

Article

Virtual Professional Development to Increase Knowledge, Use, and Self-Efficacy of Teachers Teaching Emergent Multilingual Science, Technology, Engineering, Math, and Social Studies Content: A Mixed Methods Case Study

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Abstract: The number of English language learners, often referred to as emergent multilinguals (EMs), in schools has significantly increased over the last decade, and teachers are not fully prepared to teach this growing population because of limited training and a lack of skills necessary to address academic needs in both language and content. This mixed-methods study explored the effectiveness of an online professional development (PD) to increase teachers' knowledge, skills, use, and self-efficacy in teaching science, technology, engineering, math, and social studies (STEMSS) content and the English language in tandem. Vygotsky's socio-cultural theory and Lave and Wenger's community of practice theory guided the development, documentation and analysis of the impact of the professional development. Twenty-four Arizona K-12 teacher participants completed a pre-survey, an online PD, and, finally, a post-survey and interview. Dependent *t*-test results provided evidence the PD significantly increased participants' self-reported knowledge, use, and self-efficacy to support EMs' academic vocabulary in content areas. The impact of the PD on these three constructs was further supported with data-driven themes generated from the interview data. Participants overwhelmingly valued the peer interaction for increasing their knowledge and understanding of effective pedagogical practices and their self-efficacy in supporting EMs in their classrooms.

Keywords: professional development; English learners; emergent multilinguals; STEM; community of practice; technology



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1. Introduction

Providing high-quality public education for Emergent multilinguals (EMs) is essential for our nation (Archerd, 2013; Lucas et al., 2018; Tellez & Manthey, 2015; Weinstein & Trickett, 2016). While the U.S. education system has made strides in addressing the academic and linguistic needs of culturally and linguistically diverse populations, the increasing number of EMs presents significant challenges (Archerd, 2013; Li, 2016; U.S. Department of Education, 2019; Weinstein & Trickett, 2016). In 2015, the U.S. Department of Education identified teacher shortages in areas such as English as a Second Language (ESL) and Bilingual Education (BLE). Additionally, many educators report feeling inadequately prepared to meet the needs of these students (Archerd, 2013; Lucas et al., 2018; Szymanski & Lynch, 2020). During the 2013–2014 school year, over 4.5 million students—approximately 9.3% of K-12 enrollment—were classified as EMs, a rise from 8.8% a decade earlier (U.S. Department of Education, 2019). The U.S. Department of Education (2019)'s Office of

English Language Acquisition noted that EMs consistently perform lower in reading and mathematics on national assessments.

Various programs, including pull-out English language development and bilingual initiatives, have been implemented over the past two decades to support EMs. However, research by [Honigsfeld \(2009\)](#), building on [Ovando et al.'s \(2006\)](#) work, shows that many ESL programs prioritize grammar over immersive language learning, leading EMs to miss vital content instruction. Although these programs offer small-group English skill development, they often fail to integrate English learning within natural classroom contexts. In contrast, the rise of dual-language programs has gained momentum, benefiting both EMs and native English speakers through an additive approach ([Lucas et al., 2018](#)). Research by [Collier and Thomas \(2014\)](#) emphasizes the importance of high-quality content instruction for effective language learning, demonstrating that students can acquire a second language without sacrificing their primary language skills.

Currently, Arizona public schools serve around 85,000 EMs ([Arizona Department of Education, 2019](#)), underscoring the need to address their educational experiences both linguistically and academically. Studies have shown that state policies have had limited success in closing the EM achievement gap (e.g., [Garcia & Weiss, 2017](#); [Rumberger & Tran, 2010](#)). As the population of EMs continues to grow, teachers need to be equipped with effective strategies for bilingual development, including curriculum content and assessment methods ([Lucas et al., 2018](#)). However, restrictive policies like Proposition 203, enacted in Arizona in 2000, and recent efforts to take the state back to this time period ([Kaveh et al., 2022](#)) have significantly diminished teacher preparation for EMs, reducing ESL and BLE course requirements to three credit hours for the Structured English Immersion endorsement ([de Jong et al., 2010](#)). This drastic reduction means teachers receive less than 10% of the training needed to effectively support EMs.

With limited professional development resources available, many teachers seek additional training from local colleges and organizations to enhance their knowledge and skills in serving EMs. This study addresses the critical gap in support and training for teachers of language learners (TLLs), especially as EMs' academic and linguistic needs grow in increasingly diverse classrooms ([Tellez & Manthey, 2015](#); [Szymanski & Lynch, 2020](#)). Despite the commitment of the U.S. education system to support EMs, they continue to score lower on national assessments ([U.S. Department of Education, 2019](#)), while TLLs often feel unprepared to meet these students' needs ([Karabenick et al., 2004](#); [Li, 2016](#); [Rubinstein-Avila & Lee, 2014](#); [Szymanski & Lynch, 2020](#)). The limitations imposed by policies such as Proposition 203 exacerbate this problem, leaving teachers with insufficient training and resources to effectively support their EM students.

As the demand for comprehensive instruction in STEM and 21st-century skills increases ([Hagler, 2015](#)), it is imperative that EMs receive integrated content instruction that incorporates language learning strategies for meaningful educational experiences. However, literature on the efficacy of integrated STEM instruction for EM academic language development remains sparse ([Lucas et al., 2018](#)). Developing a STEM curriculum tailored to EMs' needs is essential for the professional growth of TLLs. Without effective professional development, teachers' limited knowledge will hinder their ability to support the growing EM population, perpetuating the lower performance of EMs on national assessments.

This mixed-methods case study aims to document and analyze the effects of an online STEM professional development (PD) series on TLLs' knowledge, skills, and self-efficacy in fostering EMs' academic language development. Implementing evidence-based strategies through online PD is critical to address the gap in support and training for TLLs, particularly as EMs' academic and linguistic needs evolve in diverse classrooms ([Lucas et al., 2018](#)). Additionally, it is essential to evaluate PD programs based on their impact on behavior

change, enabling administrators to confidently encourage TLL participation in convenient yet effective training (Lucas et al., 2018). The findings of this study will provide valuable insights for enhancing professional development aimed at improving TLLs' effectiveness in teaching EMs STEM content. The research questions and hypotheses guiding the study were as follows:

RQ1. What gains from pretest to posttest did TLLs report regarding their STEMSS knowledge, use, and self-efficacy to support EMs' academic vocabulary development as a result of their participation in the online STEMSS professional development?

H1o. There are no significant gains from pretest to posttest in knowledge, use, or self-efficacy to support EMs' academic vocabulary development as a result of TLLs' participation in the online STEMSS professional development.

H1a. There are one or more significant gains from pretest to posttest in knowledge, use, or self-efficacy to support EMs' academic vocabulary development as a result of TLLs' participation in the online STEMSS professional development.

RQ2. What are teachers' perceptions of how the STEMSS PD impacted their knowledge and skills and the lesson plans developed?

2. Materials and Methods

A mixed-method case design was chosen to examine the quantitative change in knowledge, skills, and self-efficacy before and after TLLs participated in an online PD and to qualitatively explore teachers' perceptions of how the PD impacted their knowledge and skills and the lesson plans developed. The methods were based on Vygotsky's (1978) and Lave and Wenger's (1991) frameworks (see Figures 1 and 2). A pre-/post-survey was used to collect quantitative data while interviews and lesson plans were used to collect qualitative data. Utilizing the survey allowed for collection of descriptive characteristics of the sample obtained from the TLL population with targeted results to inform and draw conclusions that might impact the larger TLL population (Bergman, 2008). The pre- and post-survey was used to answer the quantitative question of whether or not the PD was effective and was used as a baseline to provide a descriptive of what change occurred to inform the qualitative exploration. The collection and analysis of lesson plans and interviews allowed a further investigation of how and why the PD was or was not effective in increasing knowledge and skills and building self-efficacy in teaching academic vocabulary to EMs. Utilizing interviews and document analysis of TLLs' lesson plans provided insight into TLLs' perceptions, opinions, and examples of how the PD impacted knowledge of pedagogical practices and understanding of meeting the needs of EMs while teaching STEMSS content, as well as insight into TLLs' self-efficacy in supporting EMs in the classroom setting. The triangulation of data from surveys, interviews, and lesson plans provided the opportunity to gain a deeper understanding of the effectiveness of the online professional development in supporting TLLs' learning of effective strategies to support EM's academic vocabulary development (see Figure 2).

