

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



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ABSTRACT: Multilingual learners (MLs) are a demographically diverse population whose academic success is impacted by a variety of contextual factors. Previous research has found that state requirements for ML teacher certification impact academic achievement for multilingual learners (Johnson & Thorne-Wallington, 2019; Thorne-Wallington & Johnson, 2022). The current study uses geospatial mapping to further examine the impact of states' ML teacher certification requirements on the academic success of multilingual learners. Specifically, this study examines whether state certification policies have a differential impact on ML achievement when more localized factors such as rural vs. urban context and additional demographic factors are included in the predictive model. The results of this study suggest that the impact of state teacher certification requirements on student outcomes is moderated by local contextual factors.

Keywords: rural education, student achievement, multilingual learners, geospatial analysis

1. Introduction

Multilingual learners are not a demographically homogenous population and their lived experiences can differ greatly depending on their local context. Specifically, local context—including student and teacher demographics (Slack & Jensen, 2020), teacher preparation (Christianson, 2016; Molle, 2021; Taie & Goldring, 2020), student achievement (Darling-Hammond, 2004; Reardon, Kalogrides, & Shores, 2019), and educational policies (Jones et al., 2009; McFarland, 2018)—plays a critical role in shaping academic success. These factors are particularly important when examining the experiences of multilingual learners (MLs), a diverse and growing subset of the U.S. student population. Understanding how these contextual elements intersect provides a foundation for analyzing equity in educational opportunities.

Recent research underscores the importance of situating analyses of teacher quality within the specific sociogeographic contexts in which students are educated. Studies have shown that the relationship between teacher certification requirements and ML achievement becomes more meaningful when moderated by local contextual variables such as the proportion of the school-age population living in rural areas (Johnson & Thorne-Wallington, 2019; Thorne-Wallington & Johnson, 2022). These findings reflect broader patterns of variation in how rurality influences access to educational resources, shaping both instructional practices and student outcomes.

The current study builds upon a substantial body of work examining inequities in access to well-prepared and highly qualified teachers. Prior research has documented how historically marginalized student populations—including MLs—disproportionately attend schools staffed by less experienced or underqualified teachers (Akiba et al., 2007; Cardichon et al., 2020; Clotfelter et al., 2005; Dabach, 2015; Goldhaber et al., 2015; Lankford et al., 2002; Peske & Haycock, 2006). However, despite extensive research on the impacts of teacher quality and staffing on learner outcomes, less is known about how variation in teacher certification policies at the state level influences achievement. For students with diverse backgrounds, such as multilingual learners (MLs), examining the impacts of local context can be particularly important. Thus, the current study examines how differences in teacher certification policies interact with local demographic and geographic contexts—particularly rurality—to influence ML achievement. By integrating these historical and contemporary insights, this study seeks to determine whether disparities in teacher certification policies contribute to variation in ML achievement across different local contexts.

2. Theoretical framework

Multiple areas of literature inform the research presented here. First, there is a large body of literature elucidating the significance of teacher preparation on student success (e.g. Hill & Flynn, 2004; Loeb et al., 2014). Secondly, previous research has identified differences in the effects of policy on residents in urban and rural areas. Finally, the intersectional impacts of race and socioeconomic status on school experiences are well-documented (e.g., Darling-Hammond, 2004; Gee, Asmundson, & Vang, 2023). This intersectionality becomes increasingly important with the diversification of rural areas (e.g., Slack & Jensen, 2020). This study examines whether localized relationships between state-mandated teacher certification requirements and multilingual learner achievement are further affected by rural vs. urban contexts, when controlling for demographic variables.

2.1. Geographical context

The current paper is interested in the role of “rurality” in moderating impacts of state teacher certification policies on ML achievement. For the purpose of this investigation, “rurality” is defined as percent of school-age population living in a specified rural area. This variability can be particularly important when investigating impacts at a local level because population density can affect related factors such as availability of funding and trained teachers, as well as the demographics of a specific area. Our previous research found that the ML teacher certification requirements differentially impacted ML achievement depending on rural vs. urban context (Thorne-Wallington & Johnson, 2022). The current study builds on this research to more closely examine whether local demographics can explain the differential impacts.

