Foundational Reading Knowledge of Rural Special Educators of Students with IDD

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Abstract

Rural elementary special education teachers primarily working with students with intellectual and developmental disabilities (IDD) may have less access to training in foundational reading content. We report results of a foundational reading knowledge assessment administered to a national sample of 220 special education teachers working in various locales. On average, teachers answered 67% of items correctly. We conducted subgroup analyses using two approaches for parsing school locales (i.e., *postsprawl dichotomous* and *proximity*). Using the *postsprawl dichotomous* approach, we found that rural teachers (M = 13.13; SD = 2.47) had significantly greater knowledge than non-rural teachers (M = 11.84; SD = 3.17; p = .005). Descriptive item analyses revealed that rural teachers scored higher on several items assessing knowledge of terminology and lower on application items. The omnibus test was significant for the *proximity* group analysis as well (p = .048), but no pairwise comparisons were significant. We discuss implications for research and practice.

Keywords: intellectual disability, elementary (education), rural values/concerns, teachers/teaching

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Elementary special education teachers responsible for teaching children to read require foundational reading content knowledge, including knowledge of teaching word reading skills (e.g., phonemic awareness, phonics; Castles et al., 2018; Moats, 2009). Special education teachers working with students with intellectual and developmental disabilities (IDD)[1] in rural schools represent a cross-section of teachers who may be less likely to receive necessary training in foundational reading instruction. While teachers working in rural schools have many strengths (e.g., strong community ties; Kuenzi, 2021), they may have less access to professional networks and ongoing coaching support (Glover et al., 2016; McCabe & Ruppar, 2023), which has implications for both student achievement and teacher retention (Berry et al., 2011; Billingsley, 2004). Additionally, a historic emphasis on sight word instruction for students with IDD may contribute to a limited scope in training for special education teachers focused on this population (e.g., Browder et al., 2006). As an increasing amount of research supports the efficacy of code-based approaches to reading instruction for students with IDD (e.g., Sermier Dessemontet et al., 2019), it is important to investigate whether teachers across U.S. regions and locales are prepared to provide such instruction. In this study, we

1 We use the term intellectual and developmental disabilities (IDD) as a broad categorization inclusive of students who may receive special education services under the disability classifications of intellectual disability, autism, multiple disabilities, developmental delay, or other health impairment (not ADHD).

examine whether there are differences in teachers' knowledge based on school locale, using two methods of parsing school locale classifications (Roberts et al., 2020).

Reading Instruction for Students with IDD

Historically, elementary students with IDD, particularly those with extensive support needs (ESN), have not had access to comprehensive reading instruction (Keefe & Copeland, 2011). Federal legislation over the last 20 years has increased accountability metrics for schools and districts by mandating annual reporting of all students' academic progress. This has drawn increased attention to the quality and content of literacy instruction for students with IDD (Every Student Succeeds Act, 2015; Individuals with Disabilities Education Act, 2004).

One particular area of concern pertains to how students with IDD are taught to read words. In the past, whole word memorization was emphasized in reading intervention research (Browder et al., 2006) and reading programs frequently used with this group of students (e.g., Edmark; Bruni & Hixson, 2017). However, this approach provides little opportunity for students to generalize skills to read new words (Sermier Dessemontet et al., 2019). A recent meta-analysis of phonics intervention studies in which at least two-thirds of participants had IDD provided strong evidence of positive effects of code-based instruction on students' decoding skills ($g = 1.42$; Sermier Dessemontet et al., 2019). Notably, the effect size was substantially larger for single-case design studies (*n* = 8; g = 1.94) than group design studies (*n* = 6; *g* = 0.41).

Beyond intervention research, observation studies investigating business-as-usual reading instruction for students with IDD indicate many teachers still spending time on inefficient practices for word reading instruction (e.g., whole word memorization; Sermier Dessemontet et al., 2022; Lindström & Lemons, 2021). Both studies also reported inconsistencies in the instruction students received across classrooms (some within the same school building), which calls attention to the influence of individual special education teachers on curricular decisions and instructional approaches (Sermier Dessemontet et al., 2022; Lindström & Lemons, 2021). One teacher characteristic that influences instructional decision-making is their foundational reading content knowledge (Authors, in preparation).

Importance of Foundational Reading Content Knowledge

Teachers’ foundational reading knowledge (i.e., content knowledge, instructional practices) has recently garnered national attention. In the last five to ten years, 39 states have introduced structured literacy legislation that requires educator preparation programs and local education agencies to adhere to state mandates in one or more of the following categories: (a) teacher preparation content standards, (b) teacher certification requirements, (c) professional development and coaching for in-service teachers, (d) reading assessment, (e) curricular materials, and (f) instructional strategies and intervention intensity (Schwartz, 2022). Increased student achievement in states issuing these policies (e.g., Mississippi; Heubeck, 2023) provides some additional evidence supporting the importance of elementary teachers' knowledge of and preparation to provide reading instruction aligned with principles of structured literacy (e.g., explicit phonics instruction; Spear-Swerling, 2022). As structured literacy policies are introduced across the United States, examination of how teachers' knowledge increases across school locales may illuminate where additional training initiatives and resources are needed.

Foundational Reading Knowledge Measures

Many measures have been developed to assess teachers' foundational reading knowledge (Hudson et al., 2021). Across these studies--and measures--teachers have generally demonstrated greater accuracy on items assessing knowledge of definitions (e.g., phonemic awareness) as compared to items requiring knowledge application (e.g., counting or manipulating phonemes; Hudson et al., 2021). However, both types of knowledge are necessary for teaching early reading (Moats, 2009).

For this study, we used the *Teacher Knowledge Assessment: Structure of Language* (TKA:SOL) to measure teachers' foundational reading knowledge (Bos et al., 2001). Bos and colleagues (2001) initially administered the measure to both pre- (n = 286) and in-service (n = 252) elementary teachers. Of the in-service teachers, respondents primarily taught general education (n = 181; 63%) and special education (n = 44, 15%) in Grades K-3. On average, in-service teachers correctly responded to 12.0 items correctly (60%; *SD* = 2.8). Teachers were very accurate (> 90% accuracy) on items that required them to identify a word with a short vowel sound (*slip*), match words beginning with the same sound (*chef-shoe*), and match words with the same vowel sound (*tife-find*). They had the most difficulty (< 25% accuracy) with counting the number of phonemes in *box* (four) and identifying an example of a voice-unvoiced pair (*p-b*; Bos et al., 2001).