The target population for this study was TLLs who teach EMs in K-12 schools in Arizona. A purposive, convenience sample was obtained using volunteers who met the selection criteria. Recruiting efforts included information about the study and an online link posted, with permission, on several teacher listservs and social media pages that frequently post teacher opportunities. The TLLs voluntarily participated in the online PD by signing up on a Google Doc that requested the participant's name, school, grade level taught, number of EMs in their classrooms, content area/s taught, and contact information. Twenty-four TLLs were recruited. This number aligned with both Hinde and Ekiss (2005), Hinde et al. (2007), and Dorn et al.'s (2005) research methods to effectively conduct and assess content and language PD with the target population and also with a G*Power for a dependent

t-test for three dependent variables with an adjusted error/alpha of $0.5/3 = 0.0167$ that suggested a minimum of 19 participants. A recruiting pool of 24 was needed to allow for a possible 20% rate of attrition to ensure the minimum G*Power analysis numbers were met. The first 24 teachers to sign up made up the participant group for this study. Once 24 participants signed up, they were sent the pre-survey and submitted a lesson plan and a consent form to participate in the study with all requirements stated.

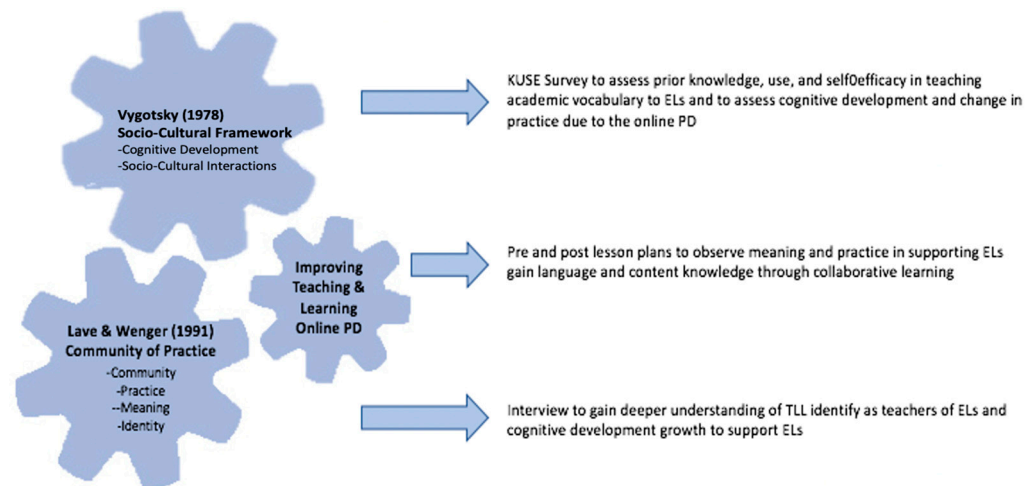


Figure 1. Vygotsky (1978) and Lave and Wenger (1991) Theoretical framework informing research study.

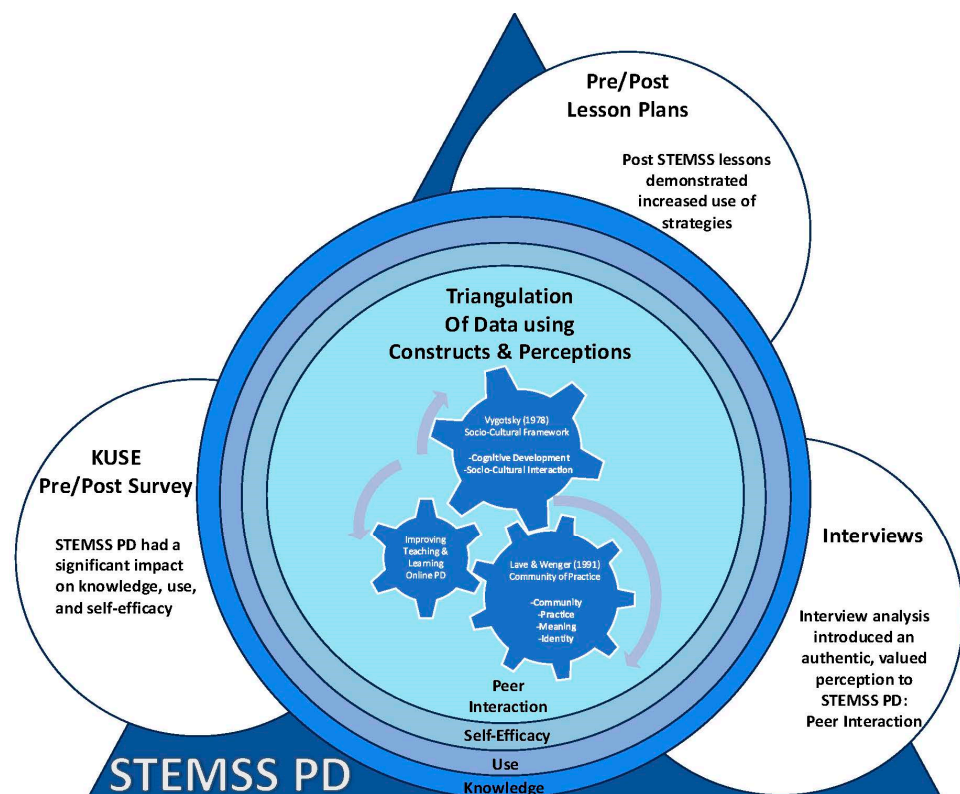


Figure 2. Triangulation of data using constructs and perceptions based on research design informed by Lave and Wenger (1991) and Vygotsky's (1978) frameworks.

The STEMSS PD series materials consisted of instructional PowerPoints with four digital *stops* on the journey to learning about how to use the 10 selected strategies when teaching STEMSS content in the K-12 classroom. Each PowerPoint included links to various articles, videos and resources for TLLs to gain additional knowledge about the content

being presented for those who wanted to explore further. In addition, there were activities to engage in the content with modeling of the 10 strategies while learning about them. All modules were accessible to all TLLs online with only Wi-Fi needed. The quantitative portion of the study included a pre- and post-survey based on the Knowledge, Self-efficacy, and Understanding (KCU) study from [Oakes et al. \(2018\)](#). This tool was modified as the Knowledge, Use, and Self-Efficacy (KUSE) survey and evaluated for reliability and validity by [Chavez-Thibault \(2017\)](#). Cronbach analyses of the survey surpassed the 0.70 reliability threshold with all three constructs testing between 0.87 and 0.97 ([Chavez-Thibault, 2017](#)). The KUSE tool was selected for this study as the variables measured aligned with the purpose, methods and need of the study. The KUSE survey (Appendix A) measures the three constructs of knowledge, use, and self-efficacy of using EM academic vocabulary strategies in STEMSS content instruction. Each construct is obtained from analysis of responses from 25 questions with consistent verbiage across the three constructs. For example, the first question under each construct is a similar question across all three scales, relating to either knowledge, use, or self-efficacy. For example, teachers are asked to respond to the following statement for knowledge: I am knowledgeable about developing academic language across science content using specific strategies. For the use subscale, teachers are asked to respond to the following statement: In my teaching, I develop academic language across science content using specific strategies. In the efficacy subscale, teachers responded to statements such as the following: In my teaching, I am certain I can develop academic language across science content using specific strategies. The items all used a 5-point Likert response scale with the following anchors: 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree, and Not Applicable. In a study of the KUSE by [Chavez-Thibault \(2017\)](#), the Knowledge pre- and post-reliability scores were 0.94 and 0.92, Use scores were 0.95 and 0.87, and Self-Efficacy scores were 0.97 and 0.94, respectively. The survey also includes demographic questions regarding age, number of years taught, degrees, and number of EMs in the classroom. The survey was given as soon as TLLs were selected to gather pretest data on TLLs' knowledge, use, and self-efficacy and then again after the TLLs completed the online PD to obtain the posttest data set.