2.2. Teacher certification requirements

Teacher preparation is consistently found to impact student achievement (e.g., López et al., 2013), but there is no federal policy for teacher certification related to MLs. As a result, training requirements for teachers of multilingual learners can differ greatly from state to state, or even district to district. The 2015 reauthorization of the Elementary and Secondary Education Act (ESEA), known as the Every Student Succeeds Act (ESSA), emphasizes the importance of “local control” and defers teacher certification requirements to the state level, while noting that programs must meet civil rights requirements defined under *Castañeda vs. Pickard* (1981) which requires that personnel be able to effectively implement an

educational program for MLs. Without national certification requirements, individual states have developed diverse requirements, yet there is limited research regarding which of these requirements are most effective for student success. Previous research has found that there is a relationship between state-level certification requirements and academic achievement of MLs. Specifically, states that allow teachers to become qualified only by passing a standardized test have lower multilingual learner academic achievement (Johnson & Thorne-Wallington, 2019; Thorne-Wallington & Johnson, 2022).

2.3. Rural education significance

Public health, public policy, and educational fields have all found differential impacts of federal and state policies on rural populations (e.g., Jones et al., 2009; McFarland, 2018). Broad approaches to national or statewide funding formulas and concomitant policy constraints lead to differences in governance of urban and rural schools (Liggett, 2010). Policy impacts can also be highly localized within different rural communities in the same state, where some rural communities are impacted by policies that do not affect other communities. In Oklahoma, for instance, indigenous communities have faced policies that specifically suppress their native languages in favor of English immersion (Chew & Tennell, 2023) whereas similar policies are not applicable to other rural communities in the state.

Within rural education systems, previous research has found significant gaps in student achievement for a variety of subgroups, including multilingual learners (Johnson et al., 2014). One explanation for these gaps is related to state policies for distributing school resources and funding. School funding formulas at the national or state level may not adequately account for changing demographics or language development needs. Rural communities can experience rapid shifts from homogeneity to racially and linguistically heterogeneous populations (Licher, 2012; Rastogi & Curtis, 2020). As historically homogeneous rural districts encounter burgeoning enrollments from diverse subgroups, discernible differences in services across districts develop (Kreck, 2014). These differences can develop because funding formulae are often based on group size, which results in insufficient funding to meet multilingual needs in low-incidence populations (Jimenez-Castellanos & Topper, 2012; Hill & Flynn, 2004).

There are numerous additional factors that contribute to ML achievement and may vary based on local context. For instance, while there is a range of professional development practices that have been identified to support MLs in rural schools (e.g., Hamann & Reeves, 2013; Haneda & Wells, 2012; Hill & Flynn, 2004; Kreck, 2014), educational programming and opportunities available to multilingual learners and their teachers may vary across districts (e.g., Strong & Escamilla, 2023). Additionally, geographic region is a significant predictor of long-term ML success (Strong & Escamilla, 2023) and ML demographic characteristics can vary greatly across schools and districts (Christianson, 2016). The current study aims to investigate how contextual factors may explain the localized relationship between teacher certification requirements and ML achievement.

2.4. Race and socioeconomic considerations

With the passage of ESSA, multilingual learners (MLs) are more closely monitored as a subgroup. However, viewing multilingual learners from a monolithic perspective is deeply rooted in a deficit-based approach that focuses on a singular social construct (i.e., English proficiency; e.g., Kibler & Valdés, 2016; Rosa, 2016; Rosa & Flores, 2017). Other learner characteristics and experiences must be considered, requiring more nuanced approaches to investigations of ML achievement (e.g., Strong & Escamilla, 2023). Multilingual learner demographics within and across schools and districts are highly localized, as are their associated academic, sociocultural, emotional, and logistical needs and strengths.