Beachy and colleagues (2023) recently administered the TKA:SOL to two samples of teachers: a national sample (*n* = 144; first administration) and a sample from one urban school district in Texas (*n* = 91; second administration). The purpose of the first administration was to refine the measure and conduct psychometric analyses. Item-level data from the first administration suggests that the same items remained easy and difficult for teachers as in Bos and colleagues' (2001) study, with some variability in the precise ordering of items by level of difficulty. Prior to the second administration, Beachy and colleagues (2023) eliminated five items with varying levels of difficulty, resulting in a 15-item measure with two subscales (i.e., phonemic awareness, phonics) for the second administration. Teachers' mean score on the reduced TKA:SOL measure was 63.9%. Notably, this is not a direct comparison to Bos and colleagues' (2001) report mean accuracy of 60% due to the removal of five items. Nonetheless, it does not indicate a substantial change in teachers' foundational reading knowledge over the last two decades, as measured by the TKA:SOL. Beachy and colleagues (2023) also reported results of subgroup analyses and found that teachers with more than 3 years of experience (i.e., 4-7, 8-15, or 16-19 years; *M* range: 65-77%) significantly outperformed teachers with 1-3 years of experience (*M* = 50%; *SD* = 21%). However, teachers with 20 or more years of experience did not have significantly higher accuracy than the teachers with 1-3 years of experience (*M* = 64%; *SD* = 19%).

Rural Teachers' Foundational Reading Knowledge

We did not identify any studies in which subgroup analyses have been conducted to compare teachers' foundational reading knowledge by locale. However, two recent studies (Jordan et al., 2018; Kehoe & McGinty, 2024) measured rural general education teachers' foundational reading knowledge using iterations of the *Teacher Knowledge Survey* (TKS; Moats, 2009; Piasta et al., 2009). Jordan and colleagues (2018) administered a 32-item version of the TKS to Grades K-1 teachers (*n* = 66) working in rural, low-income schools. Teachers had an average of 8.75 years of teaching experience. Prior to item reduction, teachers responded to 17.66 of the 32 items correctly (55.2%; *SD* = 4.46), indicating an average knowledge score on par with that reported in a previous study using an iteration of the TKS (i.e., Piasta et al., 2009; 52%). After confirmatory factor analysis, the authors reduced the measure to 24 items and reported a mean score of 71.02%, which is a higher estimate than those reported in previous studies that did not focus on rural teachers (e.g., Bos et al., 2001; Moats & Foorman, 2003; Piasta et al., 2009). Controlling for age, race, and grade, teacher experience was a significant predictor of foundational reading knowledge ($\beta = 0.22$; $p = .02$; $d = 0.61$; Jordan et al., 2018).

In another sample of 34 general education teachers working with students aged 5-8 in rural (remote) schools, Kehoe and McGinty (2024) reported that teachers had an average TKS score of 52.8% (*SD* = 10.2%), which is similar to previous administrations of the TKS (e.g., Piasta et al., 2009). Teachers demonstrated greater accuracy (> 80%) on items requiring them to count syllables and determine when 'ck' spells /k/. Their sample of teachers had approximately double the amount of average teaching experience (*M* = 16.97; *SD* = 8.8) as in Jordan and colleagues' (2018) sample, yet average scores were similar. Together, these studies indicate that general education teachers working in rural and non-rural environments have commensurate levels of content knowledge. Rural special education teachers' foundational reading knowledge, however, has received less attention.

Training and Professional Development in Rural Schools

Rural special education teachers experience greater challenges with accessing professional development due to the complexity of their roles (e.g., McCabe & Ruppar, 2023). Funding constraints in rural schools may expand special education teachers' roles and responsibilities, requiring them to teach students across multiple grade levels, content areas, and disability classifications (Rude & Miller, 2018). Such a dynamic role requires breadth and depth of knowledge, yet rural special education teachers report difficulty with establishing professional networks due, in part, to the small number of special education staff in their schools or districts (Berry et al., 2011; McCabe & Ruppar, 2023). In a survey of 203 former rural special education teachers randomly selected from 33 states, one third of respondents identified traveling long distances to attend trainings and securing a substitute as barriers to accessing professional development (Berry et al., 2011). The importance of professional development (PD) is amplified for special education teachers working with students with IDD, as they have (a) historically received less pre-service training in providing comprehensive reading instruction using code-based approaches for word reading instruction (Allor et al., 2009; Katims, 2000) and (b) demonstrated sustained shifts toward providing such instruction following professional development (Ahlgrim-Delzell & Rivera, 2015).

Several research groups have explored virtual professional development (PD) in rural settings as a tool to bridge the training access gap. Studies have focused on both multicomponent interventions for elementary students with reading difficulty (e.g., Vernon-Feagans et al., 2013, 2018) and instructional practices for individual reading domains (e.g., vocabulary; Collins et al., 2016). Together, results of these studies highlight the capacity of a virtual PD program to: (a) increase rural teachers’ knowledge and strengthen their practices and (b) improve student achievement. Further they foreground the value of live coaching via video conferencing, as virtual PD programs that included real-time modeling and coaching during intervention implementation (Vernon-Feagans et al., 2013, 2018) yielded greater student gains than a program with asynchronous components (e.g., recorded modules, readings) and consultation that did not occur during live instruction (Collins et al., 2016). As researchers continue to investigate effective approaches to professional development for rural teachers, comparison of teachers' knowledge across communities on a national scale, along with other mediating factors (e.g., theoretical orientations toward reading, classroom make-up), may offer implications for future training efforts tailored to rural contexts (Glover, 2017).

Methods for Locale Subgroup Analyses

To understand variability in the effects of educational policies, practices, or training initiatives across school locale classifications, it is important to consider the implications of locale parsing strategies (Roberts et al., 2020). Blunt dichotomies (e.g., rural vs. non-rural) can produce misleading interpretations of impact and decenter the strengths of rural communities (Roberts et al., 2020). Thus, decisions about data disaggregation have considerable implications when conducting subgroup analyses (Roberts et al., 2020). Their and colleagues (2020) outline five approaches to parsing data by locale (*blunt dichotomous*, *postsprawl dichotomous*, *superimposed quartiles*, *proximity*, and *fully nuanced*), all of which offer advantages and disadvantages for accounting for contextual differences in community types.

Purpose and Research Questions

The purpose of this study is to: (a) report results of a foundational reading knowledge assessment administered to a national sample of special education teachers who teach students with IDD in various school locales across the United States and (b) compare results of two approaches to examining differences in knowledge of teachers working in different locales. We ask the following questions:

1. Can special education teachers working with students with IDD accurately answer foundational reading knowledge content questions?
2. Do special education teachers’ mean scores on the *Teacher Knowledge Assessment: Structure of Language* differ significantly by their school’s locale?
3. Are different results obtained when using two different approaches to parsing school locales (i.e., *postsprawl dichotomous* vs. *proximity* approach)?

