political, social, and educational changes that support inclusive opportunities for their ELs.

Cultural Knowledge

In addition to teachers' general feelings of self-efficacy, their understanding of diverse cultures and ability to integrate that knowledge into teaching can impact their ability to effectively teach linguistically and culturally diverse students (e.g., Choi, 2013; de Jong & Harper, 2005). High levels of sociolinguistic consciousness, and the connection between culture and identity, provide a foundation for creating a welcoming classroom and delivering culturally responsive instruction (e.g. Lucas & Villegas, 2011). Increased exposure to intercultural experiences and training in culturally responsive pedagogy can positively impact teachers' perceptions of ELs and reduce negative or prejudicial attitudes (e.g., Mellom et al., 2018; Youngs & Youngs, 2001).

Language Knowledge

Knowledge of language development and linguistics is consistently recognized as important in preparing EL teachers, though there are vastly different perspectives regarding what is considered sufficient knowledge of language structure and development. Typically, these differences center around three key topics: understanding linguistic theory, applying linguistic knowledge in a teaching context, and demonstrating significant experience learning another language. An understanding of linguistics, including structural and developmental patterns across languages, has been shown to be critical to the academic success of English learners (Menken & Antunez, 2001). Many errors that ELs make can be attributed to typical language development, or can be analyzed in the context of innate patterns in universal language. Teachers who are unaware of such traits or patterns may attribute errors to other causes, from a deficit perspective. Such approaches can result in misidentification for special education services or lowered expectations (e.g. Umansky et al., 2017). There is also evidence that teachers who show a monolingual bias may engage in subtractive approaches to language acquisition and linguicism (e.g. Menken & Kleyn, 2010; Phillipson, 2016).

Linguistically responsive teachers (LRTs) value and support linguistic diversity in the classroom and outside the classroom (Lucas & Villegas, 2011; Lucas et al., 2008). Indeed, Lucas and colleagues place particular focus on how effective LRTs apply knowledge of key principles of second language acquisition to identify language demands in classroom tasks and scaffold instruction to support the academic and linguistic backgrounds of their students (2011, 2008). This approach is supported by the performance-based *Standards for Initial TESOL Pre-K–12 Teacher Preparation Programs* developed by the TESOL International organization and used by the Commission for the Accreditation of Educator Preparation (CAEP) to assess and accredit programs that prepare and license PreK–12 EL educators (CAEP, 2017; TESOL, 2019). These TESOL standards outline specific areas of linguistic knowledge that effective EL teachers should possess, as measured through assessments related to lesson design and delivery.

Another important consideration when training teachers in the area of language development is the positive impact of teachers' personal experience learning another language. A growing body of research supports the benefits of learning another language for teachers of English learners (e.g., Loeb et al., 2014; Rader-Brown & Howley, 2014; Shin, 2008; Tellez & Waxman, 2005; Youngs & Youngs, 2001). Learning another language increases teachers' empathy for the language learning process, as well as supports their understanding of typical language development, both of which may lead to higher expectations and outcomes for English learners in their classrooms. In lieu of extensive language learning opportunities, Lucas & Villegas (2013) suggest that preservice teachers should be engaged in tasks that support self-reflection on their "preconceptions about ELL students, language diversity, and the role of languages other than English in schools" and cultivate an "awareness of language as a focus of analysis" among other goals related to the field of linguistics and sociolinguistics (p. 103).

Practicum Experiences

Teachers' skills, in general, develop rapidly when given a chance to apply them in the field (e.g., Harris & Sass, 2011; Papay & Kraft, 2015; Zeichner, 2010), such as through a practicum experience. However, some evidence suggests that teachers' feelings of self-efficacy can actually decrease following a practicum (e.g., Atay, 2007). Atay (2007) suggests that this decrease in self-efficacy could be related to teachers' overconfidence before entering the field and their increased awareness of weaknesses following their field experiences, highlighting the complexity associated with trying to determine best practices associated with EL teacher preparation.

In sum, teacher skills and attitudes are influenced by their opportunities to develop cultural and linguistic knowledge, either through extensive coursework or field-based practicum experiences. It is important to consider how such rigorous levels of preparation are reflected in state-wide EL certification requirements, before examine the impacts that these policies may have on local districts and schools, whose EL population demographics and needs may differ by geographic location.

State Approaches to EL Teacher Certification

As population characteristics change, policy innovations related to affected populations are required (Jackson, 2009; Portes & Smagorinski, 2010). In the case of teacher certification, the P-12 student demographic shifts require an accompanying shift in the requirements related to preparing teachers to teach culturally and linguistically diverse students. As of fall 2017, 10 states reported that 10% or more of enrolled public school students were ELs, while the majority of states, including the District of Columbia, have seen steady increases in EL population since 2010 (NCES, 2020). Importantly, these increases in EL populations are unevenly distributed across local school districts. While some districts have high concentrations of English learners, other districts are considered

"low-incidence" districts (where less than 5% of the total students enrolled in the district are ELs). The percentage of districts that have high concentrations of ELs and the patterns of districts that are classified as "low incidence" are geographically dependent, differing across and within states (U.S. Department of Education, 2017a). However, minimum EL certification requirements are determined primarily at the state-wide level. Thus, a nuanced examination of the relationship between state-wide EL teacher certification requirements and EL achievement, while accounting for geographic location is needed.

Previous research related to EL teacher preparation requirements have often focused on state-wide populations with large and established EL populations who speak Spanish, the most common native language for ELs in the United States (e.g. Lopez et al., 2013). Emerging EL growth across the nation and even across individual school districts, however, is accompanied by a much more diverse and localized set of needs in terms of both language and educational background. For instance, the National Center for Education Statistics (2020) reports that the number of native speakers of Swahili, Nepali, and Karen more than quadrupled from 2008 to 2017, while some estimates indicate that as many as 10% of English learners qualify as students with limited or interrupted formal education (SLIFE) backgrounds (Potochnick, 2018). These emerging populations are often concentrated in specific regions. Thus, the preparation that teachers need in order to successfully support their diverse students who are acquiring English as an additional language may differ by geographic location. The current study seeks to determine what relationships exist between certification requirements for EL teachers and EL achievement, at the local level. However, in order to identify what these relationships may be, a clear definition of "EL teacher certification" is required.