To address the research question that was qualitative in nature, two sets of data were collected (see Figure 2). As part of completing the online PD, TLLs developed a STEMSS lesson plan (Appendix B) to implement into their classroom. These lesson plans were analyzed for use of and integration of EM academic vocabulary strategies to teach STEMSS content. They were coded for the strategies implemented (Appendix C). The TLLs who participated were also interviewed using a researcher-developed semi-structured interview protocol (Appendix D). The interview questions were first vetted by an expert in qualitative methods and English learning to ensure they best aligned with the purpose of the study and would inform the research as designed. Three TLLs working in the field were interviewed using the protocol as a field test and asked to respond to the questions based on a face-to-face professional development series they attended to determine if the questions elicited responses that would answer the research question. The protocol appropriately provoked responses that would target the research question for a professional development experience by TLLs in the field.

3. Results

The demographics of the participants are presented in Table 1. Of the 24 participants, 6 teachers were between 22 and 32 years of age, 7 teachers were between 33 and 43 years, and 11 were 44 years of age or older. Seven of the participants were in their first five years of teaching, three had taught more than five years but less than ten, and fourteen had taught more than 10 years. Ten reported they were in their first five years of teaching EMs,

three had taught EMs for more than five but less than 10 years, and eleven TLLs had taught EMs for more than 10 years. It is interesting to note that nine participants had a bachelor's degree, fourteen had a master's degree, and one had a doctoral degree. Fourteen of the participants held a Structured English Immersion (SEI) endorsement, and eleven had either an English as a second language (ESL) endorsement (seven teachers) or a bilingual (BLE) endorsement (six teachers). Seven participants reported no endorsements to support EMs. Finally, 12 participants were currently teaching in a general education classroom, with all others teaching in a language-supported classroom. These demographic characteristics of the participant sample can inform and allow researchers to draw conclusions regarding generalizability to the larger TLL population or other samples (Bergman, 2008).

Table 1. Participant demographics.

Participant	Age	Education	Endorsement	Years Teaching	Years Teaching EMs	Classroom Type
1	44	MA	none	1	1	Gen. Ed
2	24	MA	SEI	1	1	Gen. Ed
3	28	MA	none	2	2	Gen. Ed
4	51	MA	none	13	4	Lang.
5	50	MA	ESL	19	3	Gen. Ed
6	40	BA	SEI, BLE	9	1	Lang.
7	41	MA	SEI, ESL	19	19	Lang.
8	41	MA	none	8	8	Gen. Ed
9	46	EdD	SEI, ESL	21	21	Lang.
10	45	BA	ESL	18	18	Lang.
11	39	BA	SEI	19	19	Gen. Ed
12	43	MA	SEI	19	19	Lang.
13	61	MA	none	20	20	Lang.
14	26	BA	SEI	4	4	Gen. Ed
15	48	MA	SEI, ESL, BLE	25	25	Lang.
16	24	BA	SEI, ESL, BLE	1	1	Gen. Ed
17	22	BA	SEI, BLE	2	2	Gen. Ed
18	23	BA	SEI, BLE	2	2	Gen. Ed
19	48	BA	ESL	20	6	Lang.
20	57	BA	none	36	12	Lang.
21	52	MA	SEI	27	17	Lang.
22	61	MA	SEI, BLE	39	18	Lang.
23	40	MA	SEI	18	15	Lang.
24	43	MA	none	10	10	Lang.

To establish the reliability and validity of the data, subscale reliabilities were examined and the data assumptions necessary for the planned dependent *t*-tests were evaluated prior to running the analyses. The G*Power (17 March 2020—Release 3.1.9.7) analysis for a dependent *t*-test with an adjusted error/alpha of $0.5/3 = 0.0167$ suggested a minimum of 19 participants would be required. Twenty-four participants were recruited to account for the possibility of attrition. Twenty-four participants completed the study, exceeding the sample size required. The pre- and post-survey employed was initially developed for the Knowledge, Self-efficacy, and Understanding (KCU) study from Oakes et al. (2018), which was adapted from Lane and Oakes. This instrument was then modified as the Knowledge, Use, and Self-Efficacy (KUSE) Survey and tested for reliability and validity by Chavez-Thibault (2017). Cronbach subscale reliability estimates for the pre-survey subscales and the post-survey subscales surpassed the 0.70 reliability threshold; all three constructs reported estimates above 0.91 for the pre-survey and 0.81 for the post-survey (Table 2).

Table 2. Cronbach analysis reliability statistics.

Construct	Cronbach's	Cronbach's	N of
	Alpha Pre	Alpha Post	Items
Knowledge	0.923	0.908	25
Use	0.918	0.897	25
Self-Efficacy	0.974	0.809	25
Knowledge, Use, and Self-Efficacy	0.931	0.875	75

RQ1. The first research question posed was as follows: What gains from pretest to posttest did TLLs report regarding their STEMSS knowledge, use, and self-efficacy to support EMs' academic vocabulary development as a result of their participation in the online STEMSS professional development? The null hypothesis was rejected in that there was one or more significant differences from pretest to posttest in knowledge, use, or self-efficacy to support EMs' academic vocabulary development as a result of TLLs' participation in the online STEMSS professional development. Descriptive statistics for each of the variables at pre- and post-PD are provided in Table 3.

Table 3. Pre/post KUSE data.

	Mean	N	Std. Deviation	Std. Error Mean
Knowledge				
Pre	2.635	24	0.267	0.055
Post	3.627	24	0.367	0.075
Use				
Pre	2.593	24	0.292	0.06
Post	3.504	24	0.436	0.089
Self-Efficacy				
Pre	3.014	24	0.655	0.134
Post	3.718	24	0.317	0.065

Three dependent *t*-tests were run, one for each variable. To protect from Type I error, a Bonferroni adjustment was made to the *p* value; the original alpha of 0.05 was divided by the number of analyses, three, and an alpha of 0.017 was established for all analyses. The results of the dependent *t*-tests are in Table 4. Statistically significant differences between the pre and post data were reported for all three variables. For knowledge, there was a significant difference from pre-survey to post-survey (MD = 0.991, SD = 0.453) with $t(23) = 10.726$, $p < 0.017$. The difference score for the use of strategies variable was also significant (MD = 0.901, SD = 0.412) with $t(23) = 10.815$, $p < 0.017$. For self-efficacy in using the strategies to support EMs in the classroom during STEMSS instruction, the difference between pre and post was also significant (MD = 0.614, SD = 0.463) with $t(23) = 6.501$, $p < 0.017$. The null hypothesis was rejected. The participants reported that their knowledge, use, and self-efficacy regarding the identified strategies for supporting TLLs to teach EMs in the classroom significantly increased from pre- to post-participation in the PD series.

Table 4. KUSE paired-sample *t*-test.

