STEM Teachers' Preparedness for English Language Learners

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Abstract

The growth of English Language Learners (ELLs) in the K-12 education system has sparked discussions regarding STEM teachers' ability to meet the needs of these learners. STEM teachers have reported that they do not feel prepared and often lack professional development opportunities to develop the necessary skills to meet these needs. (August & Shanahan, 2010; Ballantyne, Sanderman, & Levy, 2007; Janzen, 2008, U.S. Department of Education, NCES, 2001). However, STEM teachers' preparation for ELLs, their participation in ELL specific professional development activities, and the degree of inclusion of ELL students in STEM disciplines is relatively unexplored. The most recent School and Staffing Survey Teacher Questionnaire was used to analyze STEM teachers' credentialing related to ELLs, their participation in ELL specific professional development activities, and the degree of ELL student participation in STEM classrooms. It was found that very few STEM teachers had ELL credentialing. While more than half indicated having ELLs in their service load, less than 25% participated in any ELL specific professional development activities.

Keywords: *STEM education, School and Staffing Survey Teacher Questionnaire, English Language Learners*

Background

The fastest-growing student population in U.S. schools today is children of immigrants; half of whom do not speak English fluently (Calderón, Slavin, & Sánchez, 2011; McFarland et al., 2017; NCES, 2016; U.S. DOE, & U.S. DOJ, 2015). These individuals are often referred to as English language learners (ELLs). The ongoing growth of the population of ELLs has led to increased attention on this unique population within the K-12 educational environment (NCES, 2016). Nationally, ELLs constitute nine percent of all public school students and are enrolled in 75% of public schools (U.S. DOE, & U.S. DOJ, 2015).

As the population of ELLs has grown, it has become clear that teachers are not well prepared to meet the needs of this demographic (García, Arias, Harris, & Serna, 2010). The growing linguistic diversity within schools in the United States has produced a sense of urgency toward helping teachers support the academic success of language minority students (Molle, 2013). There is an ongoing push in educational literature for all teachers and policymakers to familiarize themselves with the unique demands of educating ELLs (Liu, Thurlow, Erickson, Spicuzza, & Heinze, 1997). Despite the widespread call for professional development related to building teachers' aptitude to best meet the needs of ELLs, these resources are sparse (August, & Shanahan, 2010; Ballantyne, Sanderman, & Levy, 2007; Janzen, 2008; U.S. Department of Education, NCES, 2001; Zehler, et al., 2003b).

For ELL students to have adequate opportunity for academic achievement in STEM classes, teachers will need to develop knowledge and skills specific to ELLs (Samson, & Collins, 2012). To help ELLs catch up when they fall short in core knowledge, it has been suggested that all disciplines should practice vocabulary knowledge, reading, and writing instruction (Calderón, Slavin, & Sánchez, 2011). However, the educational environment ELLs often face clearly illustrates the shortcomings of the educational system in meeting the needs of this group. Outside of the core content classes, ELLs are often in classrooms and schools filled with nothing but ELLs, learning English from, and practicing it with, one another (Fillmore, 2014).

Criticisms of educational environments that isolate ELLs from language-rich interaction with their peers who are fluent in English provide further support for the necessity of preparing teachers to accommodate ELLs' needs within the context of the traditional classroom. Despite the increased demand for teachers to focus on the needs of ELLs, they often lack the knowledge and institutional support necessary to address the complex educational needs of ELLs (Lee, 2005). Ballantyne, Sanderman, and Levy (2007, p.10) commented on this issue, stating, "The recent increase in ELLs in U.S. classrooms has been rapid, and teacher education and professional development has not yet caught up with the demographic shift."

Many teachers have a fundamental misunderstanding about how long it takes for a student to acquire a new language, how speaking a language other than English at home impacts a student's learning of English, and the correlation between speaking ability in English and English comprehension (Ballantyne, Sanderman, & Levy, 2007; Karabenick, & Clemens Noda, 2004; Reeves, 2006). Addressing these issues is fundamental to preparing teachers to meet the needs of ELL students, and the absence of this knowledge is also reflected in teachers' perceptions of their own abilities. Research on teachers' perceptions shows that they are not confident in their ability to effectively teach ELLs (Reeves, 2006; U.S. Department of Education, NCES, 2001), and that they would like to have more instruction on this topic (Alexander, Heaviside, & Farris, 1999).