Individual states determine teacher certification requirements and define what "type" of EL certification is possible to earn in a specific state (Every Student Succeeds Act or 'ESSA', 2015). There are three distinct patterns in state approaches to which teachers are required to be certified to teach ELs: 1) require all teachers to become fully certified to teach ELs, 2) require all teachers to complete a minimum level of coursework related to ELs (but not full certification), or 3) only require teachers in a specifically designated EL position to pursue EL coursework or certification. In some states, particularly states with large populations of English learners, all teachers who have one or more English learners in their class must be fully EL certified (e.g. California; CDE, 2020). In a high incidence state such as California this results in the majority of teachers becoming EL certified. In other states, with lower incidence populations, all teachers may be required to take limited EL related coursework (i.e. an EL specific course, or a course that addresses EL needs within the course objectives), though full EL certification is only required for a subset of teachers who wish to specialize in working with English learners[3]. Another complication for defining "EL certification" is that while most states offer some version of an EL-specific teaching credential as described above, the pathway to this credential varies (Sandy, 2006). Some states require numerous hours of academic coursework to earn some version of "EL teacher certification" (e.g. Missouri), other states only require a passing score on standardized tests (e.g. Kansas), and still other states require both coursework and a passing score on a standardized test (e.g. Indiana). As a first step in examining impacts of EL certification requirements on student outcomes, the analyses for the current project focus on the minimum requirements mandated by each state in order to earn a teaching certificate that is specifically designed to address the needs of English learners, regardless of the title of the certificate in a given state. Importantly, this research is focused on examining *what* the minimum

[3] The context in which EL certified teachers work varies by state, district, and even at the school level, and is beyond the scope of this paper. These contexts can include dual language, bilingual, co-teaching, sheltered instruction, push-in, pull-out, and co-teaching settings, among others (see Lopez & Santibañez, 2018).

requirements for EL certification are, at the state level, not *who* is required to pursue EL certification. The teachers that choose to pursue this locally defined "EL teacher certification" may include mainstream teachers who are seeking additional certification in teaching English learners[4] or teachers whose primary role is to work with English learners[5]. This work builds on and adds nuance to equally important analyses that examine EL related training that the some states require, to differing degrees, of all certified teachers in a given state (e.g. Lopez et al., 2013).

The Role of Geographic Location

The effects of geographic location on student achievement are complex. Teachers tend to teach near their teacher preparation programs and in the districts in which they completed their student teaching (e.g., Goldhaber et al., 2017; Krieg et al., 2016). While there are many benefits to teachers who have intimate knowledge of their school communities and students, this pattern can limit teachers' understanding of surrounding communities and can be particularly limiting in areas of rapidly changing demographics. Teachers in states with dichotomous concentrations of homogeneous rural and more diverse urban populations can face particular challenges in educating English learners due to lack of previous exposure to diverse populations (Walker et al., 2004). The current project aims to explore the potentially differential impacts of state-wide EL certification requirements on the academic achievement of local EL populations, given the influences of geographic location on the demographics of local teacher populations[6].

In sum, frameworks such as those provided by Lucas and colleagues (2013, 2011, 2008) highlight a series of components that strengthen the preparation of teachers of English learners. These components include productive, asset-based beliefs about ELs and teacher feelings of self-

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[4] It is important to note that, in many states, if the mainstream teacher also has an EL specific certification, a state may determine that ELs in that teacher's classroom do not need additional services from an EL specialist because it is presumed by the state that the mainstream teacher's training is sufficient to meet the EL's specific needs as allowed under ESSA (2015). Thus, the current project examines the EL specific certification requirements, regardless of the core role of the teacher who is pursuing that certification.

[5] The definition of which teachers (i.e. EL specialists, mainstream, dual language, and/or bilingual teachers) are required to become EL certified varies by state (Lopez & Santibañez, 2018). Additionally, the state requirements for districts to hire teachers who are EL certified differs by state (as allowed by ESSA). For instance, in some low incidence districts, there may be no officially EL certified teachers required in the district, though teachers may be required to complete some other form of EL professional development. For example, Missouri does not require a district to have an EL certified teacher if the district serves less than 20 ELs (DESE, 2018), though the teachers working with the EL students must have some EL specific professional development. Such approaches are likely contributing factors to research that finds that some EL training for all teachers improves EL outcomes (e.g. Lopez et al., 2013), though states still differ greatly in whether or not they require all teachers to receive EL specific training. Thus, the current project focuses, first, on a level of EL related training that does exist in every state – all states have some type of EL specific teaching certificate which is intended to prepare teachers who specialize in teaching ELs. As some policy makers may consider this approach to be sufficient in addressing EL needs, research is needed to determine how successful this minimum level of certification is, at the local, state level. Further research will build on these findings to explore additional factors that may affect outcomes at the local level.

[6] For some states, the recognition that teachers need training related to English learners is still relatively new. In a comprehensive review of EL teacher training requirements, Ballantyne, Sanderman, and Levy (2008) found that 15 states had no requirement of any kind related to training all pre-service teachers to address the specific needs of ELs. Given the recency in which some states have implemented EL specific training for all teachers, the current project focuses specifically on the requirements related to the more established practice of specialized EL teacher certification. Future research will address the important practice of preparing all teachers to teach English learners.

efficacy, knowledge of language development and acquisition, ability to apply culturally relevant and linguistically supportive pedagogy, ample field experiences with English learners, and preparation relevant to specific geographic location. Each of these factors will be examined in the current study, in relation to their ability to predict EL academic performance.

Data Sources and Methods

Research Questions

While there is ample research related to the skills and knowledge needed to effectively teach English learners, little research has directly examined how EL teacher certification requirements aligned to those skills and knowledge are related to the academic outcomes of English learners at the local level. The role of geographic context provides additional nuance that not only fills a gap in the field, but is also essential given state local control over teacher certification policies as established by ESSA (2015) and the vast diversity of English learners at the state, county, and district levels.

Lopez, Scanlon, and Gundrum (2013) examined the role of teacher certification requirements on 4th grade Hispanic English learners' reading outcomes on the National Assessment of Educational Progress (NAEP). They found that some areas of individual coursework, specifically coursework in language development and assessment were positively related to higher NAEP scores at the state level. They also found that states that required some EL related training for all teachers, in addition offering a specialized certification to teach English learners, led to higher achievement scores. López & Santibañez (2018) further recognized the role of local context (with a focus on Arizona, California, and Texas), finding that certification requirements that reflected identified best practices in the field led to improved teacher self-efficacy and improved academic outcomes for emerging bilinguals. The current project builds on this foundational research by specifically considering the role of the local context across the nation when examining relationships between teacher certification requirements and student achievement.

Lopez and colleagues (2013) focused their analyses on Hispanic ELs which limits the ability to apply the results to geographically diverse contexts given the linguistic and educational diversity of EL populations across states and counties. Expanding the definition of EL to include all English learners provides a full scope of the impact of teacher certification requirements on EL outcomes, which can then be explored at the local and subgroup levels in future research projects. Additionally, recently states have begun to add an option for teachers to earn an EL specialist certification based solely on a passing score on a state designated standardized assessment that measures EL knowledge and skills, without requiring any EL specific coursework. The impact of this popular pathway, often used by teachers or districts to expedite the EL certification process in order to fill staffing needs, was not specifically addressed in previous studies. The current study will specifically examine impacts of this 'test only' option, in comparison with certification options that require EL coursework. Finally, using Geographic Weighted Regression (GWR) in addition to the Ordinary Least Squares (OLS) analyses in the current project provides an opportunity to demonstrate whether GWR results in a better fit for each model, thus giving additional nuance to the data by helping to identify significant patterns in the data that differ by geographic location.