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-Tailed)
Knowledge Post-Pre	0.991	0.453	0.092	10.726	23	0.000
Use Post-Pre	0.910	0.412	0.084	10.815	23	0.000
Self-Efficacy Post-Pre	0.614	0.463	0.094	6.501	23	0.000

RQ2. The second research question posed was as follows: What are teachers' perceptions of how the STEMSS PD impacted their knowledge and skills and the lesson plans developed. Teachers' perceptions of how the STEMSS PD impacted their knowledge and skills and the lesson plans they developed was further informed and established through analysis of pre- and post-PD lesson plans submitted by participants and through interview data. The lesson plans were analyzed using qualitative content analysis (Bengtsson, 2016). The strategies were initially highlighted and then recorded for each occurrence of use. In the initial lesson plans submitted (Table 5), participants employed a total of four strategies across the lesson plans. Three TLLs used sentence stems, seven used a form of quick chat or quick write, three used word walls, and five used graphic organizers in their lessons. No other strategies that were the focus of the PD were employed.

Table 5. Pre/post lesson plan data.

Strategy	Observed in Initial Lesson Plan	Observed in PD Lesson Plan
Sentence Stems	3	14
Quick Chat/Write	7	19
Word Walls	3	6
Big Books	0	1
10 Important Sentences	0	1
Color-Coding	0	5
Graphic Organizers	5	13
Interactive Notebooks	0	7
Murals/Graphic Input Charts	0	2
Songs and Chants	0	2

4. Discussion

Once the explicit mentions of strategies were identified and recorded, further analysis of the interview data (see Table 6) was conducted using content analysis (Bengtsson, 2016) and revealing four themes with regard to teachers' perceptions of how the STEMSS PD impacted their knowledge and skills and the lesson plans developed. The primary perceptions were categorized into themes that aligned with the three constructs: knowledge, use, and self-efficacy. An additional theme identified was labeled as the value of peer interaction.

Table 6. Interview data.

Strategy	Shared Out in Interview
Sentence Stems	18
Quick Chat/Write	21
Word Walls	7
Big Books	5
10 Important Sentences	2
Color-Coding	7
Graphic Organizers	21
Interactive Notebooks	9
Murals/Graphic Input Charts	3
Songs and Chants	5

Theme 1: Knowledge. TLLs talked about new knowledge, or renewed knowledge of strategies, and their increased understanding of why the strategies are effective in supporting EMs. One TLL3 spoke about word walls and murals:

“Was a refresher that I had forgotten about that strategy I learned about in my first two years of teaching. It was so profound to me at the time and I had completely

forgotten about it so that was really helpful to relearn about it and how it works and benefits my students in science, social studies and math”.

She later explained that the murals “help tell a story and helps students make connections—especially for visual learners to know what they are thinking and can verbalize what I want them to learn. Because of this I want to use this in my teaching”. The perception was that the strategy helped teachers support their students through new knowledge of an effective teaching strategy that they could implement into their teaching. This demonstrated the connected of new knowledge through the implementation into their lesson plan.

Another TLL shared she “learned about songs and chants and how to use them when teaching about content. The biggest challenge would be to find the right chant for the content to keep the students engaged, but I’m really excited about using it” (TLL1). This teacher also stated she:

“Really liked the information on graphic organizers because I learned so much more about how to use them to make them effective in my teaching. And also 10 important sentences and quick chants that I’m committed to using—these will be my go-tos.”

“The PD had a huge impact on helping me learn how to help my students. I have 80% EMs in my classroom and I learned a lot of new strategies. Like with color-coding, I didn’t know the impact that it could have on helping my EMs in the classroom”.

These teacher perceptions demonstrate how the knowledge they gained about use of the strategies to support EMs impacted how they believed they were better able to support their students in the classroom. This also transferred over to the application of these strategies into their lesson planning for classroom instruction. TLL10 explained, “now that I know that these strategies work, I am more confident in helping my EMs”. This teacher later explained that she implemented the strategies into her lesson plan and could see using them in her everyday teaching. The perception that these strategies would support their students while teaching content impacted their lesson design for future lessons.

Theme 2: Use. Participants also commented on new knowledge related to using strategies to teach both content and language in tandem, supporting both the curriculum and the linguistic needs of the students. These conversations elaborated into the use of the strategies with multiple references to better understanding how to use the strategies to teach content while supporting language.

TLL5 also “really liked word walls and the article that explained why they are effective and how to use them and then examples were provided in the PD. This really helped me learn how I can use them in my classroom”. TLL2 had also implemented this strategy into her lesson plan to support her teaching of the content.

“The PD had really concise, good information that clearly explained how to use the strategies and why they are effective which saved a lot of time for me. Because they were so well explained in the descriptions and articles and videos I think they were really good information that I could use”.

This same TLL went on to say:

“Although many of the strategies were familiar to me, they gave me examples of how to use them to teach my EMs and how my EMs could benefit from using them in science and math so I can use them more effectively. I don’t think I was using them as effectively before or as well as they could be to help my students plus now I have more concrete ways how to use them”.

Later in the interview, the TLL explained how:

“The resources the PD provided really helped my knowledge but also gave me resources that I don’t have to file through online to find examples or how to use them, making it so much easier to actually use when I write my lesson plans. And, I can go back to using them as a refresher and continue to learn from them when I need them”.

Another participant (TLL3) explained a similar benefit to learning how to use the strategies: By using the 10 important sentences but adapting it to my students and the content.

“I can make sure the students really understand the important part of the information in the reading. I could also identify 10 words to start to build understanding of the academic vocabulary when we first read the passage and then go back to review the sentences to build understanding of the content while focusing on the language, I really like this idea that I want to use”.

TLL3 then explained how:

“The majority of my EMs are visual learners so the strategies I now know how to use to help their visual learning but also build their vocabulary, and I think this will be good for all my students since it’s not just good for EMs but good teaching in general using these strategies to teach”.

This teacher was able to identify how to use the strategies gained from the PD and adapt them to her own content area and grade level, making the strategies more meaningful and useful.

Another participant, TLL11, adapted the information on using the strategies because they were “so user friendly and not intimidating to use for students who will adapt easily and because they are relevant to how they learn”. This teacher especially benefited from the graphic organizer explanation and examples because they were “easy to implement and an effective strategy that will be huge for EM students”. TLL11 also implemented the color-coding strategy into her lesson plan with graphic organizers because it “is so effective and EM students can learn the content while learning how to use language to learn the content”. These perceptions of how the PD assisted in TLLs’ learning of how to use the strategies in their own teaching reflect how the participants embedded the new knowledge into their teaching by reflecting on the impact they would have with their students and the ease of using them in their content area.

Theme 3: Self-Efficacy. Participant comments on knowledge and use were intertwined with self-efficacy reflections on how the new knowledge and understanding increased their confidence and awareness in how to best support EMs in their classroom. A secondary teacher, TLL15, stated:

“The PD really opened my eyes to things I was doing wrong or not efficiently and to some new techniques I never heard of being at the secondary level. I learned how to easily adapt and incorporate these strategies at my level while supporting EM students using effective strategies. The murals and interactive notebooks could be used to introduce or build prior knowledge, to focus on vocabulary, or to incorporate into practice of the concepts while delving deeper. This increased my self-confidence because it gave me skills to help students, and I’m really excited about using these with them when I teach. For instance, with the 10 important sentences I would have given myself a one or two and now my confidence would be a 10 because I know exactly how to use it and how I will use it with my lessons. I also think it will give my students more confidence because

they will be using and talking about the content while they are learning it and they can use it at home”.

This teacher was able to articulate that the new knowledge and skills learned supported her self-efficacy in supporting EMs in the classroom. She also provided clear examples of how learning about the strategies and thinking about how they could be used to support the students increased self-efficacy in teaching EMs.