The National Education Association (2011) advocated that teachers be provided practical, research-based information, resources, and strategies to teach, evaluate, and nurture ELL students if they are to succeed. However, access to these resources in practice is often limited. Samson and Collins (2012, p.20) reported, "in our review of the research, we identified oral language development, academic language, and cultural diversity as critical bodies of knowledge and skill areas for all teachers of ELLs that were noticeably absent in the areas of policy and practice." As the needs of ELLs gain national attention, educational researchers continue to advocate that expectations for improved student outcomes should be rooted in support for teachers (Calderón, Slavin, & Sánchez, 2011).

In concurrence with the push for reforms in teacher education and training to meet the needs of ELLs, there is also a call for research on effective strategies for educating this group of students. August and Shanahan (2010) stated there still are not enough studies exploring what works with English learners. In discipline specific investigations, there has been a noted absence of research on effective ways to prepare Mathematics and Science teachers to work with ELLs in mainstream Mathematics and Science classrooms (DelliCarpini & Alonso, 2014; Lee, 2005). This lack of research into effective strategies for educating ELLs and preparing teachers to implement such strategies highlights a need for further investigations into these issues from multiple fields of research. Samson and Collins (2012, p.8) broadly stated that, "Currently, at the various stages of teacher preparation, certification, and evaluation, there is insufficient information on what teachers should know about teaching ELLs."

There is a growing body of literature on STEM educational initiatives that show overlapping interest with work on ELLs' educational needs. Collaborative groups are a core feature of modern STEM education principles (Breiner, Harkness, Johnson, & Koehler, 2012) and the use of cooperative learning to support the needs of ELLs is widely supported by researchers (August, & Shanahan, 2010; Calderón, Slavin, & Sánchez, 2011; Fillmore, 2014; Krashen, 1981; Pereira & de Oliveira, 2015). Furthermore, tactile activities that utilize hands-on learning experiences and manipulatives, are also characteristic of STEM education and have been reported as an effective tool for educating ELLs (Honigsfeld, & Dunn, 2009).

The "context of reception" (Portes, & Rumbaut, 2001; Schwartz, et al., 2014) that these students face when entering into the K-12 education system is heavily impacted by the level of preparedness of their educators. An educational system that fails to meet the needs of diverse learners contributes to a negative perception of opportunities within the educational environment and in the labor market beyond school (Portes, & Böröcz, 1989; Portes, & Rumbaut, 2014). Due to their specific language needs, ELLs are at greater jeopardy of struggling academically (Honigsfeld, & Dunn, 2009). However, STEM teachers' preparedness to meet the needs of these learners has been relatively unexplored.

Research Questions

In the United States, the fastest-growing student group is children who are categorized as ELLs (Calderón, Slavin, & Sánchez, 2011). As the nation turns its focus toward preparing the next generation to fill positions in STEM careers, there is a growing need for research that investigates STEM teacher preparedness for working with ELLs. This investigation was guided by questions regarding the education of ELLs in STEM education. It involved examining the caseloads of ELL students in STEM classrooms, the credentialing of STEM educators in relation to ELLs, and professional development related to the education of ELLs. In an effort to construct a national profile of STEM educators the following questions were specifically addressed:

1. Nationally, what are STEM teachers' service loads of ELLs?
2. Are there regional variations in service loads?
3. Nationally, what percentage of STEM teachers hold Linguistic related credentials?
4. Are there regional differences in Linguistic related credentials?
5. Nationally, what percentage of STEM teachers hold Culture related credentials?
6. Are there regional differences in Culture related credentials?
7. Nationally, what amount of ELL focused professional development do STEM teachers participate in yearly?
8. Are there regional differences in professional development participation?

	Number of Teachers	Mean Age	Mean Years of Experience
Science	226,700	41.63	12.75
Mathematics	281,990	41.00	13.01
Technology	50,610	46.72	15.48

Table 1. National STEM teacher demographics.

Method

Participants

Federally, STEM education is broadly defined as core offerings within the sub-disciplines of Science Education, Mathematics Education and Technology and Engineering Education. In formal K-12 education, engineering has become a specific course of study and/or independent courses within Technology Education. The target population for this investigation was K-12 STEM teachers who were separated into the categories of Science, Technology, and Mathematics. Placement into these categories was determined by their main teaching assignment.