This research was driven by three research questions: (1) Are there geospatial patterns in requirements for certification to teach English learners (ELs)? (2) Do these state requirements correlate with EL achievement by state? (3) Does including the geospatial weight improve model fit?

Data Sources

In order to answer these questions, we collected data on how states certify EL teachers as well as EL achievement by state. To collect data on EL teacher certification requirements by state we consulted state education department websites and contacted state departments of education, coding the requirements based on the factors in Table 1. Because many states have a variety of types of EL certification, we used the type or level of certification with the fewest requirements needed to specifically work with ELs that still met the standard of traditional (rather than alternative) certification. Because many of these variables are binary conditions (i.e. coursework required or not required; only a test required) these variables were coded as dummy variables with a binary condition of 0 or 1. Each of these conditions was mapped to show the patterns of the variables across the country, with large variability observed.

We then obtained EL achievement data on the National Assessment of Educational Progress (NAEP) exam from the U.S. Department of Education. Using the NAEP data presents some inherent limitations for this study that are widely associated with national standardized testing.[7] We decided to use these data, while acknowledging the limitations, because the data enabled us to avoid differences in state-administered tests, improving consistency in the reliability and validity of the test results between and amongst states. Additionally, the NAEP exam is one of the only nationally-normed tests that identifies and collects data on ELs. We chose to use fourth- and eighth-grade English Language Arts and Math measures because those data are widely reported and encompass the greatest amount of the diversity of EL populations including ELs who enter U.S. public school in later grades or require additional time and EL support before being able to exit out of EL programs (e.g. 'long-term ELs' (U.S. Department of Education, 2016) – those English learners who are in an EL program for six or more years).

Variables

Dependent Variables

Our dependent variables were NAEP scale scores collected nationally for the 2018-2019 academic year. We used scale scores to avoid the artificial cut points associated with categorization of achievement scores, and we were able to pull data disaggregated by ELs from the NAEP website.

Independent Variables

Our independent variables were identified from the extant literature and were defined using the most up-to-date information available as of Spring 2019. We first identified three categories of certification requirements: states requiring only a test (TEST ONLY), states requiring only coursework (COURSEWORK ONLY), and finally states requiring coursework and a certification test (COURSEWORK & TEST). These three categories emerged organically through the data collection process, whereby all states fit into one of these categories.

Great variability in EL teacher certification requirements was observed by state, with some states offering multiple options for certification. When a state offered multiple pathways, we chose to identify the least restrictive option, i.e. if a state offered an option to take coursework, or to obtain a passing score on a test to become certified, the state was classified as TEST ONLY. We elected to do this based on the idea that the *minimum* requirements for obtaining certification to teach ELs was the focus of our research question and a pathway that many teachers choose for a variety of financial, personal, and professional reasons. As the literature review demonstrates, *additional* professional development is strongly linked to EL achievement, so we can assume that

[7] These issues are discussed more fully in the limitations section at the end of this paper.

more requirements would be correlated with higher test scores. By categorizing states based on the minimum requirements, we wanted to capture whether those requirements were correlated with higher or lower achievement. This information could also then be used to set a baseline for certification requirements—i.e. allow state policymakers to understand how those minimum requirements impact EL outcomes.

We then collected data based on which courses were required in the states that required coursework in order to obtain EL teacher certification (i.e. COURSEWORK ONLY and COURSEWORK & TEST). There were several challenges in the collection of these data. First, the state requirements were not easily accessed for many states. We began first with the state department of education websites and looked for certification requirements, and particularly for a course matrix that defined course-level expectations for learning. From there, there were 19 states that did not list course requirements with the certification requirements, so we contacted each remaining state department of education via email and phone call and inquired about the requirements. Many states allowed individual teacher preparation programs to define what specific coursework fulfilled the state requirements, so we also contacted universities to obtain programs of study to elucidate these requirements. We then categorized these requirements by the *content area competencies* identified in the literature as key to EL praxis (see Table 1). At each decision point in the data categorization process, if the *content competencies* were mentioned in the required coursework documentation we collected, we noted this topic area as required (coded as "1"). As a result, multiple *content area competencies* could be included in a given course. This helped us to maintain consistency in our decision making at each stage, by using the lowest possible threshold for traditional EL certification allowed by each state. This process also allowed us to capture greater variability between states and to examine the nuance of requirements beyond required credit hours.

Table 1

EL Content Area Competencies

Content area competency	Number of states requiring competency	Abbreviation
EL methods	33	Methods
EL assessment	30	Assessment
Linguistics	31	Linguistics
Language and culture	22	Culture
Sociolinguistics	14	Sociolinguistics
EL policy	12	Policy
Second language acquisition	9	SLA
Psychology of the exceptional child	16	Psychology
Literacy foundations	10	Practicum

Table 1 cont.

EL Content Area Competencies

Content area competency	Number of states requiring competency	Abbreviation
Second language experience	16	Experience
Second language exam	9	Exam
Other second language requirement	3	Other
Second language course hours	2	L2 hours
Total credit hours required	33	Hours
Test pass score	17[a]	Score
Only test required[b]	11	Test only
Only coursework required[b]	27	Courses only
Test and coursework required[b]	6	Coursework and test

Note: [a]States requiring a test, with or without coursework. Pass scores were different for each state. [b]For EL certification.

The data collection process was inherently evaluative as the variance in state requirements, state reporting, and university autonomy were demonstrated throughout the process. We found significant geospatial variation in how these requirements are distributed across the country (See Table 1). Describing the political processes by which state certification requirements are codified by state boards and departments of education, as well as how they are interpreted and implemented by teacher preparation programs is beyond the scope of this project. However, given the extreme variability uncovered through this data collection process, further research on these issues is warranted.