Another participant, TLL9, also felt the PD supported growth in both skills and self-efficacy. She explained how:

“Last year I didn’t have a solid year with my EMs and I may have over-simplified the content rather than making the content more accessible. I learned that they can do the same learning just not at the same pace or in the same way but with authentic learning experiences. As I was going through the PD I actually further researched how I could use the strategies in my pre-planning and I broadened my portfolio which is making me more confident in using them”.

This TLL’s perception was that by adding new knowledge to address current struggles in supporting EMs, it increased her confidence in teaching this student population.

Claims of increased self-efficacy also came from dialog about how effective the strategies were while using them with students, increasing students’ confidence in language while learning the content. These reflections, as noted by the TLLs, increased their own self-efficacy in teaching their content to students. TLL13 noted that due to the changing modalities of teaching (i.e., moving to hybrid and online due to COVID restrictions), the support from the PD:

Was really timely because everything is up in the air and it is really challenging moving to teaching online. The PD gave me new options for teaching with examples of how I can improve my lesson plans. This really boosted my confidence because I’m a little lacking for my kids with online teaching and the way the PD presented the material and used the strategies actually gave me more ways to teach my students that I’ll be able to work with my students online.

Another participant, TLL5, had similar thoughts sharing:

“I think it’s a lot easier for the kids using graphic organizers and 10 sentences, even if online in our new science curriculum. These strategies helped me transition the curriculum to using it every day and the students really liked it. Although I already knew these strategies the way it was taught to me online made me more confident in using them with my students.”

“I really liked learning how to use the pictorial (graphic) input charts because they were so flexible in teaching and developing academic vocabulary. The PD helped me feel more comfortable and knowledgeable. When I used them with my students it helped bring back my confidence for teaching, especially after a rough year moving to online. Learning about these strategies right before the school year and seeing other teachers use them refreshed my knowledge and made me more confident and excited about the school year in seeing how I would apply them. The biggest thing is it was pretty easy to implement them and seeing how effective they were”.

These reflections on connecting knowledge, skills, and ease of use once having the skills while being able to apply them to current teaching methods helped developed self-efficacy in teaching as seen through these teachers’ perceptions of the benefits of participating in the PD trainings.

Theme 4: Value of Peer Interaction. A fourth theme revealed using inductive coding was the impact that peer interaction during the PD had on increasing knowledge of

strategies, learning how to effectively use strategies, and self-efficacy. TLL13 reflected that through:

“The support of the other teachers who wanted to implement the strategies when we were sharing, it made me more conscious that I am going to use these strategies and I’m going to be more intentional about teaching and using these strategies. By using the strategies, I am already confident in using and hearing other teachers give examples of their successes in using the strategies like with graphic organizers and word walls; it helped me use the strategies and then the kids ended up learning better in my class”.

TLL6, who teaches 1st grade, noted:

“I feel more prepared and willing to try the new strategies with my younger students because of how I heard the other teachers weaving the strategies together. The PD was a great refresher and with the current situation in online teaching, I got to learn strategies that I could use online as well and some of the other teachers shared some good ideas how to do this”.

This TLL later said:

“I want to look at the challenge with virtual teaching and encourage my students because the most important thing we can do is support language and weave these strategies into teaching so our students can be successful. I look at this as an opportunity rather than as a challenge”.

A second teacher, TLL21, responded similarly to the benefit of participating in this PD with other teachers while preparing to teach online, stating:

“I’ve been a traditional teacher for the past 19 years and this is my first time teaching online. I feel like we all (the participants during the sharing times) are all swimming through these hurdles and this training specifically provided me the right direction with how to incorporate these activates and stuff into online education which was very helpful. This boosted my confidence a lot during this revolutionary year. All these new apps were really amazing and connecting with my students by using these apps and strategies after only six days of doing this PD was really good”.

This TLL later recommended, “I would have liked more opportunities to talk with the teachers (other participants) to bound ideas and collaborate more because this really helped me as a traditional teacher hear ways to teach online”. Yet another participant, TLL17, shared how:

“The PD really boosted my confidence especially in how to write lessons and plan for my classroom. I learned and then read some of the other teachers’ comments on how to teach my EMs content while supporting them in the classroom and the resources and examples really boosted my confidence, especially with other teachers’ examples”.

This same TLL later commented, “I really liked the real teacher feedback and examples a lot of them (participants) provided, being able to see what actual teachers are using in the classroom and how they are using the strategies with EMs was really useful”. These participant comments were generated from both reflections on the benefits of the PD and the desired improvements of the PD. The TLLs appreciated learning from other TLLs, how they use the strategies and/or plan on using the strategies in their classrooms. Sharing personal connections through PD reflection pieces increased conceptual understandings of the strategies in new ways beyond the multiple resources and examples provided in the PD

itself. Participants who commented on the desired improvements of the PD desired more peer interaction. TLL14 noted she thought they were one of the first ones going through the PD as there was not much dialog when they were participating. This fourth theme on the value of peer interaction impacted self-efficacy. As TLLs both saw actual examples in the PD and heard from colleagues about how strategies were successful in other similar grade levels or subject area lessons, they felt more confident that they could use the strategies in their own classrooms.

5. Conclusions

An implication of the findings for first research question is the online PD for TLLs is effective and increases TLLs' knowledge, skills, and self-efficacy in supporting EMs while teaching content and language in the K-12 classroom. The PD aligns with [Thacker's \(2017\)](#) work on voluntary PD opportunities that guide the use of real-world experiences through engaging PD to support similar experiences in teachers' own classrooms. [Newberry et al.'s \(2018\)](#) research in creating a lens for TLLs to better connect real-world experiences to standards-based teaching was embedded in this PD with experiential and application-aligned learning to support effective teaching that is embedded in cultural and linguistic capital ([Kim & Viesca, 2016](#); [Yosso, 2005](#)). Embedding this strategy was successful in contributing to the change that TLLs reported. The PD also demonstrated how to teach academic vocabulary using strategies in content instruction ([Greenleaf et al., 2018](#)) and embedded multiple opportunities for this through building a community of practice ([Lave & Wenger, 1991](#)) through discussions and sharing of ideas and experiences that helped build a shared identity (domain), shared interactions (community), and shared experiences (practice). Through participation in this community of practice, teachers collectively increased in knowledge, use, and self-efficacy after a series of experiences as part of the online STEMSS PD.

The inference that can be made from these findings, that TLLs' classroom teaching behaviors promoting EMs' academic vocabulary development will increase, is supported by [Brinson and Steiner's \(2007\)](#) research on how the role of teacher knowledge and skills in pedagogical practices impact teacher efficacy and how teachers' behaviors changes when their efficacy is increased. Other factors that may have influenced the results include the minimal amount of time involved in the study (specifically related to increase in self-efficacy) and the varying years the TLLs had been teaching EMs. As noted in the results, the TLLs who had minimal change were more likely to be those who had taught for more than ten years and the teachers who had dramatically more increase in knowledge, skills, and self-efficacy were more likely to have taught for less than five years (Appendix G). Despite these factors, the findings of research question one directly achieved the purpose of the study in identifying and documenting a PD that increases knowledge, use of strategies, and self-efficacy in supporting TLLs to teach STEMSS content and language to EMs. The development and effectiveness of the PD for TLLs can directly address the problem of TLLs needing support and training to meet the academic and linguistic needs in their increasingly diverse classrooms, which is noted as being one of the most critical growing pedagogical needs for TLLs ([Tellez & Manthey, 2015](#); [Weinstein & Trickett, 2016](#)).