Method

Participants and Sampling

Our participants are drawn from a larger sample of respondents who completed a survey with several components. The present study included 220 special education teachers in the United States. To be eligible to complete our survey, participants had to: (a) teach at least one student with an intellectual or developmental disability in Grades K-5 and (b) report information we could use to determine their locale classification (National

Center for Education Statistics [NCES], n.d.). Teacher respondents were primarily white (84.1%) and female (95.9%). They had an average of 12.52 (*SD* = 8.93) total years of teaching experience. The range of total teaching experience was mostly consistent across all subgroups (range: 0-39), but there were no teachers with fewer than 6 years of experience in the remote subgroup. Nearly all participants reported that their highest degree earned was a bachelor's (34.1%) or master's (63.6%) degree. Table 1 displays demographic characteristics for the full sample of teachers in addition to demographics parsed by locale classification. In general, the demographic characteristics of the full sample were consistent across locales. A few notable differences include a: (a) lower proportion of racial/ethnic diversity in the distant and remote subgroups, (b) lower proportion of teachers with master's degrees in the remote subgroup, and (c) greater proportion of teachers with doctorate degrees in the remote subgroup. Respondents represented all five United States regions (i.e., Northeast, Midwest, Southeast, Southwest, West). A greater number of respondents were from the Northeast (40.9%) and West (20.9%), compared to the other three regions.

We report on participants' teaching contexts (i.e., grade level, teaching environment, students' primary disability classifications) in Table 2. Most respondents taught students in Grades K-5 only, but a small percentage of teachers taught some students in Pre-K (5.9%) or one or more grades above Grade 5 (17.3%). Respondents primarily worked in resource

(50.9%), inclusion or co-taught (27.7%), or self-contained cross-categorical classrooms (27.3%). In addition to our initial criteria of teaching students with IDD, we required that teachers indicate teaching students with autism, intellectual disability, multiple disabilities, developmental delay, or other health impairment (not ADHD). Almost all respondents reported teaching students receiving services under the IDEA disability classifications of autism (91.8%) and/or intellectual disability (76.4%). A smaller number of respondents reported that they taught students with multiple disabilities (37.3%) or a developmental delay (1.8%).

Survey

We developed a survey with five components: (a) teacher demographics, (b) teaching context, (c) instructional practices, (d) foundational reading knowledge, (e) theoretical orientations toward reading, and (f) teacher expectations. In this study, we report results of the foundational reading knowledge measure along with teachers’ demographics and teaching contexts.

Demographic and Contextual Information

The initial sections of the survey included multiple choice and short answer questions requesting basic demographic information (e.g., gender, race/ethnicity) and information about respondents’ teaching contexts (e.g., grade levels taught, students’ disability classifications, classroom type).

Teacher Knowledge Assessment: Structure of Language

We used Bos and colleagues (2001) *Teacher Knowledge Assessment: Structure of Language* to measure teachers' foundational reading knowledge (e.g., phonemic awareness, phonics). The assessment includes 20 multiple choice questions for which respondents select the correct answer from five to six response options, all of which included an "I don't know" option. All item descriptors are provided in Table 4. Full item wording, along with response options, was published in a previous study (Bos et al., 2001). Bos and colleagues (2001) reported Cronbach's alpha as a measure of the scale's reliability ($\alpha = .60$); they attributed low reliability to the low number of items and low variability. We examined the internal structure of the scale and confirmed its unidimensionality using Rasch analysis in a previous study (Authors, in preparation). As part of our psychometric evaluation, we removed two misfitting items from the scale, resulting in an 18-item measure. Prior to data analysis, we recoded all TKA:SOL items into dichotomous variables (1 = correct, 0 = incorrect). We coded "I don't know" responses as incorrect.

Procedures

We used *The Generalizer* webtool (Tipton & Miller, 2024) to generate four lists of elementary schools, stratified across various demographic characteristics (e.g., school size, race) and designed to be representative of schools across the United States. The lists rank schools in order of how well their demographics align with the stratum average school. Starting at the top of each list, research assistants (RAs) collected teachers' email addresses from teacher directories on school websites. RAs completed a 60 min training on how to navigate the websites, focusing on variability in directories and titles for special education teachers. In addition to our primary method for recruiting teachers, we also advertised the survey to related special education organizations (e.g., CEC, AAIDD) and at research and practitioner conferences. We allowed teachers to request an invitation to the survey via a Google form by providing their school email address. Prior to sharing a survey invitation, we used teachers' email addresses to verify their eligibility to participate.

We invited participants to complete the survey by sending them an email invitation to our survey on the REDCap web platform. To eliminate the risk of ineligible respondents gaining access to the survey, we enabled the reCAPTCHA feature and used an invitation-only recruitment procedure. Respondents were offered a 1-in-25 chance to receive a $50 Amazon gift card if they opted to complete a gift card entry form.

Locale Classification

We identified the school locale for each teacher using their school's NCES ID, drawn from *The Generalizer* school lists (Tipton & Miller, 2024). The NCES school look-up tool (https://nces.ed.gov/ccd/schoolsearch/) provides one of 12 NCES locale classification codes for each school (e.g., City - Large [11]). Locale classifications are designated by population density and distance from urban centers and are grouped into four broad categories: rural, town, suburban, and city (NCES, n.d.). The rural category encompasses three classifications: fringe (41), distant (42), and remote (43), with the remote locale representing areas most distant from small and large urban areas. Similarly, the town category includes fringe (31), distant (32), and remote (33) locales; however, these locales are distinct from rural locales in that they are located within small urban areas but still at a distance from larger urban areas (i.e., population > 50,000). Suburban locales include large (21), midsize (22), and small (23) areas, categorized by the population of the urban areas in which they are located in and around (range = 50,000-250,000). Notably, all suburban areas are *outside* of principal cities. Finally, cities are categorized as large (11), midsize (12), and small (13), but they are all located *inside* principal cities and are distinguished by population size with a population of 250,000 or more indicating a large city (NCES, n.d.). We report the number of respondents working in each NCES locale in Table 3.

In this study, we employ both the *postsprawl dichotomous* and *proximity* approaches to subgroup analyses (Thier et al., 2020). The *postsprawl dichotomous* approach (rural vs. non-rural) combines distant (32, 42) and remote (33, 43) locales to represent rural communities (Thier et al., 2020). In contrast, the *proximity* approach parses locales into five subgroups: city (11, 12, 13), suburb (21, 22, 23), fringe (31, 41), distant (32, 42), and remote (33, 43; Thier et al., 2020). We also report descriptive statistics for the TKA:SOL using a *fully nuanced* approach, disaggregating data for each of the 12 NCES locale classification codes (see Table 3).