Methods

Variable relationships were defined and tested using Geographic Weighted Regression (GWR) as well as Ordinary Least Squares (OLS) regression, and the two models were compared for goodness of fit. Because we were particularly interested in the impact of including the geospatial weight, we ran GWR and OLS for each model, then examined the R^2 and AIC(c) criteria for each model to determine goodness of fit. This allowed us to not only look for significant correlations, but also to better understand how well the model described the correlations. Once these analyses were completed, local R^2 values and statistically significant beta coefficients from the GWR were given spatial perspective by mapping them with ArcMap (ESRI, 10.7). ArcMap is a geographic information system (GIS) software that spatializes data to produce maps and analyze spatial relationships. By creating models for each independent variable, we were able to look for confounding and moderating variables, which led us to a better model fit for each individual independent and dependent variable. Using this new technique to build on previous research helps us to better elucidate the spatial dependence of variable relationships related to teacher certification

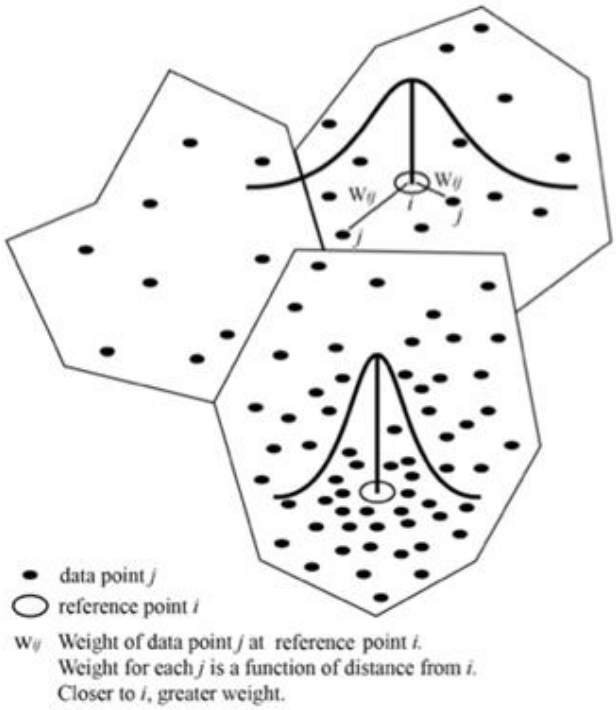
requirements in different states. That is, if adding spatial relationships into the models improves model fit, this indicates that geographic location influences those relationships.

Geographic Weighted Regression (GWR)

GWR reflects geographically clustered data as a continuous spatial pattern. One of the assumptions of regression analysis is that the observations are independent of one another. When examining state-level data, however, we know that populations are not constrained by state borders; states nearest to one another should be most alike in terms of EL student population (as compared to EL populations in distant states). This is based on Tobler's first law of geography (Miller, 2004): "Everything is related to everything else, but near things are more related than distant things," (p. 284). With spatially autocorrelated map distributions, however, units are spatially dependent by definition (Meade & Emch, 2010). Similarity based on geographic location is best represented on a continuum, without strict differences based on geographic boundaries such as state or district lines. The nature of these relationships is estimated by GWR, which creates a geographic weight for each state using a spatial kerning process illustrated in Figure 1 below. These models show that spatial relationships vary across the United States. Creating a map using Geographic Information Systems (GIS) provides an opportunity for analysis of whether variable relationships change as a function of location. A geographic variation in the regression relationships is referred to as "nonstationarity" (Fotheringham et al, 2002), meaning that relationships that are significant in one region may not be significant in another part of the country. Unlike in multi-level analysis, the coefficients in GWR are not random, but are a direct function of their spatial location as determined by the geographic weights (Fotheringham et al., 2002), so the importance of place is accounted for in the model.

Figure 1

Spatial Kerning



Source: (Meade & Emch, 2010)

Data Analysis

GWR uses a spatial kerning process to weight data points according to their proximity to a specific location. Data points closer to the specific location are more heavily weighted than more distant points, and through this process of differential weighting by location, GWR calculates an optimum number of "nearest neighbors." These "nearest neighbors" are then used to derive each local regression coefficient. Through this process, GWR modifies the standard regression equation to include a geographic weight (u_i, v_i). Incorporating geographic weights, the regression equation for GWR is: $y= b_0(u_i,v_i)+ b_1(u_i,v_i)x_{i1}+b_k(u_i,v_i)x_{ik}+e$

A local regression equation is computed for each state based on the data from that state and the group of its nearest neighbors, thus demonstrating the strength of correlation for the states when accounting for nonstationarity. These local regression coefficients are then used to calculate the global R^2, demonstrating the goodness of fit. The significance calculations, however, use the local coefficients to demonstrate whether the correlation is, in fact, a significant finding.

For the current study, the relationship between each variable and the NAEP scale scores for fourth grade math and reading as well as eighth grade math and reading for each state was calculated separately using GWR. Like traditional OLS regression, GWR produces R^2 and adjusted R^2 values, both of which measure goodness of fit. The R^2 value varies from 0.0 to 1.0, where higher values are preferred. The coefficient is interpreted as the proportion of variance accounted for by the regression model. In GWR, the degrees of freedom is a function of the bandwidth so the adjustment may be substantial in comparison to a global model like OLS. For this reason, the Akaike Information Criterion (AICc) is preferred as a means of comparing models. The AICc is a measure of model performance and can be useful when comparing different regression models. The model with the lower AICc value provides a better fit to the observed data. This is not an absolute measure of goodness of fit, but is useful for comparing models with different explanatory variables as long as they apply to the same dependent variable. If the AICc values for two models differ by more than 3, the model with the lower AICc is considered to have a better fit. Comparing the GWR AICc value to the OLS AICc value is one way to assess the benefits of moving from a global model (OLS) to a local regression model (GWR) as well as to compare the fit of different regression models. Because we were interested in looking at a large number of certification criteria, this was particularly beneficial for understanding how correlations between the different certification requirements and different outcome measures vary based on whether an OLS or GWR model was used, and also helped us compare model fit between independent variables. This improved model fit indicates that using GWR can provide a better explanation of the correlations observed here, as compared with traditional OLS models.

For the study conducted here, R^2 values and beta coefficients relationships were calculated first using SPSS and then ArcMap software. Significant GWR models were mapped with ArcMap GIS software to show variation in local regression models across the country. In order to control for the high family-wise Type I error rate, the Benjamini-Hochberg correction for multiple comparisons was applied (Thissen et al., 2002). We chose to include the beta coefficients in the final maps because of their usefulness in interpreting the directionality of the relationship. If the beta coefficient is positive, the interpretation is that for every 1-unit increase in the predictor variable, the outcome variable will increase by the beta coefficient value. Similarly, if the beta coefficient is negative, for every 1-unit increase in the predictor variable, the outcome will decrease by the beta coefficient value. This means that for positive correlations, test scores go up and for negative they go down, showing the direct correlation between the certification requirements and EL outcome measures. While school composition research makes clear the important role that geographic location has on academic outcomes, GIS and, particularly GWR have not been widely used to

examine education related outcomes, particularly as related to ELs. By using a GWR model that includes location, and offering a different analytical lens, the current research attempts to exhibit some of the nuances that exist in studying factors that impact achievement scores and policies related to teacher certification requirements. The comparison of model fit allows us to further elucidate the additive nature of including geographic weights in these regression models.