Teachers with response codes indicating Science General, Biology or Life Sciences, Chemistry, Earth Science, Integrated Science, Physical Sciences, or Physics were categorized as Science teachers. Teachers were categorized as Technology teachers if their response codes indicated: Construction Trades, Engineering, or Science Technologies (including CADD and drafting), Manufacturing and Precision Production (electronics, metalwork, textiles, etc.), Communications and Related Technologies (including design graphics, or printing). Teachers were categorized as Mathematics teachers if they responded with a category code indicating Algebra I, Algebra II, Algebra III, Basic and General Mathematics, Business and Applied Math, Calculus and Pre-calculus, Geometry, Pre-algebra, Statistics and Probability, or Trigonometry. Demographic information regarding the number of teachers, mean age, and mean years of teaching experience for the STEM disciplines is displayed in Table 1.

Instrumentation

This study employed data from the most recent Schools and Staffing Survey (SASS). The SASS is composed of five questionnaires: a School District Questionnaire, Principal Questionnaire, School Questionnaire, School Library and a Media Center Questionnaire, and the Schools and Staffing Survey Teacher Questionnaire (SASS TQ). The SASS TQ was utilized. This study analyzed data from the restricted-use data files of the 2011-2012 SASS TQ which contains variables and information not available in the public-use data set.

The Schools and Staffing Survey (SASS) is conducted by the National Center for Education Statistics (NCES) on behalf of the U.S. Department of Education in order to collect extensive data on American public and private elementary and secondary schools. Tourkin, Thomas, Swaim, Cox, Parmer, Jackson, Cole, and Zhang, (2010, p.1) stated that the,

> "SASS provides data on the characteristics and qualifications of teachers and principals, teacher hiring practices, professional development, class size, and other conditions in schools across the nation. The overall objective of SASS is to collect the information necessary for a comprehensive picture of elementary and secondary education in the United States. The SASS was designed to produce national, regional, and state estimates for public elementary and secondary schools and related components and is an excellent resource for analysis and reporting on elementary and secondary educational issues."

Variables Analyzed

This exploratory study examined STEM teachers' service loads of ELLs, credentialing related to ELLs, and professional development related to ELLs nationally and regionally. Table 2 provides information on the SASS TQ variables used in the analyses. Variables included are professional development, service load, teacher type, region, teacher age, and teaching experience, and credentialing.

The construction of the credentialing variables was more complicated than the response to a single questions or variable. Teachers' credentials were measured by the combination degrees, graduate certificates, and state-level certifications in response to questions that covered bachelor's degrees, second majors, master's degrees, doctorate or professional degrees, and primary and secondary state teaching certificates. The variables of Cultural and Linguistic credentials were chosen from the complete list of degree, majors, and state certification codes listed in the SASS TQ survey. The codes that best reflected credentialing relevant to the categories of Cultural and Linguistics were selected.

Credentials were categorized as Cultural credentials if the teacher had any of the following: (a) Area or ethnic studies excluding Native American Studies, (b) Cultural studies, (c) Native American Studies, (d) Anthropology, or (e) International Studies. Credentials that were categorized as Linguistic if the teacher had any of the following: (a) ESL or bilingual education: General, (b) ESL or bilingual education: Spanish, (c) ESL or bilingual education: Other, or (d) Linguistics.

Variable	SASS TQ Questionnaire item
Teaching assignment	16. This school year, what is your main teaching assignment field at this school?
Teaching experience	**TOTYREXP. Teacher's adjusted years of teaching experience.
Age	**AGE T. The participant's age in years.
ELL identification	15. Of all the students you teach at this school, how many are of limited-English proficiency or are English-language learners (ELLs)? (Students of limited-English proficiency [LEP] or English-language learners [ELLs] are those whose native or dominant language is other than English and who have sufficient difficulty speaking, reading, writing, or understanding the English language as to deny them the opportunity to learn successfully in an English-speaking-only classroom.)
Credentials	25a. Do you have a bachelor's degree? 25d. What was your major field of study? 25e. Did you have a second major field of study? 25f. What was your second major field of study? 25g. Did you have a minor field of study? 25h. What was your minor field of study? 28. Have you earned any of the degrees or certificates listed below? If yes, include major field of study. Vocational certificate, Associate's degree, Second Bachelor's degree, Second Master's degree, Educational specialist or professional diploma (at least one year beyond a master's level), Certificate of Advanced Graduate Studies, Doctorate or first professional degree. 37a. Which of the following describes the teaching certificate you currently hold that certifies you to teach in this state? 37b. Using Table 3 on page 23, in what content area(s) and grade range(s) does the teaching certificate marked above allow you to teach in this state? 37d. Using Table 3 on page 23, please record all additional content areas and grade ranges in which this certificate allows you to teach. Up to five additional selections are allowed.
PD participation	49a. In the past 12 months, have you participated in any professional development on how to teach limited-English proficient students or English-language learners?
Hours of PD	49b. In the past 12 months, how many hours did you spend on these activities?
Region	**REGION is one of four regions in the US: Northeast, Midwest, South, and West.