Generalizability

The Generalizer webtool (Tipton & Miller, 2024) calculates a generalizability index (range: 0-1) which describes the degree to which the sample is representative of the United States as a whole. Generalizability index values above 0.9 indicate high generalizability (Tipton & Olsen, 2018). For this sample, the United States generalizability index was 0.97 for the United States, indicating very high generalizability (Tipton & Miller, 2024).

Data Diagnostics

Confidence in data quality has been cited as a limitation of online research in the past (Meade & Craig, 2012; Roberts & Allen, 2015). To increase confidence in our data quality, we used several strategies including: (a) removing responses with completion times of fewer than 10 minutes; (b) embedding three attention checks within the survey (e.g., *What is the fourth month of the year?)*, (c) embedding a consistency check on a demographics item, and (d) confirming that participants indicated that they taught eligible grade levels and students with eligible disability classifications on both the consent and survey forms. We eliminated 43 responses that did not meet one or more of these criteria, primarily due to ineligible grade levels and student disability classifications. We analyzed missing data patterns in SPSS Version 29.0. All eligible responses were included in our analysis, and we rescored missing data values on the TKA:SOL as incorrect responses.

Data Analysis

Descriptive Statistics

We conducted all descriptive analyses in SPSS Version 29.0. This included requesting frequencies for categorical variables and descriptive statistics for continuous variables. We used the crosstabs procedure to analyze demographic variables and item difficulties by locale subgroup (e.g., remote, fringe). Additionally, we calculated Cronbach's alpha as a measure of reliability.

One-Way ANOVA

For our initial analysis, we examined group mean differences using two locale parsing strategies: *postsprawl dichotomous* and *proximity* (Thier et al., 2020).

Postsprawl Dichotomous Approach Subgroup Analysis. For this subgroup analysis, we compared teachers' mean knowledge using the *postsprawl dichotomous* approach (i.e., rural vs. nonrural; see Locale Classifications, above). We planned to use one-way ANOVA with post hoc pairwise comparisons of group mean differences for both grouping approaches, but our data violated two assumptions of ANOVA: equal group sizes and equal variances (Pituch & Stevens, 2016). Instead, we used Welch's ANOVA (Welch, 1951), which can be used when the equal variances assumption is violated.

Proximity Approach Subgroup Analysis. To examine locale subgroups in a more nuanced manner, we used the *proximity* approach (Thier et al., 2020). We compared (a) city, (b) suburban, (c) fringe, (d) distant, and (e) remote locales. NCES locale classification codes comprising each subgroup are reported in the Locale Classifications section above. Due to violations of ANOVA assumptions (i.e., equal group sizes and equal variances), we used Welch’s ANOVA (Welch, 1951) for the omnibus test. We tested nine pairwise contrasts (e.g., city vs. remote) using Dunnett’s T3 multiple comparison procedure, which is robust to unequal variances and a more appropriate choice when group sizes are small (i.e., < 50; Dunnett, 1980).

Results

Missing Data

Of the 18 variables representing items on the TKA:SOL assessment, 13 had missing data values (range: 1-3 missing values per variable; *Mdn* = 1). Across all 220 survey responses, 15 had missing data values (range: 1-2 missing values per respondent). The total percentage of missing values across all values was 0.46%.

Descriptive Statistics

Teachers correctly answered an average of 13.39 out of 20 items (67.0%) on the TKA:SOL. On the abbreviated measure (based on results of a previous Rasch analysis; Authors, in preparation), teachers correctly answered 12.10 out of 18 items (67.2%) on average. We calculated Cronbach’s alpha as a measure of reliability for the 18-item scale, and the alpha value was acceptable ($\alpha = .726$; Bandalos, 2018).

Descriptive statistics for each of the 18 retained TKA:SOL items, disaggregated by *proximity* group, are provided in Table 4. A few items stand out as having greater variability across subgroups. Remote teachers were approximately 25% more accurate when asked to define *consonant blend* or *digraph* than teachers in the other four *proximity* groups. However, remote teachers were markedly less accurate in identifying a voiced-unvoiced pair (*p-b*) or isolating the second phoneme in *queen* (/w/). Distant teachers were more accurate when asked to define *phonics*, reverse the phonemes in *ice* (enough), and identify a word without a silent letter (*phop*) relative to other groups. Notably, three items that distant and remote teachers demonstrated greater accuracy on required knowledge of definitions, rather than application of that knowledge.

Inferential Statistics: Postsprawl Dichotomous Analysis

We obtained a significant result for our hypothesis test examining differences in teachers' knowledge using the *postsprawl dichotomous* approach to subgroup analysis. The results of Levene's test for equal group variances was significant (p = .027), indicating that the assumption of homogeneity of variances was violated. Thus, we proceeded with Welch's ANOVA. The result of the omnibus test demonstrated a significant difference in teachers' knowledge ($F(1, 79.19) = 8.454$; p = .005). Special education teachers in rural settings (i.e., distant and remote locales; M = 13.13; SD = 2.47) had significantly greater knowledge than those in non-rural settings (M = 11.84; SD = 3.17).

Inferential Statistics: Proximity Group Analysis

Our analysis of knowledge differences using the *proximity group* approach also yielded a significant result for the omnibus test, but not for pairwise comparisons. The results of Levene's test for equal group variances was significant when applying this approach (p = .018), indicating that the assumption of homogeneity of variances was violated. Thus, we again proceeded with Welch's ANOVA. The result of the omnibus test was significant (F(4, 65.53) = 2.546; p = .048), indicating significant differences in teachers' average foundational reading knowledge by *proximity* group. Absolute values of mean differences ranged from 0.038 (distant vs. remote; p = 1.000) to 1.599 (remote vs. fringe; p = .194). However, none of the group mean differences were significant (see Table 5 for multiple comparison post hoc test results).

Discussion

Across all locale groups, teachers answered approximately 67% of foundational reading knowledge questions correctly. Average knowledge scores by *proximity* group (i.e., city, suburb, fringe, distant, remote) ranged from 64.3% to 73.2%, with teachers in the remote group having the highest average score. Using the *postsprawl dichotomous* approach, average accuracy for teachers in non-rural settings was 65.7%, compared to 72.9% for teachers in rural settings.

We achieved different results using two different approaches to parsing locale classifications for subgroup analyses. For both the *postsprawl dichotomous* and *proximity* locale parsing approaches, the omnibus tests were significant. However, no pairwise comparisons were significant when we compared *proximity* subgroups (e.g., city vs. remote). We concluded that there are significant differences in teachers' foundational reading knowledge within our sample, with teachers in rural schools demonstrating greater accuracy on the TKA:SOL. However, we were unable to detect differences between subgroups (e.g., city vs. remote) using the *proximity* approach to parsing locales, possibly because we had to use a more conservative procedure for pairwise comparisons due to low sample size and high variability across subgroups.