Previous researchers have found that because geographic region is a stronger predictor of identification of English learners as “Long-Term English Learners” than other factors, future research should avoid “perpetuat[ing] the inaccurate view that...English learners necessarily share essential characteristics and experiences” (Strong & Escamilla, 2023, p. 61). Across all student groups, racial and socioeconomic disparities can exacerbate other barriers to academic success and access (Darling-Hammond, 2004). Calls for researchers to consider the impacts of these factors in relation to studies of ML academic achievement have become increasingly prevalent (e.g., Kubota & Lin, 2006; Von Esch, Motha, & Kubota, 2020).

Other factors such as income, access, and teacher staffing are also highly localized, with the potential for impacting ML achievement. Individuals living in rural communities experience higher rates of poverty as compared to their peers in urban communities (e.g., Schaefer & Mattingly, 2016). Multilingual learners from low-income families may lack access to high-quality language development programs, specialized support, and extracurricular opportunities, limiting their linguistic and/or academic growth (Abrams & Kong, 2012). Differences in teacher workforce diversity are also important considerations because teachers’ race and ethnicity can affect expectations for students from certain racial backgrounds, which can impact students’ self-perceptions and academic motivation (e.g., Gershenson et al., 2016; Papageorge et al., 2020). These factors highlight the need to include geographic location with intersectional characteristics when examining student achievement.

2.5. Research questions

Building on our previous research examining the relationship between ML teacher certification requirements and ML achievement, we examined the three following questions:

1. Does including an urban/rural measure improve model fit for correlations between ML achievement based on ML teacher certification requirements by state?
2. Does including additional contextual factors such as percent non-white, free and reduced lunch, and percent multilingual speakers improve model fit?
3. When including multiple explanatory variables in the model, do any patterns emerge? 3. Data sources and methods

We began by gathering data from state education department websites, contacted state departments of education, and coded requirements based on the variables listed in Table 1. Because states offer a variety of ML certification types, we focused our analyses on traditional (as opposed to alternative) certification routes. Within the traditional certification options, we examined the type of ML certification with the least requirements (i.e. the minimum required to become traditionally ML certified in the state). Because many of the variables are binary conditions (i.e. coursework required or not required) the variables were coded as dummy variables with a binary condition of 0 or 1.

We defined rural population by creating an independent variable denoting the percent of school-age population living in a rural area, which was needed to measure distribution of student populations across states. This new variable was then included in the models to show if a link existed between rural/urban status and ML teacher certification requirements (see Table 1).

Table 1. Variables Collected and Number of States Requiring that Variable

Variable	Number of states that require the variable
Test only	11
Courses only	24
Courses and test	14
Required courses:	
Methods	33
Assessment	30
Linguistics	31
Culture	22
Curriculum	14
Sociolinguistics	12
Policy	9
Second Language Acquisition	16
Psychology of the Exceptional Child	2
Literacy	10
Practicum required	16
L2 Experience	9

Next, we accessed ML achievement data from the NAEP database for our ML student achievement data. We used 4th grade and 8th grade English Language Arts (ELA / “Reading”) and Math measures because these data are widely reported and allow for the best measurement of academic language proficiency. One limitation is that these data are reported at the state, not district, level. We used the most recent NAEP dataset, which was collected in 2022. Data were geocoded and then linked to US Census open access TIGER shapefiles.

ArcGIS software was used to map the factors for pattern analysis. Ordinary Least Squares and Geographic Weighted Regression (GWR) were performed for each relationship. Correlations were examined for all factors listed in Table 2 and ML achievement based on the 4th grade and 8th grade reading and math exams. Each GWR was mapped to show the R²s and the geographic weights used to determine nonstationarity in relationships (stationarity refers to relationships as stable across an area) (Brunsdon et al., 2002). The local R² values were mapped, as were the t-value beta coefficients. The results of these regressions were mapped to show local R² values, significance, and nonstationarity.