Note. ** denotes a NCES/IES created variable; PD is professional development

Table 2. The identification and abbreviated description of variables and used in the study.

In addition, response codes to questions regarding state-level certification areas indicate that a participant holds credentials that certify them to teach in the subject matter indicated by their response codes. The response codes used for degree and graduate certificate content areas were identical to those used for state certifications and thus the same rationale was used to choose the specific codes that best fit the categories of Cultural and Linguistic credentials in regards to any degrees or graduate certificates a participant held.

Procedures

This study was a secondary analysis of the most recent 2011-2012 SASS TQ restricted-use license dataset and employed methodology was similar to Ernst and Williams (2014, 2015) and Williams, Kaui, and Ernst (2015). Data were analyzed using AM Statistical Software. Data were weighted using the Teacher Final Sampling Weight (TFNLWGT) variable and the SASS TQ supplied 88 replicate weight variables. The methodology included appropriate protocols as required by the Institute of Education Sciences (IES). Specific reporting protocols require the results intended for dissemination be sent to IES for approval and authorization for release. The results were approved for dissemination.

Additionally, the National Center for Educational Statistics (NCES) and IES require that all weighted n's were rounded to the nearest 10 to assure participant anonymity. As such, the data included in tables may not add to the total N reported due to rounding adjustments. Per NCES and IES recommendations when analyzing data from the SASS TQ, weighted response value of less than 50 were noted as not being stable. Weighted data found to be unstable were replaced with an asterisk in the tables.

Results

The results from the descriptive analysis of 2011-2012 SASS TQ dataset regarding STEM teachers' service loads of ELLs, their credentialing related to ELLs, and their professional development participation regarding ELLs are summarized in Tables 3 and 4. These tables include national and regional data.

Service load and credentials

Table 3 summarized STEM teachers' service loads of ELLs and ELL credentialing. Nationally, a majority of STEM teachers reported having at least one ELL student in their service load. Mathematics teachers had the highest percentage of teachers with ELL students (59.1%) in their service loads and technology teachers had the highest mean number of ELL students (7.60) in their service loads. Nationally, across the STEM disciplines represented, the number of participants who indicated that they possessed a degree, graduate certificate, or state certification in an area that was categorized as either Cultural or Linguistic was extremely low. Cultural degrees and Linguistic state-level certifications were the most common credentials that participants possessed nationally although rates were also low.

Regional analysis of STEM teachers' service loads of ELLs and credentialing related to ELLs demonstrated a large variation between the national and regional conditions. For STEM teachers in the Northeast region, the percentage of teachers who had ELLs in their service loads and the mean number of ELLs in the teachers' service loads were lower than the national rates. The percentage of STEM teachers in the Northeast who had a Linguistic or Cultural degree or certification were similar to the national rates. A notable difference is that 3.65% of Science teachers in the Northeast region reported possessing a degree in the Cultural category which is more than twice the national rate of 1.31%.

The Midwest region had the lowest percentage of STEM teachers with ELLs in their service loads and they had the lowest mean number of ELLs in their service loads among the four regions. Measures of Cultural and Linguistic credentials were also lower than the corresponding national rates for all categories with the exception of Science teachers regarding Cultural certifications.

The percentage of teachers who had ELLs in their service load for Science and Mathematics teachers in the South were slightly higher than the national rates. The rate for Technology teachers was slightly below the national rate. The mean number of ELLs for STEM teachers' service loads in the South were slightly lower than the national average. The percentage of STEM teachers in the South who reported having a state-level Linguistic certification were higher than the national rates.