Our results are encouraging, as they suggest that despite reports of less access to training opportunities for special education teachers working with students with IDD in rural schools (Berry et al., 2011), distant and remote teachers together (i.e., rural teachers) demonstrated significantly greater knowledge than non-rural teachers (i.e., cities, suburbs, fringe). However, it is important to note that teachers in remote and distant locales scored higher on several TKA:SOL items assessing knowledge of foundational reading terminology and lower on items that required them to apply that knowledge. Though knowledge of terminology is important, application items are a better indicator of teachers' preparedness to teach foundational reading skills (Moats & Foorman, 2003; Moats, 2009).

The average TKA:SOL accuracy we report for teachers in our sample (67%) is comparable to previous samples in which teachers were assessed using versions of the same measure (Bos et al., 2001 [60%; 20 items]; Beachy et al., 2023 [63.9%; 15 items]). Bos and colleagues reported that less than half of in-service teachers correctly answered 8 of the 20 items. Fewer than 25% of teachers accurately identified a voiced-unvoiced pair or counted the number of phonemes in ‘box.’ Between 25% and 50% of teachers correctly answered questions requiring them to define foundational reading terminology (*digraph, phonics, phonological awareness*), count phonemes in ‘grass,’ identify the second phoneme in ‘queen,’ or identify a word without a silent letter.

Within our sample, teachers’ accuracy on the TKA:SOL was at or below 50% for only four of the 18 retained items, indicating increased accuracy as compared to Bos and colleagues’ (2001) sample. The four most difficult items in our sample overlapped with the most difficult items reported by Bos and colleagues. The primary difference between the two samples was our observed increase in teachers' average accuracy (> 60% on all definition items). This pattern may be attributed to overall national trends emphasizing foundational reading content in special education teacher preparation programs (Drake & Wash, 2020).

Because prior studies measuring rural teachers’ knowledge, specifically, used a different foundational reading assessment, we cannot make a direct comparison to their results (i.e., Jordan et al., 2018; Kehoe & McGinty, 2024). However, it is of note that distant teachers in our sample had greater average accuracy than all other subgroups (i.e., city, suburb, fringe, remote) on three of the four most difficult items, but they had the lowest average score on the most difficult item. In contrast, remote teachers scored highest on the most difficult item by a small margin and lowest on three of the four most difficult items. Considered together, these findings highlight the importance of examining accuracy and locale with an appropriate lens of complexity, as oversimplification of either can yield different results and interpretations.

Prior research has also reported an association between teaching experience and increased foundational reading knowledge for non-rural (Beachy et al., 2023) and rural teachers (Jordan et al., 2018). In our sample, the respondents in the remote subgroup had relatively more years of total teaching experience and no teachers with fewer than six years of teaching experience (range: 6-33 years). Further, two respondents had doctoral level degrees, reflecting the highest proportion of respondents with doctoral degrees in any subgroup. It is possible that greater knowledge in the remote subgroup is indicative of increased experience and training and does not reflect potential disparities in access to in-service training for teachers in rural schools. Alternatively, these findings may be explained by increased efforts to connect rural teachers to training resources using innovative approaches such as virtual professional development (Collins et al., 2016).

Limitations

Our results should be interpreted with consideration of several limitations. First, the size of our sample and distribution of respondents across subgroups limited our options for hypothesis testing. We used more conservative analyses to compensate for unequal group sizes and unequal variances. Thus, it is possible that we would have produced different results with a larger sample, equally distributed groups, and equal variances across subgroups. Second, we were unable to use a *fully nuanced* approach to subgroup analyses due to sample size (Thier et al., 2020). However, we reported descriptive statistics for each of the 12 locale classification groups (see Table 2). Third, greater knowledge of foundational reading terminology may have inflated TKA:SOL scores for teachers working in schools in remote or distant areas. Although rural teachers demonstrated significantly higher average knowledge than non-rural teachers on the TKA:SOL, the measure did not directly assess applied pedagogical knowledge (i.e., as implemented in schools). Finally, as with any distribution of an online survey, there is a risk that respondents may have provided inaccurate or inattentive responses that could alter results. Though it remains a possibility, we used many strategies to increase confidence in the quality of our data during the data collection and analysis phases (e.g., invitation-only distribution, attention and consistency checks).

Implications for Research and Practice

Our findings have several implications for research and practice. Future studies may consider recruiting a larger sample of teachers with a sufficiently equal distribution of respondents across all 12 NCES locale classifications to permit a *fully nuanced* approach to examining potential differences in teachers' foundational reading knowledge across locales. Additionally, collecting data pertaining to respondents' certification type (e.g., disability-specific vs. cross-categorical) or whether they teach reading to students with IDD who have extensive support needs versus students with fewer support needs may provide greater insight into potential adjustments to teacher preparation and training in efforts to increase students' reading achievement and teacher retention. Future research, using similar parsing strategies, should also examine other facets of teachers' knowledge (e.g., pedagogical content knowledge, knowledge of learners; Shulman, 1987) and application of their knowledge during instruction.

Limited access to professional development has long been cited as an issue for rural special education teachers (Berry et al., 2011; McCabe & Ruppar, 2023). However, in this study, we report that teachers in the distant and remote *proximity* groups had the highest average TKA:SOL scores, which is counter to deficit framings of rural education (Roberts et al., 2020). With consideration of item-level data, our descriptive results uncover nuances in knowledge differences among rural and non-rural teachers, indicating that rural teachers had greater knowledge of foundational word reading terminology but less knowledge of applied definitions relative to non-rural teachers. We hypothesize that this pattern may stem from rural teachers' participation in asynchronous or static learning opportunities and/or self-teaching efforts (e.g., reading curricular materials) combined with less access to support from coaching and consultative staff (Glover et al., 2016). Thus, training activities that increase flexibility but reduce interaction (e.g., watching a pre-recorded lecture) should be carefully weighed and balanced with direct interaction (e.g., live virtual coaching; Glover, 2017; Vernon-Feagans et al., 2013, 2018) when designing virtual professional development programming related to word reading instruction. Finally, collaboration across locales through professional learning communities (Glover et al., 2016) and school-university partnerships (Barnett & Huang, 2024) may further facilitate knowledge sharing and development.

Conclusion

Knowledge of rural teachers working with students with IDD represents an important area of study, as there are relatively few rural teachers and students with IDD, regardless of the various ways these groups are defined. Thus, both are at risk of being overlooked from a numbers perspective. In the interest of providing equitable reading instruction to students with IDD being served in rural settings, more work needs to be done to understand the strengths and needs of rural teachers as they relate to reading knowledge and to offer effective, context-driven professional development that supports high-quality implementation.