Results

To answer the three research questions posited above, we analyzed each independent variable and dependent variable and then mapped the statistically significance relations, which are reported below (See Table 2). To preview the key results, we found a significant, negative relationship between NAEP scores and states that only require a passing test score to obtain an EL certificate. In contrast, we found significant, positive relationships between NAEP scores and states that required coursework in addition to a passing test score. We also found significant relationships with specific types of required coursework, outlined in more detail below. Importantly, we found that many of these relationships were moderated by geographic location. Such spatial dependencies are best represented visually, through maps, which are included in with the results reported below. There are two types of maps provided. With each set of results, the first map represents model fit using R^2 values, showing how much of the variance in the data is accounted for in the model, according to geographic location. The second map for each set of significant results shows how specific states influenced those significant results.

Table 2

Statistically Significant Models

Explanatory variable	NAEP Test Grade / Subject	Global R^2 value (GWR)	AICc (GWR)	Adj. R^2 (OLS)	AICc (OLS)
Test only	4th Math	0.12	316.88	0.09	298.64
Test only	4th Reading	0.17	348.66	.016	342.22
Test only	8th Math	0.14	341.19	0.13	335.79
Test and courses	4th Math	0.08	312.54	0.08	307.43
Test and courses	8th Math	0.11	273.62	0.10	255.06
Methods	4th Math	0.13	310.25	0.12	290.03
Methods	8th Math	0.10	273.11	0.10	267.67
Assessment	4th Math	0.14	303.11	0.11	291.94
Assessment	4th Reading	0.19	334.28	0.18	327.55
Culture	4th Math	0.14	309.08	0.12	299.71
Culture	4th Reading	0.21	340.09	0.20	331.11

Test Only

Statistically significant models were found for TEST ONLY states for fourth grade reading and math (Figures 2-7 below). The *t*-statistic for these relationships was negative, indicating that if a state does require only a test for EL certification, student test scores are correspondingly lower. Local R^2 values ranged from near zero to 0.23, indicating that as much as 23% of variance could be explained by only requiring a test to obtain EL certification in those states. The models for each

grade and subject have distinct similarities for this variable, with the primary difference that there are many more null values in the NAEP reporting for the eighth grade models.

Figure 2

Local R^2 values, fourth-grade math NAEP and TEST ONLY

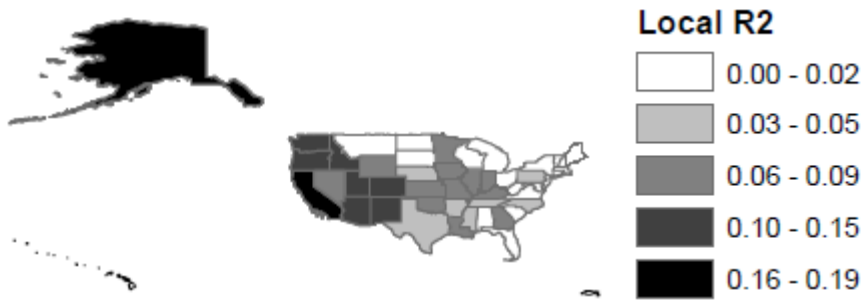


Figure 3

t-test statistic and significance by state, fourth-grade math NAEP and TEST ONLY

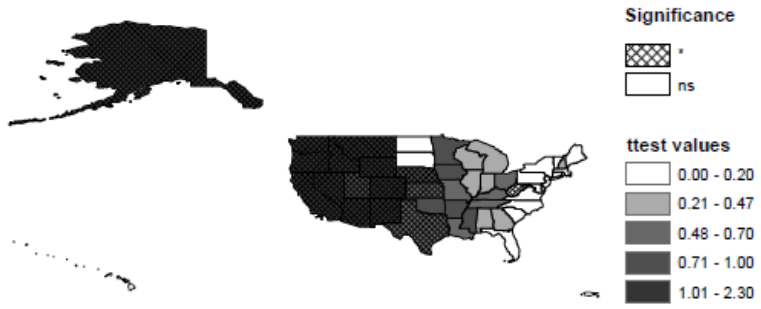


Figure 4

Local R^2 values, fourth-grade reading NAEP and TEST ONLY

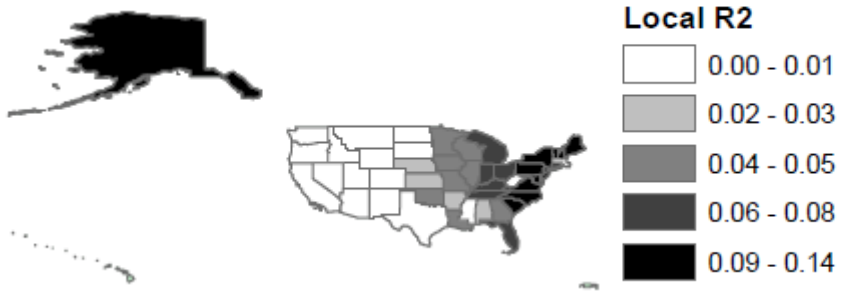


Figure 5

t-test statistic and significance by state, fourth-grade reading NAEP and TEST ONLY

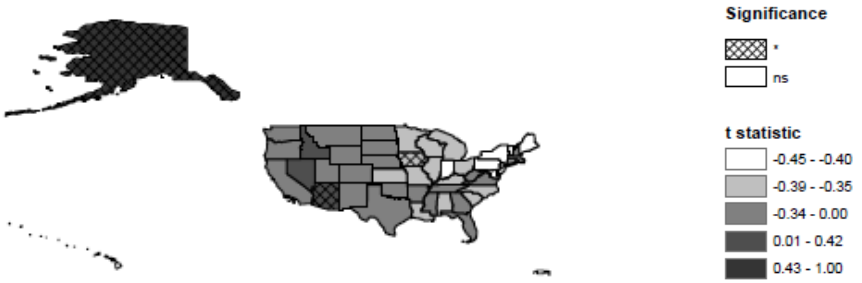


Figure 6

Local R^2 values, eighth-grade math NAEP and TEST ONLY

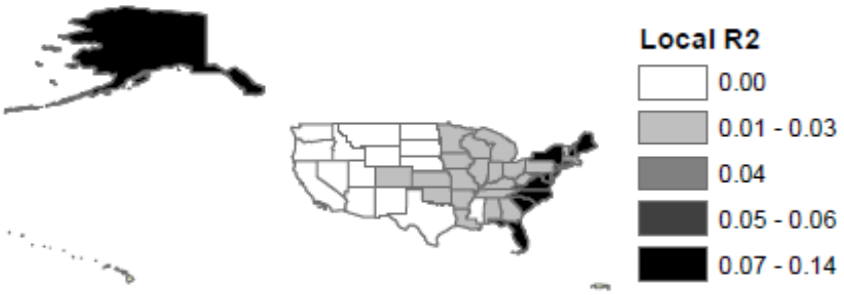


Figure 7

t-test statistic and significance by state, eighth-grade math NAEP and TEST ONLY

Coursework Only

No statistically significant relationships were found for states requiring only coursework.