From the positive results, expanded access to this PD is a noted implication as well as expansion of PD programs on identifying successful strategies to support TLLs in the field. Results for research question two provided further support for the quantitative findings in identifying teachers' perceptions of how the STEMSS PD impacted their knowledge and skills in teaching and developing lessons to teach both content and language in their classrooms. Synthesis of findings across document analysis of lesson plans and interviews revealed an overarching theme of the effectiveness of peer engagement to build knowledge,

use, and self-efficacy in supporting EMs, as was promoted in the online PD. These findings aligned with [Fore et al.'s \(2015\)](#) and [King's \(2016\)](#) research on the necessity of socio-cultural interactions and shared experiences through an ongoing community of practice for PDs to be effective in increasing knowledge and application of knowledge to pedagogical practices. The findings also build on [Hagler's \(2015\)](#) research on 21st century skill building and [Zhang et al.'s \(2014\)](#) research on teachers' perceptions of PD that new knowledge must be perceived as useful, easy to use, and effective to ensure the chance for implementation of new concepts to teaching practices.

The connections between teachers' perceptions and impact on learning were corroborated in the qualitative analysis. The participating TLLs communicated their interest in the PD and appreciated the knowledge gained. The participants had a need to increase their knowledge in how to teach content to EMs and the data show that the PD met that need. This finding was consistent with [Fanni et al. \(2013\)](#), [Beijaard et al. \(2004\)](#), and [Kan and Murat's \(2018\)](#) focus on purpose and need as reasons that teachers participate in voluntary training and, in part, are reasons that PD can impact pedagogical change.

The qualitative findings demonstrated these impacts through self-reported change in teacher perceptions of strategies to support their teaching. The findings may have been impacted by participant bias given that the TLLs had an expressed interest in or need for gaining the new knowledge as they chose to voluntarily participate in the study and complete the PD. The author of the online PD was also the researcher of the study, so it is possible that researcher bias entered into the data analysis; however, the intended purpose of the PD was to specifically address the problem expressed by providing needed support and training for TLLs. The purpose of the study was to document and analyze the impact of the STEMSS online professional development on the teachers' knowledge, skills and self-efficacy in supporting EMs' academic language development in the classroom and the study achieved this purpose. In doing so, the findings can inform the design of professional development to include engaging teachers with other teachers to learn about, share, and discuss new strategies or approaches as an effective way to support teachers in using these strategies in their classrooms to support EMs or to help support teachers' growth and development of self-efficacy. Participants expressed additional need for resources on the strategies embedded in the PD and desire for additional investigation of those strategies found to be beneficial for the participants' teaching methods. Each of the 10 strategies was included in the PD with research on why the strategy was effective, procedures on how to use the strategy, and examples of using the strategy in content instruction.

Participants provided suggestions for improvement, which included more examples and modeling the use of the strategies through videos as well as providing concrete examples by teachers who have used them in the field so the strategies can more easily be replicated in their own classrooms. In response to the teachers' suggestions, one implication of these findings is that for PD to be most helpful to teachers it needs to provide teachers with explicit modeling of new teaching methodologies. This implication is supported by [Matuk et al.'s \(2015\)](#) investigation of customization of PD to build and support teachers' experiences, knowledge, and needs. With their STEM PD research, [Miles et al. \(2015\)](#) also pointed to the need for collaboration, communication, modeling, and support for implementation when training teachers on effective practices in STEM. The current findings are consistent with and can build upon these research findings. Another implication reflected in the thematic finding is that for PD to be most effective, the procedures should utilize peer engagement to assist in the increase of teachers' knowledge, use, and self-efficacy. Based on [Lave and Wenger's \(1991\)](#) community of practice theory, the findings align with the body of knowledge on e-Learning that inspired this study, including [Lam et al.'s \(2014\)](#) use of technology to increase perceptions of e-learning strategies for teachers

to support students' learning and [Heflin et al.'s \(2017\)](#) research on mobile technology on attitudes, engagement and learning.

The current findings also aligned to the text mining research of [Zawacki-Richter and Latchem \(2018\)](#) on education and integrated technology and support research advancement with particular importance of e-learning best practices for supporting TLLs in today's classrooms where modalities are changing, even for those in traditional school settings. Though unplanned, the timing of this study fell amidst the COVID-19 pandemic and with schools moving to online and hybrid modes, teachers were eager to find resources and e-learning tools and the challenge to find participants was, perhaps, lessened; however, the immense pressure for teachers to learn at such a quick pace heightened the urgency for effective e-learning practices within the PD to ensure that the PD was effective and time-efficient. One additional implication from the qualitative findings is the need for ongoing collaboration to support TLLs. This implication is supported through participant comments on how important the collaboration was to them, such as TLL11 who mentioned, "I learned a lot from the other teachers (participants) who shared their ideas on how they were going to use the strategies. I wish there was more of that". TLL3 also shared, "the other teachers' ideas and knowledge also made a big difference in the PD". In addition, several other TLLs suggested changes to the PD to include more opportunities to engage with their peers. This need for collaboration is reinforced through [Lave and Wenger's \(1991\)](#) research and can further support the application of a community of practice theory in teaching and learning contexts. The necessity of additional training and resources needed to support TLLs with the growing population of EMs in today's classrooms is not isolated as evidenced by previous and ongoing research by [Berg et al. \(2012\)](#), [Tellez and Manthey \(2015\)](#), and [Weinstein and Trickett \(2016\)](#).

The STEMSS project findings have the potential to impact policy in Arizona related to how teachers are prepared to serve the diverse populations found in K-12 classrooms and how they are supported throughout their teaching career. Considering EMs are the fastest growing demographic population in K-12 classrooms with almost 1 in 10 students being EMs across the country. In 2013 the Arizona English learner Task Force was dissolved and the Arizona Board of Education assumed its statutory responsibilities for EMs. Modifications to Proposition 203 a result of SB1014 and HCR2026 were made and in the 2020–2021 school year schools in Arizona were allowed four research-based program models to be implemented at the K-12 level across Arizona as opposed to the prior single SEI program model in effect since 2000 ([Arizona Department of Education, 2020](#)). This illustrates the restrictive policy and changing climate of how Arizona serves EMs in their public schools. Implications of this current study have the potential to impact policy by providing new research findings on an effective PD model to support TLLs work with EM in classrooms and using these findings to push for increased resources including additional teacher training.

In focusing on addressing the problem of needed support and training for teachers struggling to meet the academic and linguistic needs of ELLs in their increasingly diverse classrooms, a PD was designed and developed reflecting best practice methods from [Vygotsky's \(1978\)](#) socio-cultural theory and [Lave and Wenger's \(1991\)](#) communities of practice. The purpose of this study was to document and analyze the impact of this newly developed STEMSS professional development on TLLs' knowledge, use of strategies, and self-efficacy in teaching EMs both content and language in the K-12 classroom. Twenty-four TLLs completed the PD and provided supporting evidence that the PD provided significant benefits in their knowledge, skills, and confidence in teaching EMs content while supporting their linguistic needs. These benefits included increased knowledge of strategies to teach content and language in tandem, the increased use of these strategies in teaching STEMSS, and improved confidence in their abilities to implement the strategies.

The positive findings support recommending expanding the opportunity for TLLs to access the PD and the development of additional resources on strategies to embed within the PD. Future practice should primarily focus on expanding access to the PD by expanding it outside of Arizona and translating the PD to offer it in Spanish to support academic language development of bilingual educators while training them on effective linguistic strategies while teaching content. In addition to expanding the reach of the PD, the findings could impact policy across the country in teacher training for this growing population of students. This, then, would have a larger impact on EMs and bridging the achievement gap these students face in American schools (Garcia et al., 2010). This also would further align this research to that of Echevarria et al.'s (2008) research on lesson procedures to support EMs, Estapa and Tank's (2017) research on STEM professional development, Zawacki-Richter and Latchem's (2018) work on e-learning PD, and Tellez and Manthey's (2015) work on strategy PD to support TLLs. Furthermore, the STEMSS PD research could begin to inform policy in training TLLs and best practices in PD for TLLs who teach content in the K-12 classroom while looking at how PD can increase knowledge, use, and self-efficacy in utilizing strategies to support teaching content and language to English learners. Finally, a consortium to bring TLLs and key stakeholders together to continue to grow these resources and inform additional recommended practices would further support TLLs in their field. Accessibility to these resources and providing a voice to the TLL community would ensure these recommended practices further the research's impact on the educational community.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by ASU Knowledge Enterprise Development (Approval code: STUDY00007806 Approval Date: 4 November 2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data can be retrieved by contacting the author.