References

Ahlgrim-Delzell, L., & Rivera, C. (2015). A content comparison of literacy lessons from 2004 and 2010 for students with moderate and severe intellectual disability. *Exceptionality*, *23*(4), 258–269. https://doi.org/10.1080/09362835.2015.1064417

Allor, J. H., Mathes, P. G., Champlin, T., & Cheatham, J. P. (2009). Research-based techniques for teaching early reading skills to students with intellectual disabilities. *Education and Training in Developmental Disabilities*, *44*(3), 356–366. https://www.jstor.org/stable/24233480

Bandalos, D. L. (2018). *Measurement theory and applications for the social sciences*. Guilford Publications.

Barnett, E., & Huang, T. (2024). Increasing teacher retention and supporting students with low-incidence disabilities through university partnership. *Rural Special Education Quarterly*, *43*(1), 44–57. https://doi.org/10.1177/87568705241232388

Beachy, R., Guo, D., Wright, K. L., & McTigue, E. M. (2023). The teachers' perceptions and knowledge of reading assessment survey: A validation study. *Reading & Writing Quarterly*, *39*(6), 559–581. https://doi.org/10.1080/10573569.2022.2156954

Berry, A. B., Petrin, R. A., Gravelle, M. L., & Farmer, T. W. (2011). Issues in special education teacher recruitment, retention, and professional development: Considerations in supporting rural teachers. *Rural*

Special Education Quarterly, *30*(4), 3–11. https://doi.org/10.1177/875687051103000402

Billingsley, B. S. (2004). Special education teacher retention and attrition: A critical analysis of the research literature. *The Journal of Special Education*, *38*(1), 39–55. https://doi.org/10.1177/00224669040380010401

Bos, C., Mather, N., Dickson, S., Podhajski, B., & Chard, D. (2001). Perceptions and knowledge of preservice and inservice educators about early reading instruction. *Annals of Dyslexia*, *51*(1), 97–120. https://doi.org/10.1007/s11881-001-0007-0

Browder, D. M., Wakeman, S. Y., Spooner, F., Ahlgrim-Delzell, L., & Algozzinexya, B. (2006). Research on reading instruction for individuals with significant cognitive disabilities. *Exceptional Children*, *72*(4), 392–408. https://doi.org/10.1177/001440290607200401

Bruni, T. P., & Hixson, M. D. (2017). Beyond sight words: Reading programs for people with intellectual disabilities. *Behavioral Development Bulletin*, *22*(1), 249–257. https://doi.org/10.1037/bdb0000062

Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest*, *19*(1), 5–51. https://doi.org/10.1177/1529100618772271

Collins, G. G., Goforth, A. N., & Ambrose, L. M. (2016). The effects of teacher professional development on rural students' lexical inferencing skills. *Rural Special Education Quarterly*, *35*(3), 20–29. https://doi.org/10.1177/875687051603500304

Drake, G., & Wash, K. (2020). *Teacher prep review: Program performance in early reading instruction*. National Council on Teacher Quality. https://eric.ed.gov/?id=ED602860

Dunnett, C. W. (1980). Pairwise multiple comparisons in the unequal variance case. *Journal of the American Statistical Association*, *75*(372), 796–800. https://doi.org/10.1080/01621459.1980.10477552

Every Student Succeeds Act, 20 U.S.C. § 6301 (2015). https://www.congress.gov/bill/114th-congress/senate-bill/1177

Glover, T. A. (2017). Investigating teacher professional development with distance coaching to promote students' response to reading interventions in rural schools. In G. C. Nugent, G. M. Kunz, S. M. Sheridan, T. A. Glover, & L. L. Knoche (Eds.), *Rural Education Research in the United States* (pp. 167–179). Springer International Publishing. https://doi.org/10.1007/978-3-319-42940-3_9

Glover, T. A., Nugent, G. C., Chumney, F. L., Ihlo, T., Shapiro, E. S., Guard, K., Koziol, N., & Bovaird, J. (2016). Investigating rural teachers' professional development, instructional knowledge, and classroom practice. *Journal of Research in Rural Education*, *31*(3). https://eric.ed.gov/?id=EJ1101917

Heubeck, E. (2023). Mississippi students surged in reading over the last decade. Here's how schools got them there. *Education Week*. https://www.edweek.org/teaching-learning/ mississippi-students-surged-in-reading-over-the-last-decade-heres-how-schools-got-them-there/2023/06

Hudson, A. K., Moore, K. A., Han, B., Wee Koh, P., Binks-Cantrell, E., & Malatesha Joshi, R. (2021). Elementary teachers' knowledge of foundational literacy skills: A critical piece of the puzzle in the science of reading. *Reading Research Quarterly*, *56*(S1). https://doi.org/10.1002/rrq.408

Individuals with Disabilities Education Act, 20 U.S.C. § 1412 (2004).

Jordan, R. L. P., Bratsch-Hines, M., & Vernon-Feagans, L. (2018). Kindergarten and first grade teachers' content and pedagogical content knowledge of reading and associations with teacher characteristics at rural low-wealth schools. *Teaching and Teacher Education*, *74*, 190–204. https://doi.org/10.1016/j.tate.2018.05.002

Katims, D. S. (2000). Literacy instruction for people with mental retardation: Historical highlights and contemporary analysis. *Education and Training in Mental Retardation and Developmental Disabilities*, *35*(1), 3–15. https://www.jstor.org/stable/23879702

Keefe, E. B., & Copeland, S. R. (2011). What is literacy? The power of a definition. *Research and Practice for Persons with Severe Disabilities*, *36*(3–4), 92–99. https://doi.org/10.2511/027494811800824507

Kehoe, K. F., & McGinty, A. S. (2024). Exploring teachers’ reading knowledge, beliefs and instructional practice. *Journal of Research in Reading*, *47*(1), 63–82. https://doi.org/10.1111/1467-9817.12440

Kuenzi, J. J. (2021). *The rural education achievement program: Title V-B of the Elementary and Secondary Education Act*. Congressional Research Report. https://eric.ed.gov/?id=ED614202

Lindström, E. R., & Lemons, C. J. (2021). Teaching reading to students with intellectual and developmental disabilities: An observation study. *Research in Developmental Disabilities*, *115*. https://doi.org/10.1016/j.ridd.2021.103990

McCabe, K. M., & Ruppar, A. L. (2023). Rural inclusive education for students with disabilities in the United States: A narrative review of research. *Rural Educator*, *44*(1), 40–55. https://eric.ed.gov/?id=EJ1382555

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, *17*(3), 437–455. https://doi.org/10.1037/a0028085

Moats, L. (2009). Knowledge foundations for teaching reading and spelling. *Reading and Writing*, *22*(4), 379–399. https://doi.org/10.1007/s11145-009-9162-1

Moats, L. C., & Foorman, B. R. (2003). Measuring teachers’ content knowledge of language and reading. *Annals of Dyslexia*, *53*(1), 23–45. https://doi.org/10.1007/s11881-003-0003-7

National Center for Education Statistics. (n.d.). Locale Classifications. https://nces.ed.gov/programs/edge/Geographic/LocaleBoundaries.