4. Analysis and results

We first examined ML teacher certification requirements in relation to state urban/rural population distributions using the urban/rural dichotomy measure described above. This variable was added to each Geographic Weighted Regression (GWR) model to determine whether accounting for differences in state

population geography improved the relationship between certification requirements and multilingual learner (ML) achievement. Because educational contexts often differ substantially between urban and rural settings—including teacher shortages, access to professional development, and concentrations of multilingual learners—we hypothesized that geographic context might explain additional variation in the relationship between certification policies and student outcomes.

Table 2 presents the statistically significant models and compares the original GWR models with those including the rural/urban variable. The overall pattern of significant results in terms of type of certification requirement (test only, test and courses, coursework only) and specific courses (assessment and culture) align with previous findings, where they are discussed in more detail (Johnson & Thorne-Wallington, 2019; Thorne-Wallington & Johnson, 2022). The current study’s aim is to find improvements in model fit, which were evaluated using both the global R^2 statistic and the corrected Akaike Information Criterion (AICc). In general, models with higher R^2 values explain a greater proportion of the variation in ML achievement, while lower AICc values indicate a better-fitting and more parsimonious model. Examining both statistics together provides a more complete assessment of whether including the rural/urban variable strengthened the previously identified models.

Table 2. Statistically significant models

Explanatory variable	Grade/ Subject of NAEP Test	Global R^2 value (GWR, original model)	AICc (GWR, original)	Global R^2 value (GWR, rural)	AICc (GWR, rural)
Test only	4 th Math	0.15	321.19	0.19	316.88
	4 th Reading	0.17	356.33	0.17	348.66
	8 th Math	0.14	327.11	0.13	341.19
Test and courses	4 th Math	0.08	319.43	0.10	312.54
	8 th Math	0.11	279.81	0.10	273.62
Coursework only	4 th Math	0.13	310.25	0.13	310.25
	8 th Math	0.10	278.13	0.11	273.11
Assessment	4 th Math	0.14	313.03	0.16	303.11
	4 th Reading	0.19	330.33	0.13	334.28
Culture	4 th Math	0.14	315.28	0.15	309.08
	4 th Reading	0.21	311.44	0.10	340.09

Where differences were observed, the inclusion of the rural/urban measure generally improved model performance for certification models that required testing only, testing plus coursework, and coursework only. Similarly, among models examining specific certification coursework requirements, the addition of the rural/urban variable improved the models examining assessment coursework and cultural competency coursework (see Table 2). Although the magnitude of these improvements was modest, they suggest that state geographic composition contributes to explaining the relationship between certification requirements and ML achievement. In other words, the effectiveness of certification policies may not be uniform across

states but may vary depending on the proportion of students and schools located in rural versus urban communities.

Across the statistically significant models, global R^2 values ranged from approximately .10 to .19, indicating that these models explained between 10% and 19% of the variance in state-level ML achievement. While these values indicate that certification requirements alone account for a relatively modest proportion of achievement differences, they are consistent with expectations for statewide educational policy analyses, where student outcomes are influenced by numerous interacting factors. The results suggest that certification requirements represent one meaningful component within a broader system of demographic, instructional, and contextual influences.

Next, we examined whether additional demographic characteristics further explained variation in ML achievement by incorporating measures of race and socioeconomic status (SES). Several indicators were considered, including the percentage of non-White residents, the percentage of students eligible for free or reduced-price lunch, and the percentage of residents who speak a language other than English at home. When all demographic variables were entered simultaneously, none of the models remained statistically significant. This pattern suggests that the models were likely overspecified, with substantial overlap among explanatory variables reducing the ability to detect unique relationships. The high degree of shared variance among these demographic measures may also have introduced multicollinearity, limiting the interpretability of individual coefficients.

To better identify the contribution of individual demographic characteristics, we next examined models that added only the percentage of non-White residents to the certification variables. Under this specification, the test-plus-coursework model demonstrated a statistically significant improvement in model fit relative to models without additional demographic controls. This finding suggests that racial composition explains unique geographic variation in ML achievement beyond certification requirements alone and that incorporating carefully selected demographic variables may provide a more informative model than simultaneously including multiple highly correlated measures.