Conflicts of Interest: The author declares no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

STEMSS	Science, Technology, Engineering, Math, and Social Studies
EMs.	Emergent Multilinguals
TLLs.	Teachers of Language Learners
PD	Professional Development

Appendix A. KUSE Survey

1. ID: use the first three letters of mom's first name (or dad if there is no mom) and the last four digits of your phone number (for example, Jane and 123-4567 = JAN4567) *

Knowledge of Concepts

Please rate the concepts listed below using the criteria provided. In this section, please, decide how knowledgeable you are about each principle. Please mark only one box per row.

2. I am knowledgeable about... *

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Developing academic language across science content using specific strategies	☐	☐	☐	☐	☐
Developing academic language across technology content using specific strategies	☐	☐	☐	☐	☐
Developing academic language across engineering content using specific strategies	☐	☐	☐	☐	☐
Developing academic language across math content using specific strategies	☐	☐	☐	☐	☐
Developing academic language across social studies content using specific strategies	☐	☐	☐	☐	☐
Using e-tools to develop academic vocabulary across STEMSS content	☐	☐	☐	☐	☐
Using word walls to develop academic language	☐	☐	☐	☐	☐
Using sentence starters/sentence frames to develop academic language	☐	☐	☐	☐	☐
Using color coding to develop academic language	☐	☐	☐	☐	☐
Using interactive notebooks to develop academic language	☐	☐	☐	☐	☐
Using quick chats/quick writes to develop academic language	☐	☐	☐	☐	☐
Using big books to develop academic language	☐	☐	☐	☐	☐
Using songs and chants to develop academic language	☐	☐	☐	☐	☐
Using murals and graphic input charts to develop academic language	☐	☐	☐	☐	☐
Using 10 important sentences to develop academic language	☐	☐	☐	☐	☐
Using graphic organizers to develop academic language	☐	☐	☐	☐	☐
Identifying key academic vocabulary	☐	☐	☐	☐	☐
Assessing key academic vocabulary	☐	☐	☐	☐	☐
The funds of knowledge and familial cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
The linguistic community cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
How to support ELs/DLs' academic language at home	☐	☐	☐	☐	☐
	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
How to sustain my commitment to meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
How to be confident in meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
How to be collaborative in meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
How to take leadership roles within my school community	☐	☐	☐	☐	☐

Use of Concepts

Please rate the concepts listed below using the criteria provided. In this section, please rate how you use each concept in your teaching. Please mark only one box per row.

3. In my teaching, I.. *

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Develop academic language across science content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across technology content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across engineering content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across math content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across social studies content using specific strategies	☐	☐	☐	☐	☐
Use e-tools to develop academic vocabulary across STEMSS content	☐	☐	☐	☐	☐
Using word walls to develop academic language	☐	☐	☐	☐	☐
Use sentence starters/sentence frames to develop academic language	☐	☐	☐	☐	☐
Use color coding to develop academic language	☐	☐	☐	☐	☐
Use interactive notebooks to develop academic language	☐	☐	☐	☐	☐
Use quick chats/quick writes to develop academic language	☐	☐	☐	☐	☐
Use big books to develop academic language	☐	☐	☐	☐	☐
Use songs and chants to develop academic language	☐	☐	☐	☐	☐
Use murals and graphic input charts to develop academic language	☐	☐	☐	☐	☐
Use 10 important sentences to develop academic language	☐	☐	☐	☐	☐
Use graphic organizers to develop academic language	☐	☐	☐	☐	☐
Identify key academic vocabulary	☐	☐	☐	☐	☐
Assess key academic vocabulary	☐	☐	☐	☐	☐
Incorporate funds of knowledge and familial cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
Incorporate linguistic community cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
Support ELs/DLs' academic language at home	☐	☐	☐	☐	☐
Am sustain my commitment to meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Am confident in meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
Am collaborative in meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
Take leadership roles within my school community	☐	☐	☐	☐	☐

Self Efficacy and Concepts

Please rate the concepts listed below using the criteria provided. In this section, please rate how certain you are in your ability to use or implement each concept.

4. In my teaching, I am certain I can...

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Develop academic language across science content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across technology content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across engineering content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across math content using specific strategies	☐	☐	☐	☐	☐
Develop academic language across social studies content using specific strategies	☐	☐	☐	☐	☐
Use e-tools to develop academic vocabulary across STEMSS content	☐	☐	☐	☐	☐
Using word walls to develop academic language	☐	☐	☐	☐	☐
Use sentence starters/sentence frames to develop academic language	☐	☐	☐	☐	☐
Use color coding to develop academic language	☐	☐	☐	☐	☐
Use interactive notebooks to develop academic language	☐	☐	☐	☐	☐
Use quick chats/quick writes to develop academic language	☐	☐	☐	☐	☐
Use big books to develop academic language	☐	☐	☐	☐	☐
Use songs and chants to develop academic language	☐	☐	☐	☐	☐
Use murals and graphic input charts to develop academic language	☐	☐	☐	☐	☐
Use 10 important sentences to develop academic language	☐	☐	☐	☐	☐
Use graphic organizers to develop academic language	☐	☐	☐	☐	☐
Identify key academic vocabulary	☐	☐	☐	☐	☐
Assess key academic vocabulary	☐	☐	☐	☐	☐
Incorporate funds of knowledge and familial cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
Incorporate linguistic community cultural wealth of ELs/DLs' families	☐	☐	☐	☐	☐
Support ELs/DLs' academic language at home	☐	☐	☐	☐	☐
Sustain my commitment to meeting the needs of AZ's diverse population	☐	☐	☐	☐	☐
Meet the needs of AZ's diverse population	☐	☐	☐	☐	☐

Demographics**5. What is your age?**

6. I am currently working with English learners.

Mark only one oval.

- ☐ Yes
☐ No
☐ Not Sure
☐ Other: _____

7. How many years of experience do you have working with English learners?

8. Are you fluent in a language other than English?

Mark only one oval.

- ☐ Yes
☐ No
☐ Maybe

9. Do you currently hold an SEI endorsement?

Mark only one oval.

- ☐ Yes
☐ No
☐ Not Sure

10. Do you currently hold an ESL Endorsement?

Mark only one oval.