Piasta, S. B., Connor, C. M., Fishman, B. J., & Morrison, F. J. (2009). Teachers' knowledge of literacy concepts, classroom practices, and student reading growth. *Scientific Studies of Reading*, *13*(3), 224–248. https://doi.org/10.1080/10888430902851364

Pituch, K. A., & Stevens, J. (2016). *Applied multivariate statistics for the social sciences: analyses with SAS and IBM's SPSS* (6th edition). Routledge.

Roberts, L. D., & Allen, P. J. (2015). Exploring ethical issues associated with using online surveys in educational research. Educational Research and Evaluation, 21(2), 95–108. https://doi.org/10.1080/13803611.2015.1024421

Roberts, P., Thier, M., & Beach, P. (2020). Erasing rurality: On the need to disaggregate statistical data. In P. Roberts & M. Fuqua (Eds.), *Ruraling education research: Connections between rurality and the disciplines of educational research* (pp. 107–127). Springer.

Rude, H., & Miller, K. J. (2018). Policy challenges and opportunities for rural special education. *Rural Special Education Quarterly*, *37*(1), 21–29. https://doi.org/10.1177/8756870517748662

Sermier Dessemontet, R., Linder, A.-L., Martinet, C., & Martini-Willemin, B.-M. (2022). A descriptive study on reading instruction provided to students with intellectual disability. *Journal of Intellectual*

Disabilities, *26*(3), 575–593. https://doi.org/10.1177/17446295211016170

Sermier Dessemontet, R., Martinet, C., de Chambrier, A.-F., Martini-Willemin, B.-M., & Audrin, C. (2019). A meta-analysis on the effectiveness of phonics instruction for teaching decoding skills to students with intellectual disability. *Educational Research Review*, *26*, 52–70. https://doi.org/10.1016/j.edurev.2019.01.001

Schwartz, S. (2022). Which states have passed "science of reading" Laws? What's in them? *Education Week*. https://www.edweek.org/teaching-learning/which-states-have-passed- science-of-reading-laws-whats-in-them/2022/07

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–23. https://doi.org/10.17763/haer.57.1.j463w79r56455411

Spear-Swerling, L. (2022). An introduction to structured literacy and poor-reader profiles. In *Structured literacy interventions: Teaching students with reading difficulties, Grades K-6* (pp. 1–20). The Guilford Press.

Thier, M., Beach, P., Martinez Jr., C. R., & Hollenbeck, K. (2020). Take care when cutting: Five approaches to disaggregating school data as rural and remote. *Theory & Practice in Rural Education*, *10*(2), 63–84. https://doi.org/10.3776/tpre.2020.v10n2p63-84

Tipton, E., & Miller, K. (2024). *The Generalizer*. Webtool hosted at https://thegeneralizer.org.

Tipton, E., & Olsen, R. B. (2018). A review of statistical methods for generalizing from evaluations of educational interventions. *Educational Researcher*, *47*(8), 516–524. https://doi.org/10.3102/0013189X18781522

Vernon-Feagans, L., Bratsch-Hines, M., Varghese, C., Cutrer, E. A., & Garwood, J. D. (2018). Improving struggling readers' early literacy skills through a tier 2 professional development program for rural classroom teachers: The targeted reading intervention. *The Elementary School Journal*, *118*(4), 525–548. https://doi.org/10.1086/697491

Vernon-Feagans, L., Kainz, K., Hedrick, A., Ginsberg, M., & Amendum, S. (2013). Live webcam coaching to help early elementary classroom teachers provide effective literacy instruction for struggling readers: The Targeted Reading Intervention. *Journal of Educational Psychology*, *105*(4), 1175–1187. https://doi.org/10.1037/a0032143

Welch, B. L. (1951). On the comparison of several mean values: An alternative approach. *Biometrika*, *38*(3/4), 330–336. https://doi.org/10.2307/2332579

Table 1
Teacher Demographics and Characteristics

Characteristic	Total		City		Suburb		Fringe		Distant		Remote	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender												
Female	211	95.9	65	97.0	70	95.9	37	100	27	87.1	12	100
Male	6	2.7	2	3.0	1	1.4	0	0	3	9.7	0	0
Nonbinary	0	0	0	0	0	0	0	0	0	0	0	0
No response	3	1.4	0	0	2	2.7	0	0	1	3.2	0	0
Race/ethnicity												
Black/African American	14	6.4	5	7.2	4	5.4	2	5.3	2	6.5	1	8.3
White	185	84.1	53	76.8	62	83.8	33	86.8	27	87.1	10	83.3
Hispanic or Latinx	8	3.6	5	7.2	2	2.7	1	2.6	0	0	0	0
Asian or Pacific Islander	6	2.7	1	1.4	4	5.4	1	2.6	0	0	0	0
Multiracial	2	0.9	2	2.9	0	0	0	0	0	0	0	0
Native American/Alaska Native	2	0.9	1	1.4	0	0	0	0	1	3.2	0	0
No response	7	3.2	2	3.0	2	2.8	1	2.7	1	3.2	1	8.3
Highest degree earned												
Bachelor's degree	75	34.1	24	35.8	24	32.9	11	29.7	11	35.5	5	41.7
Master's degree	140	63.6	42	62.7	48	65.8	26	70.3	19	61.3	5	41.7
Doctorate	5	2.3	1	1.5	1	1.4	0	0	1	3.2	2	16.7
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Teaching experience (years)												
Special education	10.7	8.4	10.0	7.2	10.5	8.9	12.4	9.0	10.9	8.7	9.3	8.9
Total	12.5	8.9	11.8	8.0	12.0	8.9	13.2	9.4	13.5	10.2	14.6	10.2

Note. Totals for race/ethnicity exceed the total number of responses. Total $N = 220$; City $N = 67$; Suburb $N = 72$; Fringe $N = 37$; Distant $N = 31$; Remote $N = 12$.