Coursework and Test

Statistically significant relationships were also found for NAEP math tests (fourth and eidghth grade) for COURSEWORK & TEST states, but unlike with the TEST ONLY states, those relationships resulted in a positive *t*-statistic, indicating that those relationships were associated with higher achievement scores for ELs in those states (Figures 8-11). Local R^2 values ranged from 0 to 0.19, meaning that requiring both coursework and tests explained up to 20% of variance in fourth-grade EL reading NAEP scores. Indeed, a large portion of the western US demonstrated a significant relationship in states with these requirements.

Figure 8

Local R^2 value, fourth-grade math NAEP and COURSEWORK & TEST

Figure 9

t-statistic and significance, fourth-grade math NAEP and COURSEWORK & TEST

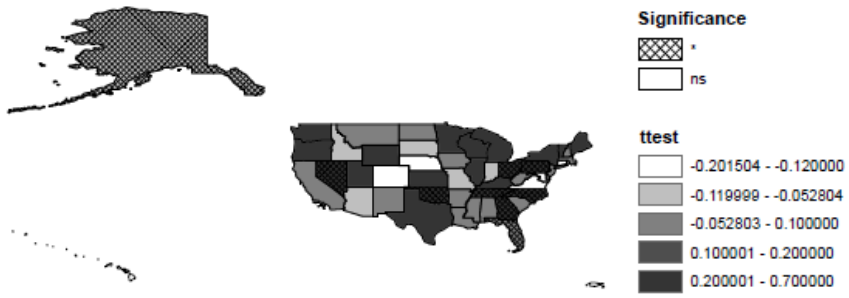


Figure 10

Local R^2 value, eighth-grade math NAEP and COURSEWORK & TEST

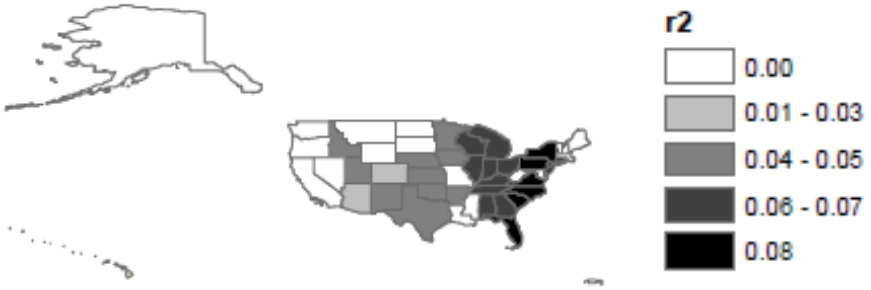
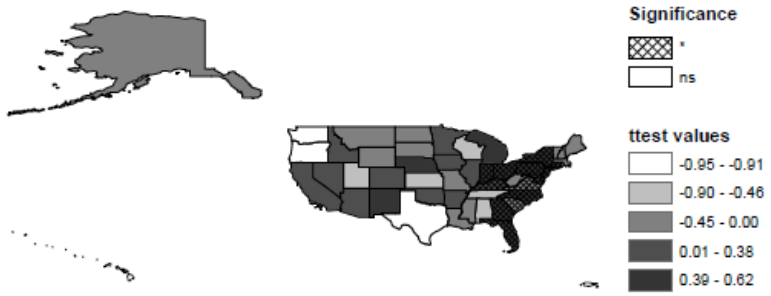


Figure 11

t-statistic and significance, eighth-grade math NAEP and COURSEWORK & TEST



Specific Required Content Area Competencies

Next, we turned to our examination of specific content area competency requirements for states that required some level coursework. First, required EL METHODS content was significant for NAEP math for both fourth and eighth grade (Figures 12-15). Local R^2 were as high as 0.21 and the t-statistics showed positive relationships. There was no clear pattern for the significant relationships for the fourth grade models, of which only three models were significant. For the eighth grade models, the significant findings were clustered along the west coast. The *t*-statistics for both fourth- and eighth-grade models were negative, showing an inverse relationship between EL METHODS as a course requirement and NAEP math outcomes.

Figure 12

Local R^2, fourth-grade math NAEP and EL METHODS

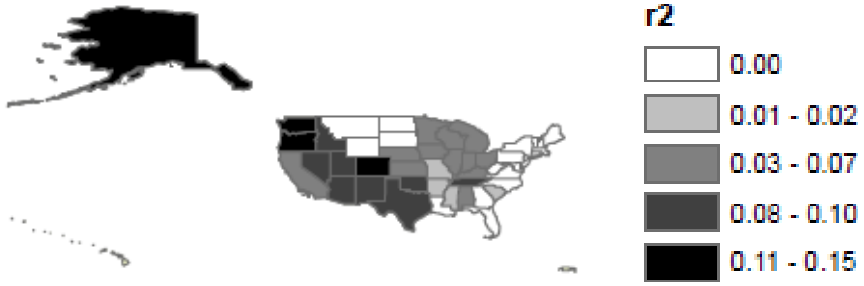


Figure 13

t-statistic and significance, fourth-grade math NAEP and EL METHODS

Figure 14

Local R^2, eighth-grade math NAEP and EL METHODS

Figure 15

t-statistic and significance, eighth-grade math NAEP and EL METHODS

ASSESSMENT coursework was significant for fourth-grade NAEP reading and math (Figures 16-19). Local R^2 values for fourth-grade math were as high as 0.23 while for reading local R^2 were only as high as 0.11. For both subject areas, the significant models were clustered on the west coast as well as Alaska, and the significant t-statistics for both were negative.