STEM teachers in the West had the highest rates of the percentage of teachers with ELLs in their service loads as well as the highest mean number of ELLs in the teachers' service loads of any region. For Science teachers, 78.5% reported having ELLs, with 80.3% of Mathematics, and 73.3% of Technology teachers reporting ELLs in their service loads. Despite having both higher rates and

Region	Teachers with ELLs	Service Load	Cultural Certification	Cultural Degree	Linguistic Certification	Linguistic Degree
Nationally						
Science $n = 226,700$	58.4%	7.10	0.19%	1.31%	3.00%	0.44%
Mathematics $n = 281,990$	59.1%	5.98	0.02%	0.53%	1.77%	0.71%
Technology $n = 50,610$	50.8%	7.60	0%	1.21%	1.03%	0.16%
Northeast						
Science $n = 45,480$	46.6%	4.61	0%	3.65%	0.81%	0.35%
Mathematics $n = 56,230$	52.5%	4.24	0%	0.25%	1.32%	1.07%
Technology $n = 13,950$	44.3%	5.32	0%	0.65%	0.00%	*
Midwest						
Science $n = 48,810$	43.1%	2.80	0.41%	0.23%	1.54%	0.37%
Mathematics $n = 57,550$	41.1%	3.13	*	0.10%	1.36%	0.19%
Technology $n = 11,580$	43.1%	3.35	0%	0.43%	0%	0%
South						
Science $n = 91,810$	63.5%	7.06	0.09%	0.60%	4.39%	0.32%
Mathematics $n = 117,050$	61.8%	4.55	0%	0.76%	2.18%	0.08%
Technology $n = 16,930$	50.6%	7.01	0%	*	2.19%	0%
West						
Science $n = 40,600$	78.5%	15.15	0.34%	1.58%	4.11%	0.86%
Mathematics $n = 51,170$	80.3%	14.35	*	0.80%	1.82%	2.38%
Technology $n = 8,150$	73.3%	18.78	0%	5.52%	1.84%	0.86%

Note. ELL is English language learner. * denotes that estimate did not meet IES reporting requirements.

Table 3. STEM teachers' mean service load and ELL cultural and linguistic credentials.

a higher mean number of ELLs in service loads than STEM teachers from the South, STEM teachers in the West had slightly lower rates of state-level Linguistic certifications than the corresponding rates for STEM teachers from the South. However, the rates of state-level Linguistic certifications for STEM teachers in the West were slightly higher than the national rates. A notable difference in credentialing in the West is the percentage of Technology teachers, 5.52%, who reported having a Cultural degree. This rate is well above the national rate of 1.21% for Technology teachers.

Professional Development

Despite over half of all teachers in the STEM disciplines reporting that they had ELL students in their service loads, less than a quarter of teachers in any of the STEM disciplines participated in ELL specific professional development activities in the last year. Table 4 shows the number of hours of professional development nationally and by region. Mathematics teachers had the highest rate of participation in ELL specific professional development activities nationally with 24.82% having taken part in some amount of professional development. For Science teachers, 23.38% had taken part in some amount of ELL specific professional development within the last year and 18.97% of Technology teachers had done so. Of all the STEM teachers who had participated in ELL specific professional development activities, the majority of participants indicated that they had spent 8 hours or less on these activities.

The percentage of STEM teachers in the Northeast who participated in ELL specific professional development activities were lower than the national average for all of the STEM disciplines. Technology teachers in the Northeast were closest to the national rates with Science or Mathematics teachers lower than their associated national rates. STEM teachers in the Midwest had the lowest rates of participation in ELL specific professional development activities among the four regions. For Mathematics and Technology teachers in the Midwest, the rates of participation in ELL specific professional development activities were less than half of their respective national rates. The percentage of STEM teachers in the South who participated in ELL specific professional development activities were higher than the national rates for each discipline. The percentage of STEM teachers in the West who participated in ELL specific professional development activities in the last year was higher than the national rates and also higher than the regional rates for each discipline.

Discussion and Conclusion

The growing ELL population across the nation has led researchers to emphasize the need for general education teachers to adapt instructional methodologies to better suit the needs of ELLs in their classrooms (Lee, 2005; Janzen, 2008). This initiative has also highlighted the need for large-scale investigations into the current state of educators' preparedness to meet the needs of ELLs in the K-12 system. Concurrent with the national attention on STEM education courses, this study examined potential indicators of STEM teachers' preparedness to educate ELLs. Literature states that STEM teachers are not well prepared to meet the needs of ELLS (DelliCarpini & Alonso, 2014; García, Arias, Harris, & Serna, 2010) and further investigation of the relationship between STEM teachers and ELLs has been called for (DelliCarpini & Alonso, 2014; Lee, 2005). Data gathered from the 2011-2012 SASS TQ, showed the wide degree of variation in STEM teachers' services loads, their credentialing, and their professional development participation rates related to ELLs both nationally and regionally.