Table 2

Teacher Context

Variable	*n*	%
Grade level		
Pre-Kindergarten	13	5.9
Kindergarten	108	49.1
First	117	53.2
Second	130	59.1
Third	144	65.5
Fourth	144	65.5
Fifth	127	57.7
Sixth	36	16.4
Seventh	12	5.5
Eighth	12	5.5
Ninth	4	1.8
Tenth	3	1.4
Eleventh	4	1.8
Twelfth	4	1.8
Teaching environment		
Resource classroom in a public school	112	50.9
Inclusive classroom in a public school	61	27.7
Self-contained cross-categorical classroom in a public school	60	27.3
Self-contained disability-specific classroom in a public school	26	11.8
Homebound instruction	2	0.9
Separate public school for students with disabilities	0	0
Alternative private/public school for students removed from other schools	0	0
Not listed	5	2.3
Students' primary disabilities		
Autism	202	91.8
Intellectual disability	168	76.4
Specific learning disability	165	75.0
Speech or language impairment	127	57.7
Emotional disturbance/behavior disorder	90	40.9
Multiple disabilities	82	37.3
Other health impairment	36	16.4

Visual impairment	30	13.6
Hearing impairment	29	13.2
Orthopedic impairment	26	11.8
Traumatic brain injury	12	5.5
Developmental delay	4	1.8
Not listed	3	1.4

Note. The totals for grade level, teaching environment, and students' primary disabilities exceed the total number of responses.

Table 3

Mean Foundational Reading Knowledge Scores by Locale

Locale	*n*	%	TKA *M*	TKA *SD*
United States Region				
Northeast (CT, MA, MD, ME, NH, NJ, NY, PA, RI, VT)	90	40.9	12.10	2.70
Midwest (IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI)	23	10.5	11.87	3.24
Southeast (AL, AR, DE, GA, FL, KY, LA, MS, NC, SC, TN, WV)	39	17.7	11.15	3.58
Southwest (AZ, NM, OK, TX)	22	10.0	12.00	3.04
West (AK, CA, CO, HI, ID, MT, NV, OR, UT, WA, WY)	46	20.9	13.04	3.15
Fully Nuanced Approach				
City: Large (11)	29	13.2	12.10	3.30
City: Midsize (12)	9	4.1	11.67	3.50
City: Small (13)	29	13.2	12.03	2.57
Suburb: Large (21)	60	27.3	11.78	3.51
Suburb: Midsize (22)	10	4.5	12.30	3.68
Suburb: Small (23)	3	1.4	11.00	3.61
Town: Fringe (31)	5	2.3	11.20	3.03
Town: Distant (32)	18	8.2	12.94	2.73
Town: Remote (33)	6	2.7	13.67	1.86
Rural: Fringe (41)	32	14.5	11.62	2.89
Rural: Distant (42)	13	5.9	13.38	2.87
Rural: Remote (43)	6	2.7	12.67	1.37
Proximity Approach				
City (12, 13, 14)	67	30.5	12.01	2.99
Suburb (21, 22, 23)	73	33.2	11.82	3.49
Fringe (31, 41)	37	16.8	11.57	2.87
Distant (32, 42)	31	14.1	13.13	2.75
Remote (33, 43)	12	5.5	13.17	1.64
Postsprawl Dichotomous Approach				
Non-rural (11, 12, 13, 21, 22, 23, 31, 41)	177	80.5	11.84	3.17
Rural (32, 33, 42, 43)	43	19.5	13.14	2.47

Note. NCES = National Center for Education Statistics. Mean knowledge score is the number of items answered correctly out of 18 items on the *Teacher Knowledge Assessment: Structure of Language* (TKA:SOL; Bos et al., 2001).

Table 4

Correct Foundational Reading Knowledge Items by Community Size and Urban Proximity Group

Knowledge Item Descriptor	Total		City		Suburb		Fringe		Distant		Remote		Missing	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Identify word with short vowel sound	205	93.6	60	90.9	69	94.5	33	89.2	31	100.0	12	100.0	1	0.5
Define syllable	146	66.4	47	70.1	48	65.8	19	51.4	22	71.0	10	83.3	0	0.0
Identify word with long vowel sound	204	92.7	61	91.0	65	89.0	37	100.0	30	96.8	11	91.7	0	0.0
Define consonant blend	158	72.8	45	69.2	54	75.0	24	64.9	23	74.2	12	100	3	1.4
Identify voiced-unvoiced pair	78	35.8	23	34.8	28	38.4	10	27.0	15	50.0	2	16.7	2	0.9
Define digraph	170	77.6	48	72.7	56	76.7	30	81.1	24	77.4	12	100.0	1	0.5
Count phonemes (eight)	190	87.2	55	82.1	62	86.1	33	89.2	28	93.3	12	100.0	2	0.9
Count phonemes (box)	34	15.6	11	16.7	12	16.7	1	2.7	7	22.6	3	25.0	2	0.9
Count phonemes (grass)	138	62.7	44	65.7	46	63.0	19	51.4	20	64.5	9	75.0	0	0.0
Identify example of phoneme deletion	178	81.3	57	85.1	57	79.2	28	75.7	26	83.9	10	83.3	1	0.5
Identify example of phoneme blending	183	83.6	57	85.1	58	79.5	30	83.3	27	87.1	11	91.7	1	0.5
Identify the second phoneme in a word (queen)	55	25.0	18	26.9	21	28.8	7	18.9	8	25.8	1	8.3	0	0.0

Define phonics	139	63.5	43	65.2	40	54.8	23	62.2	25	80.6	8	66.7	1	0.5
Identify a word with a soft c	196	89.5	63	95.5	62	84.9	32	86.5	27	87.1	12	100.0	1	0.5
Identify two words that begin with the same phoneme	195	89.0	60	89.6	65	89.0	33	89.2	26	86.7	11	91.7	1	0.5
Reverse order of phonemes (ice)	161	73.5	43	64.2	53	73.6	28	75.7	27	87.1	10	83.3	1	0.5
Reverse order of phonemes (enough)	151	68.6	47	70.1	44	60.3	27	73.0	24	77.4	9	75.0	0	0.0
Identify a word with no silent letter	80	36.5	23	34.8	23	31.5	14	37.8	17	54.8	3	25.0	1	0.5

Note. Mean knowledge score is the number of items scored correct out of 18 on the *Teacher Knowledge Assessment: Structure of Language* (Bos et al., 2001). Valid percentages are reported.

Table 5

Results of Dunnett’s T3 Multiple Comparison Post Hoc Tests

Contrast	*M* Difference	*SE*	*P*	95% CI
Fringe vs. City	-0.447	.597	.997	-2.16, 1.27
Fringe vs. Suburb	-0.254	.625	1.000	-2.05, 1.54
Fringe vs. Distant	-1.561	.684	.223	-3.54, 0.42
Fringe vs. Remote	-1.599	.669	.194	-3.59, 0.40
Distant vs. City	1.114	.615	.524	-0.67, 2.89
Distant vs. Suburb	1.307	.642	.361	-0.54, 3.16
Distant vs. Remote	-0.038	.685	1.000	-2.08, 2.01
Remote vs. City	1.152	.598	.456	-0.66, 2.97
Remote vs. Suburb	1.345	.626	.313	-0.53, 3.22

Note. 95% CI = confidence interval for group mean differences for each contrast.