The maps presented in Figures 1–6 illustrate the significant results for spatial variability as identified by the GWR analyses. The local R^2 maps identify geographic areas where certification requirements and rural population characteristics explain relatively more or less variation in ML achievement, with higher values indicating more variability. The corresponding t-statistic maps identify locations where the observed relationships are statistically stronger or weaker. If the relationship between these variables was not dependent on geographic context, the maps would appear visually uniform. The variations from state to state in the significant models indicate that the impact of the variables included in the models is dependent on local context within each state. These visualizations demonstrate that the associations between certification requirements, rurality, and student achievement are not geographically uniform. These relationships vary considerably across individual states, supporting the use of geographically weighted regression rather than a single global regression model. These differences suggest that individual contextual factors may deserve differential consideration depending on local geographic context (i.e. state by state, county by county, or district by district).

Figure 1. R^2 Values, Test only/rural population, 4th grade reading

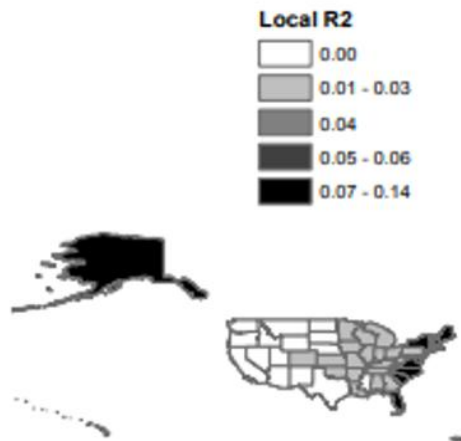


Figure 2. t statistic, Test only/rural population, 4th grade reading

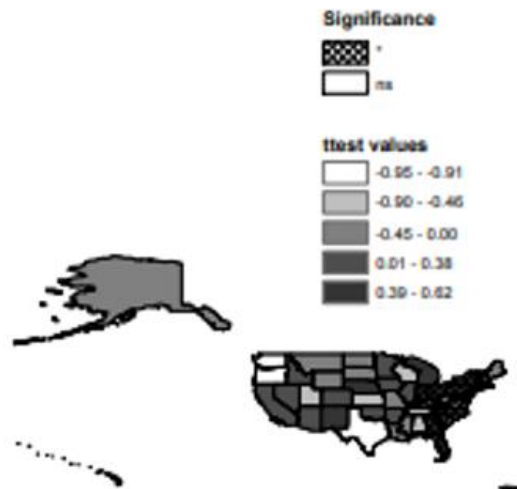


Figure 3. R^2 , Test and courses/rural population, 8th grade math

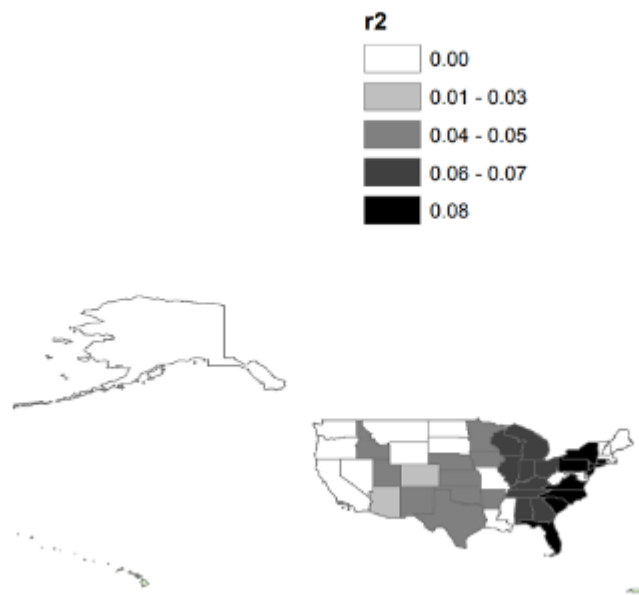


Figure 4. *t* statistic, Test and courses/rural population, 8th grade math

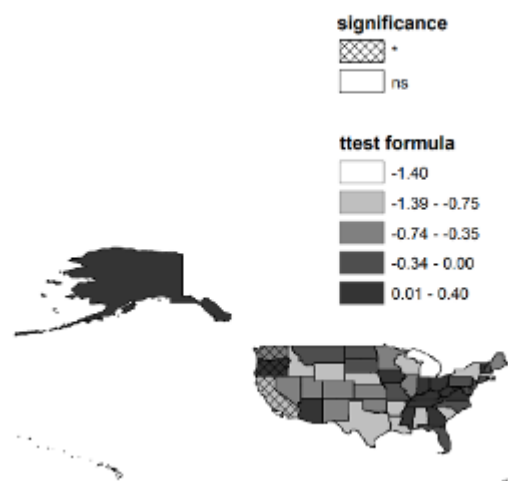


Figure 5. R^2 , culture coursework/rural population, 4th grade reading

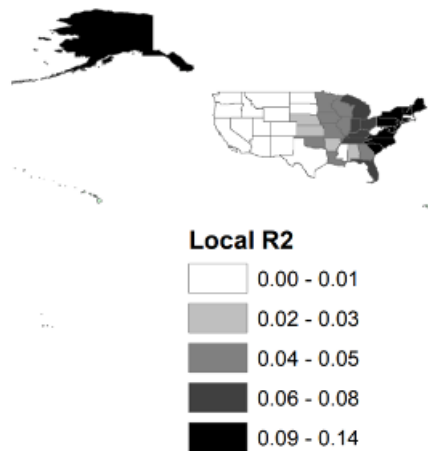
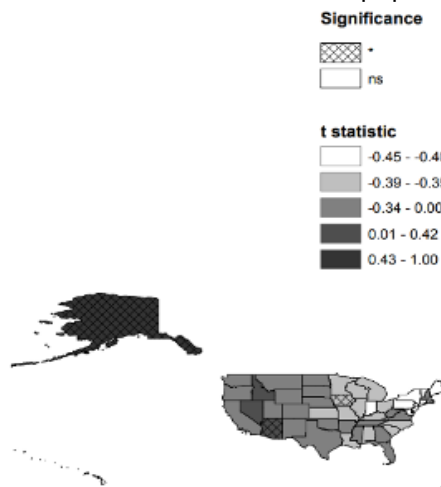


Figure 6. t statistic, culture coursework/rural population, 4th grade reading



5. Implications

These results demonstrate the importance of accounting for differences in local context when examining the relationship between state policy, teacher certification requirements, and ML achievement. Given that model fit for all three teacher certification approaches (test only, test plus coursework, and coursework only) improved when including the urban/rural statistic, geographic context should inform interpretations of certification requirements as well as recommendations for future policy. Rather than suggesting that a single certification model is equally effective across all states, the findings indicate that the influence of certification policies may depend on the geographic contexts in which teachers and multilingual learners are situated. The impact of teacher certification requirements on local multilingual learners may also differ within a given state, due to highly localized socioeconomic and demographic differences. This supports

the use of geographically weighted regression, which allows relationships to vary spatially rather than assuming that policy effects are constant nationwide.

The higher explanatory power of the test-only model is consistent with previous findings that requiring only a certification examination, with no coursework, is associated with lower ML achievement (Johnson & Thorne-Wallington, 2019). Likewise, the positive model contribution of assessment and cultural competency coursework aligns with earlier research demonstrating the value of preparing teachers to assess multilingual learners appropriately and to provide culturally and linguistically responsive instruction. Collectively, these findings suggest that certain certification requirements may support multilingual learners better than others, and that requiring some coursework has a more positive association with student success as compared with relying on certification via standardized testing.