There are differences between the frequency and intensity of ELL participation in STEM service loads. Nationally, across all of the STEM disciplines, more than half of the teachers indicated having ELLs in their service load. Technology teachers had the lowest percentage with

Region	Teachers with ELLs	ELL PD	8 or Less Hours	9-16 Hours	17-32 Hours	33 or More Hours
Nationally						
Science $n = 226,700$	58.4%	23.38%	16.90%	3.86%	1.36%	1.30%
Mathematics $n = 281,990$	59.1%	24.82%	18.29%	3.93%	1.29%	1.31%
Technology $n = 50,610$	50.8%	18.97%	12.96%	2.79%	2.35%	0.87%
Northeast						
Science $n = 45,480$	46.6%	13.69%	10.07%	1.25%	1.21%	1.14%
Mathematics $n = 56,230$	52.5%	16.78%	11.38%	2.85%	2.17%	0.39%
Technology $n = 13,950$	44.3%	14.05%	11.18%	*	1.65%	0.79%
Midwest						
Science $n = 48,810$	43.1%	12.26%	9.18%	2.07%	0.39%	0.61%
Mathematics $n = 57,550$	41.1%	11.55%	9.07%	1.76%	0.26%	0.45%
Technology $n = 11,580$	43.1%	9.08%	7.77%	0.78%	0.52%	0%
South						
Science $n = 91,810$	63.5%	29.34%	22.19%	4.90%	1.51%	0.74%
Mathematics $n = 117,050$	61.8%	29.59%	22.75%	4.74%	0.57%	1.53%
Technology $n = 16,930$	50.6%	22.00%	15.24%	4.08%	2.66%	0%
West						
Science $n = 40,600$	78.5%	34.13%	21.63%	6.60%	2.34%	3.60%
Mathematics $n = 51,170$	80.3%	37.63%	26.05%	5.69%	3.13%	2.76%
Technology $n = 8,150$	73.3%	35.15%	18.65%	7.48%	4.91%	4.05%

Note. ELL is English language learner. PD is professional development. * denotes that estimate did not meet IES reporting requirements.

Table 4. STEM teachers' ELL related professional development.

50.8% of teachers indicating that they had ELLs in their service load. However, they had the highest mean number of ELLs in there service loads with an average of 7.60.

Regional analysis of STEM teachers' preparation for educating ELLs showed the vast differences across the nation. The West had the highest percentage of teachers with ELLs in their service loads for every discipline and the Midwest had the lowest. Relatedly, STEM teachers in the West also reported the highest rates of participation in ELL specific professional development activities. Findings from regional analysis suggest a link between the percentage of STEM teachers in a region with ELLs in their service load and participation in ELL specific professional development opportunities. These findings can lead to insights on the situation nationally and regionally as well as serving to direct future efforts to improve the educational experiences of ELLs in STEM disciplines.

This study found that nationally over half of all STEM teachers have ELLs in their classes yet less than a quarter of STEM teachers participated in ELL specific professional development activities. These comparative rates of ELLs in classes to the professional development participation could encourage programs to provide more professional development opportunities. While it is reported that ELLs constitute 9% of all public school students (U.S. DOE, & U.S. DOJ, 2015), this information may be less impactful to some than the fact that nationally in STEM fields the majority of teachers indicated having ELLs in their service loads of students. Even in regions where ELLs were less common, across all of the STEM disciplines more than 40% of teachers reported having ELLs in their classes.

These findings also show that both nationally and in all regions for all of the STEM disciplines the majority of participants who indicated that they had taken part in ELL specific professional development in the last year indicated having eight or less hours of these activities. While professional development opportunities are supported as a means to build skills for working effectively with ELLs (Ballantyne, Sanderman, & Levy, 2007; Calderón, Slavin, & Sánchez, 2011), some researchers advocate for long-term programs (García, Arias, Harris, & Serna, 2010). As teachers adapt instructional methods to better suit the needs of their ELLs, there will continue to be a need for studies that investigate effective instructional practices of STEM teachers working with ELLs as well as impactful professional development models for empowering teachers with these research-based skills and understandings.

The findings of this study could be further advanced through studies of specific issues STEM teachers face when working with ELLs and how targeted professional development models could serve to build appropriate methods for adapting STEM curriculum to best suit the needs of this population of learners. Furthermore, longitudinal studies could lend insight into how STEM educators are preparing to meet the needs of this growing population of ELLs nationally and regionally. Targeted efforts should also be made in encouraging collaboration between experts in STEM disciplines and language specialist to make efficient use of the practices and methodologies that are best suited to engage ELLs in STEM disciplines in ways that support their unique learning needs.

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