Figure 16

Local R^2, fourth-grade math NAEP and ASSESSMENT

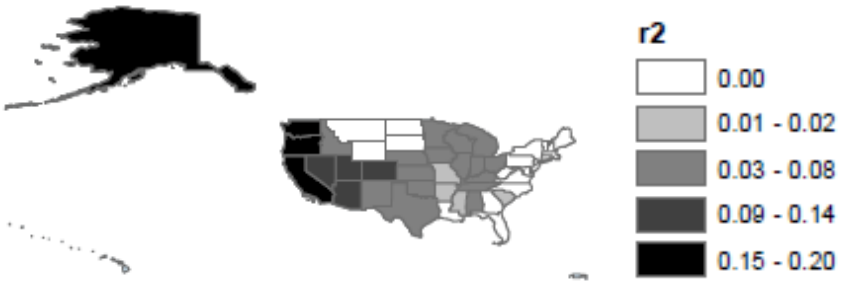


Figure 17

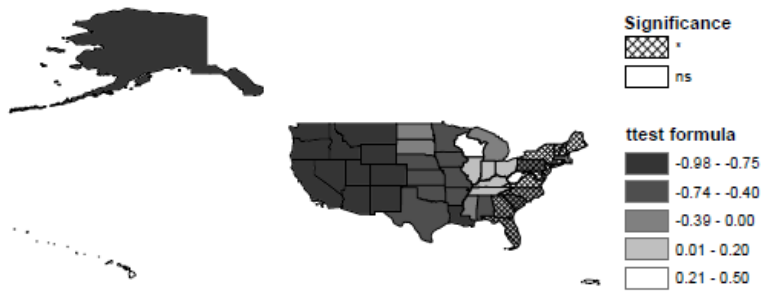
t-statistic and significance, fourth-grade math NAEP and ASSESSMENT

Figure 18

Local R^2, fourth-grade NAEP reading and ASSESSMENT

Figure 19

t-statistic and significance, fourth-grade NAEP reading and ASSESSMENT



Next, required content in CULTURE resulted in significant, negative relationships, indicating that requiring a course in culture is actually associated with poorer outcomes on the fourth-grade math and reading NAEP exams (Figures 20-23). Local R^2 values were as high as 0.27 in Nevada indicating a strong relationship, but significant relationships were also seen for lower R^2 values across the country.

Figure 20

Local R^2 values, fourth-grade NAEP math and CULTURE

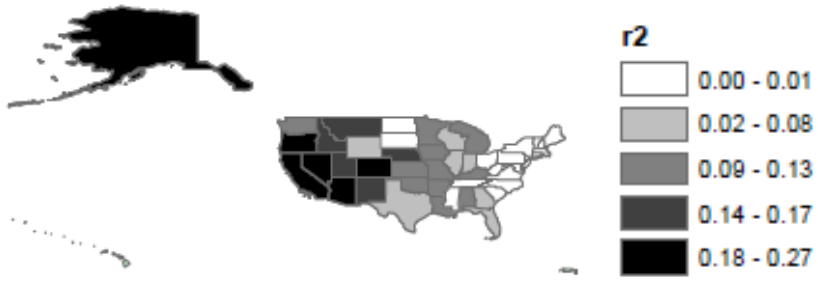


Figure 21

t-statistic and significance, fourth-grade NAEP math and CULTURE

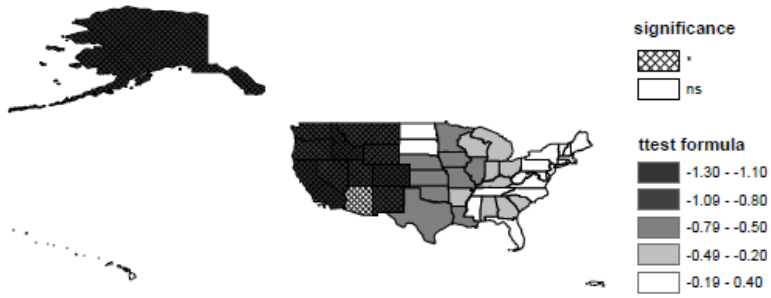
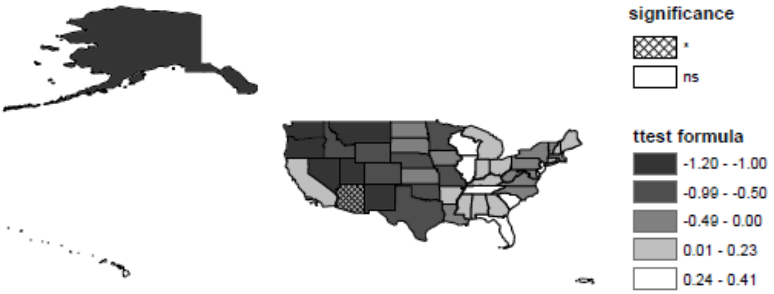


Figure 22

Local R^2 values, fourth-grade NAEP reading and CULTURE

Figure 23

t-statistic and significance, fourth-grade NAEP reading and CULTURE



The remaining required *content area competencies* and other variables did not demonstrate significant correlation with our outcome measures and so are not reported here. As mentioned above, there was great variability between the states in terms of requirements and specifically required content area competencies. Therefore, an examination of the geospatial patterns of those variables may warrant further exploration, in addition to the correlational tests conducted here.

Discussion

The current project examined the relationship between state EL teacher certification requirements and EL achievement. The data revealed some **geospatial patterns in requirements for certification to teach English learners (ELs);** specifically, we saw an improved model fit when including the geospatial weight in the models. Thus, we know that the relationships reported are nonstationary and vary by place. The fact that adding geographic relationships improved model fits indicates that GWR is a warranted research technique when examining teacher credentialing issues and how they impact ELs. While previous research has demonstrated how student populations vary across the United States, the research here using GWR demonstrates that accounting for geospatial patterns provides a more precise estimate of the effects of the teacher certification requirements that we examined. The data specifically revealed relationships between state level EL teacher certification requirements and EL achievement scores. In particular, states requiring EL specific coursework for EL teacher certification had higher fourth grade reading and

math scores, as compared to lower scores in states that require only a passing score on a test for EL certification. Additionally, scores on both math and reading were higher for fourth and eighth grade ELs in states requiring both courses and a passing test score for EL certification. These findings are compatible with existing literature and the frameworks outlined by Lucas and colleagues (Lucas & Villegas, 2011; Lucas et al., 2008). The skills and tasks (e.g. Lucas & Villegas, 2013) identified as supporting the development of linguistically responsive teachers are best carried out in EL targeted coursework and associated experiences. These findings provide strong evidence that the demonstration of memorized knowledge via a standardized test for teachers is insufficient preparation to adequately meet the diverse needs of English learners, even when accounting for the nuances of local certification requirements and EL demographics.

In terms of examining the **correlations between specific coursework required for EL certification and EL achievement**, the findings were more complex. We found that ELs in states that required a methods course had lower scores in math and reading for both the fourth and eighth grade NAEP exams. We also found that states that required some course content related to culture had lower fourth grade math and reading scores. Finally, we found that required assessment coursework had a negative relationship with fourth grade reading and math NAEP scores. Given the overwhelming consensus in the field that training in EL specific methods and assessment (Loeb et al., 2014) and developing sociocultural awareness (Lucas & Villegas, 2013) are beneficial to EL teacher development, these results deserve further investigation before any strong conclusions can be made[8]. In particular, this study only examined state defined requirements for EL teacher certification and did not examine the requirements for all certified teachers in the state. This current project builds on and is compatible with Lopez, Scanlon, and Gundrum (2013)'s findings that some EL specific training for all teachers, in addition to an EL specific certification, is related to higher EL scores on NAEP, while highlighting the need to consider local context when determining the exact nature of courses or certification pathways made available to teachers. It is clear that training a select few EL 'specialists' in EL methods, cultural awareness, and EL assessment is an insufficient approach to supporting EL success, even though is it a common approach in states with newly emerging EL populations (Walker et al., 2004).