Although the amount of variance explained by the models remained modest, this is not unexpected in statewide educational policy research, where student achievement is shaped by numerous interacting influences operating at the student, school, district, and state levels. Teacher certification represents only one component of a broader educational ecosystem that includes school funding, teacher experience, instructional resources, community characteristics, and student demographics. Nevertheless, the consistent improvement in model fit after accounting for geographic context suggests that rurality captures meaningful variation that should not be overlooked when evaluating certification policies.

Given that adding multiple demographic explanatory variables related to race and socioeconomic status had minimal impact on the overall models, the results indicate that geographic context may provide a stronger explanatory role than demographic characteristics considered collectively. One possible explanation is that these variables share substantial variance, making it difficult to isolate their unique contributions when entered simultaneously. However, there is evidence that adding a variable representing race, specifically the percentage of non-White residents, improved the explanatory power of the test-plus-coursework model. This finding suggests that racial composition may interact with certification requirements differently across geographic contexts, particularly in states with larger rural populations. The mechanisms underlying this relationship remain unclear and warrant further investigation. Future research should explore whether differences in resource allocation, teacher distribution, community demographics, or access to specialized instructional supports contribute to these geographic patterns.

An asset-based examination of multilingual learners' strengths and challenges requires considering students' experiences through an intersectional lens (e.g., Strong & Escamilla, 2023). Race and socioeconomic status (SES) are critical factors that influence the educational experiences and academic achievement of multilingual learners in rural elementary and secondary schools, yet these intersections remain underexamined (Coady, 2020). The present findings suggest that these demographic characteristics should not be viewed independently from geographic context. Rather, rurality may shape how race, SES, and teacher preparation interact to influence educational opportunities and outcomes. Understanding these intersecting influences can provide a more comprehensive foundation for developing equitable certification policies and teacher preparation programs that address the diverse needs of multilingual learners across varied educational settings.

Taken together, these findings underscore that teacher certification policies should not be evaluated in isolation. Policymakers should consider how certification requirements operate within the broader demographic and geographic contexts of their states. Certification systems that incorporate meaningful pedagogical coursework while recognizing the unique needs of rural communities may be better positioned to support multilingual learners than uniform statewide policies that do not account for local variation.

6. Conclusion

The current research highlights the challenges related to establishing statewide certification requirements that include adequate ML teaching preparation, while accounting for the unique challenges encountered by local contexts. Understanding the impact of contextual factors on MLs' academic success can inform more effective educational approaches that support diverse student populations. The current findings provide impetus for state policymakers to consider the diverse needs and characteristics of MLs in rural schools, as compared to urban schools, when developing state certification requirements.

The differing impacts of certification requirements at the local level support the need for a more nuanced and multi-tiered approach to ML teacher certification (Johnson & Thorne-Wallington, 2019). Because the characteristics and experiences of multilingual learners, and their teachers, can differ greatly, it is important for certification pathways to account for a range of approaches to teaching and learning. Teaching methods designed for large, homogeneous populations of multilingual learners will not necessarily be as effective for multilingual students who may be the only students in their classrooms who speak a language other than the majority language(s) spoken. Similarly, teaching approaches designed for multilingual students who have attended school in an English-dominant setting since early elementary school will have different needs than students who may have entered an English-medium school in adolescence. These differences can be exacerbated by additional demographic and lived experience factors such as previous schooling, linguistic background, socioeconomic status, community support, and more. As such, a teacher who is supporting a multilingual learner in a low-incidence rural district may have training needs that are distinct from a teacher in an urban district with a high concentration of diverse learners in the same state.

The current research aims to highlight these diverse multilingual teacher training needs, as well as contribute to the identification of core professional development requirements that are effective for the majority of teachers of multilingual learners. While the traditional approach to teacher training is to layer on requirements for all teachers when gaps emerge for a subset of teachers, we propose that teacher certification for multilingual learners should include a limited, common set of courses, with options for various pathways for additional training or specialization depending on the needs of the local multilingual population. Importantly, such decisions should be data-driven and considerate of the diversity of the population that is affected. At its core, the proposed approach recognizes and values the heterogeneity of the multilingual population within individual states, districts, or schools.

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