Importantly, the fact that the goodness of fit models of these significant relationships were improved when geospatial context was factored in highlights the fact that the results are dependent on local context. While the results discussed above highlight nationwide patterns of significance, such results can be influenced by strong relationships in a more limited number of states. For instance, states on the west coast, and Alaska, that required an assessment course demonstrated negative relationships for fourth grade reading and math. Thus, the impact of specific certification requirements on student outcomes differs by state. To better understand why these requirements differ by state, more investigation is needed, with a particular emphasis on local context. Possible future research could explore how states with newer EL demographic shifts choose to prioritize required coursework, in comparison to states with more established EL populations. There are also local differences in EL achievement and teacher certification related to the urban and rural dichotomy (Kreck, 2014) present in many states.

Limitations

[8] As one reviewer of this manuscript noted, these patterns may be explained by any one of a wide variety of factors, including reclassification procedures used in different states (with implications for who is classified as an EL on NAEP), historical immigration patterns, or teacher credentialing. The authors agree and note that the fact that geographic context influences whether these relationships are significant motivates the fact that future studies should examine such patterns while accounting for geospatial factors.

The current study focuses on achievement as measured by national standardized tests, which has widely recognized limitations, including the use of scale scores, proficiency score cut-offs, linguistic and cultural bias among others (Lucas & Villegas, 2013). The heterogeneity of the EL population results in a need for caution when interpreting data from standardized tests such as NAEP, which broadly categorizes students (Keiffer & Thompson, 2018). While NAEP data has many advantages, and is the best option available for the current study goals, these limitations do impact the generalizability of the data. Keiffer and Thompson (2018) found that progress of ELs may not be demonstrated without including other population groups in the analysis. This study is simply a cross-sectional look at the impact of teacher preparation on how well ELs perform on the NAEP and does not examine the growth of those students. It is possible that the benefits of certain teacher certification requirements on student outcomes would be better elucidated with longitudinal models.

Another limitation is the level of data used. The analyses are beneficial at the state level, but they are limited in their ability to capture the nuances of the populations that individual school districts serve. The analyses also do not capture the certification and training levels of individual teachers in a given district. Thus, while these outcomes show the importance of strong state guidelines that require coursework for EL teacher certification, they cannot be applied to individual district needs, which is the next step in this research agenda.

The inherent variability of the teacher education field in terms of how teacher certification is defined and applied in local contexts is a limitation that requires further research. Not only does the coursework required for EL related certification differ by state, but the context in which those certified teachers work with students in schools and classrooms is also very diverse. For instance, one teacher certified as an "EL specialist" may support students in pull-out settings, while another teacher in the same district with the same level of certification may work in a dual language classroom as one of the primary teachers (Gandara et al., 2005). In low incidence districts (i.e. less than 5% of the total student enrollment are ELs), ELs may receive most of their instruction from a teacher who has only minimal training in teaching ELs, while in nearby districts with a higher incidence of ELs, the district may require that a majority of the teachers may have additional EL certification (Keiffer & Thompson, 2018). Thus, a limitation of this research is that it does not examine the level of certification that practicing teachers actually possess, within a given district. Given that the results showed that location moderated the relationship between certification requirements and student outcomes, a next step in this line of research is to determine what may be influencing those effects. Additionally, the demographics of ELs across states and districts can vary widely. In some districts, particularly districts with diverse refugee populations, resources and systems for linguistic and cultural supports may be limited (e.g. Kiang & Supple, 2016). These differences not only have an impact on student achievement (Harris & Sass, 2011), but also influence the training that teachers need to be successful. The significant results found in this study based on geographic location, combined with potential differences in EL populations and applications of policy highlight the need for continued research with a nuanced, localized approach to examining the approaches to teacher certification requirements.

Significance

While more analyses are needed to fully elucidate the relationships between teacher certification requirements and English learner academic success, the results reported here demonstrate that variation in these factors exists across the U.S. and that GWR can illuminate the relationships among these variables. The significance of these findings can be seen at several levels. On the most basic level, these findings indicate that rigorous requirements for EL teacher

certification are predictive of EL academic success, as measured by nationally normed, standardized testing in math and reading.

These findings also highlight the importance of shifting the conversation from identifying the percentage of teachers who are certified to teach English learners (e.g. National Academies of Sciences, Engineering, and Medicine, 2017), a line of thinking born of the No Child Left Behind era of "highly qualified teachers," to focusing on the quality of the preparation that those teachers receive in order to become certified, as well as the nuanced role of local context in that preparation. Because we see improved model fit when including the geospatial weight in the models, we know that these relationships are nonstationary; the relationships vary by place. This improved model fit indicates that including the geospatial weight is beneficial as a research tool when studying state-mandated teacher certification requirements: the GWR models provide a better explanation for the correlations than traditional regression models. Thus, these requirements should be viewed from a nuanced, regional perspective that addresses the differing needs of states and districts.

As this study indicates, test only certification approaches negatively predict student outcomes and EL specific coursework during the EL teacher preparation process is predictive of higher levels of EL academic success. These knowledge areas can help to inform state policy decision-making regarding EL teacher certification requirements. The lack of uniform recommendations for teacher training across states results in great variability for how EL knowledge and skill levels are addressed. An increased understanding in regards to how EL teacher certification affects student achievement is critical to ensuring that new legislation or programs address underlying training needs, as opposed to applying surface level 'fixes' (such as TEST ONLY options) which can limit as opposed to promote student success. Simply increasing coursework requirements for teachers is also problematic as this approach may unintentionally create obstacles that exclude culturally and linguistically diverse teachers who can connect to ELs, due to the added obstacles created by such an approach (e.g., Bassok, 2013; Fuller et al., 2005). As Lucas & Villegas (2013) note, "To make the most of the precious time [teacher preparation programs] have with preservice teachers and the small proportion of it that can realistically be devoted to [EL teaching skills and knowledge], they need to ensure that the time is well-spent" (p. 100). Thus, more research is needed to determine what specific training is truly required to impact student achievement. Greater understanding of the trends and relationships of certification requirements can help policy-makers identify those factors which matter most in each individual state.

Overall, the results of this study can be further expanded by examining the relationship between EL achievement, EL teacher certification, and other local demographic factors. In investigating these relationships, mapping offers a particularly advantageous lens with which to view these relationships because maps present the data in a manner accessible to lay people who may be charged with recommending certification or policy changes.

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