- ☐ Yes
☐ No
☐ Not sure

11. Do you currently hold BLE Endorsement? **Mark only one oval.*

- ☐ Yes
☐ No
☐ Not sure

12. How many years of teaching experience do you have? *

13. What is your highest level of education?*Mark only one oval.*

- ☐ Associate's degree
☐ Bachelor's degree
☐ Master's degree
☐ Doctoral degree
☐ Other:

14. I have taught in the following programs (Check all that apply): **Check all that apply.*

- ☐ SEI
☐ ELD
☐ Bilingual pre-2000
☐ Dual Language 1 way
☐ Dual Language 2 way
☐ Special Education
☐ General Education
☐ Other:

15. I currently teach in the following type of program (Check all that apply): **Check all that apply.*

- ☐ SEI
☐ ELD
☐ Bilingual pre-2000
☐ Dual Language 1 way
☐ Dual Language 2 way
☐ Special Education
☐ General Education
☐ Other:

16. Thank you for participating in this survey. If you have any questions or would like to provide additional information, please contact kalquerrero@hotmail.com or 480-580-1558. Survey adapted from KCU by Malissa Chavez-Thibault, Ed.D. *

Appendix B. Lesson Plan Template

Lesson Title

Author	Gale Ekiss
Grade Level	6
Duration	2 class periods

Adapted from: Put name of person/organization for major attribution (delete if inappropriate)

National Standards	AZ College and Career Ready Standards	Other Arizona Standards
GEOGRAPHY STANDARDS Element Four: Human Systems 10. The characteristics, distribution and complexity of Earth's cultural mosaics. 11. The patterns and networks of economic interdependence. Pick 1-3 of these. Make sure these are measured in the assessment.	ELA (Grades K-5) or Reading Standards for 6-8 for Literacy in History/Social Studies Reading Key Ideas and Details 6-8.RH.1 Cite specific textual evidence to support analysis of primary and secondary sources. 6-8.RH.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. Integration of Knowledge and Ideas 6-8.RH.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts. 6-8 Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects Writing Production and Distribution of Writing 6-8.WHST.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. a. Produce clear and coherent functional writing (e.g., formal letters, envelopes, procedures, labels, timelines, graphs/tables, experiments, maps, captions, charts, diagrams) in which the development, organization, and style are appropriate. MATHEMATICS STANDARDS Ratios of Proportional Relationships 6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means ³⁰ / ₁₀₀ times the quantity); solve problems involving finding the whole, given a part and the	SOCIAL STUDIES STANDARD Grade 6 Strand 3 Civics/Government Concept 4 Roles of Citizenship PO 3. Describe the importance of citizens being actively involved in the democratic process (e.g., voting, student government, involvement in political decision making, analyzing issues, petitioning public officials). Strand 4 Geography Concept 4 Human Systems PO 2 Describe the environmental, economic, cultural and political effects of human migrations and cultural diffusion on places and regions. SCIENCE OR TECHNOLOGY STANDARD Pick 1-3 of these. Make sure these are measured in the assessment.

BOLD THE SIOP FEATURES THAT YOU WILL INCLUDE in your lesson (this will typically be no more than 3 in one box)

SIOP Elements		
Preparation Adapting content Linking to background Linking to past learning Strategies used	Scaffolding Modeling Guided practice Independent practice Comprehensible input	Grouping Option Whole class Small groups Partners Independent
Integrating Processes Reading Writing Speaking Listening	Application Hands on Meaningful Linked to objectives Promotes engagement	Assessment Individual Group Written Oral Example

TESOL Standard(s)
This is an example of how yours will look: ESL: English for Content Through The Use Of ESL Methodologies, The Student Will: EFC-A. Create, read, and interpret visual information relating to science, social studies, and math. A1. Draw and label maps. EFC-B. Use math skills to calculate and measure. B4. Calculate percentages EFC-C. Compose in a variety of forms. C1. Use Math, Social Studies, and Science target vocabulary. EFC-E. Comprehend reading materials. E1. Read a variety of Math, Science, and Social Studies materials.

Arizona English Language Proficiency Standards
This is an example of how yours will look—use BASIC level. Stage IV Basic Reading Standard 4: The student will analyze text for expression, enjoyment, and response to other related content areas. The student will demonstrate knowledge of reading comprehension by: B-12: identifying the author's main purpose (e.g., to inform, to persuade, to entertain). B-13: identifying the cause and effect relationship between two related events in a literary selection. B-14: drawing conclusions from information implied or inferred in a literary selection.

Overview	Look at the standards above to choose the appropriate verb.
Write a short paragraph here. This should be the BIG picture. Why should any child have to learn this?	
Purpose	Procedures Can have prerequisites to this lesson. For example: : Students should have been introduced to the European feudal system. Students should know how to calculate percentages. SESSION ONE (if TWO will follow on another day, otherwise, leave this out) a. Insert the SIOP practices as they are included in the lesson. Bold these. Period goes after the sentence not after the SIOP explanation. Use a colon to split up the element from its strategy (Scaffolding: Comprehensible Input) and parentheses. Engage: Use a motivating question or activity to engage student attention and interest. Give step-by-step directions for doing the lesson. Begin with a verb if possible (Distribute, Ask, Model, Group, Draw, Discuss, Write, Review, Solicit, Pass) Example: a. Inform students they have been transported back into time. It is the year 1100 AD and they have become serfs (peasants) living on a manor in the heart of Europe. (For ELLs-be sure the students understand the imaginary idea of time travel.). (Preparation: Adapting content, Linking to Background) b. Tell them they will need to successfully complete a series of tasks in order to return to the present. To earn this return, they must work to come up with a solution to the problem of poor wheat crop production in some areas of the manor and earn the lord's favor. Optional: You may want to set up a "reward" system for cooperative tasks and the final report. c. Let them know they are not alone, they have been transported in groups of three to the manor. Divide
Key Vocabulary	
Keep to 5 to 7 words Word 1 with definition appropriate for <u>grade level</u> and <u>language learners</u> Loam: a mixture of silt, sand, and clay Acre: A unit of area (A football field in the United States is about 1.32 acres in size!)	
Materials	
- XX. - XX - Don't list paper and pencil—but do list things that students might not have at their desk (scissors, atlases, etc) - Worksheets—Use the same words as the titles on the worksheets - Answer Keys - Maps—Use the same words as the titles for the maps.	
Objectives	
The student will be able to: 1. describe XX 2. analyze XX	

Name of Lesson (view header to add)
students into groups of three (Grouping Option: Small groups) d. Explain that you are now the reeve . (A reeve was employed by the lord to ensure that peasants worked well and did not steal from a lord.) Explore: Give students time to explore during an activity without any direct instruction. Continue to use verbs at the beginning of sentences. Example: b. Give each group time to generate ideas on what they think life was like for the peasants/serfs at this time? c. Distribute a sheet of paper to each student or have them work as a group d. Ask them to sketch what they think should be on a manor. Review that a manor is a self-sufficient unit of land owned by a lord and worked on by the serfs. (Preparation: Linking to Background) e. Before sharing ideas with the large group, have students share within their small groups so that ELLs have an opportunity to rehearse their answers. (Integrating Process: Speaking) f. Ask groups to share out their ideas. (Integrating Process: Listening) g. Let students know that over the next couple days they will be investigating and gathering information in order to solve the problem of poor crop production on the manor. If they do not solve the problem, they will not be returning to present day. h. Then explain that to help solve the problem they will need to learn about soil. i. Conduct Teacher Demonstration Engage—Session 1 (Scaffolding: Comprehensible Input) YOU MUST IDENTIFY THE SIOP PROCEDURES IN YOUR PROCEDURES. Explain: This is the time for direct or indirect instruction. Students can read information, take notes on a presentation, watch a presentation, etc. Elaborate: Students can now apply information to earlier Explore stage and complete an experiment, design an invention, complete tasks, map information, etc. Evaluate: Explain how the lesson will be assessed. Each standard given above should have a formal assessment.
Assessment
Give the criteria for grading each assessment. Students will score 80% or higher on the Inventions Worksheet for a geography and science grade to be considered mastery. - a 4 or higher on the 6 Traits Writing Rubric in the area of Ideas and Organization to be considered mastery. 80 points out of 100 on the math worksheet to be considered mastery. Extensions Give suggestions on how to develop your ideas further such as a future explorations, assignments, or websites to visit. Sources This is where you provide sources of information. Save your lesson plan as Yourlastname1-2Keywords from lessonT.doc (Ex: SmithWaterConservT.doc) T = Teacher file All student work will be in 1 file and saved as YourlastnameSamewordsasonTfile S.doc (Ex: SmithWaterConservS.doc) S = Student file

Appendix C. Coding Terms

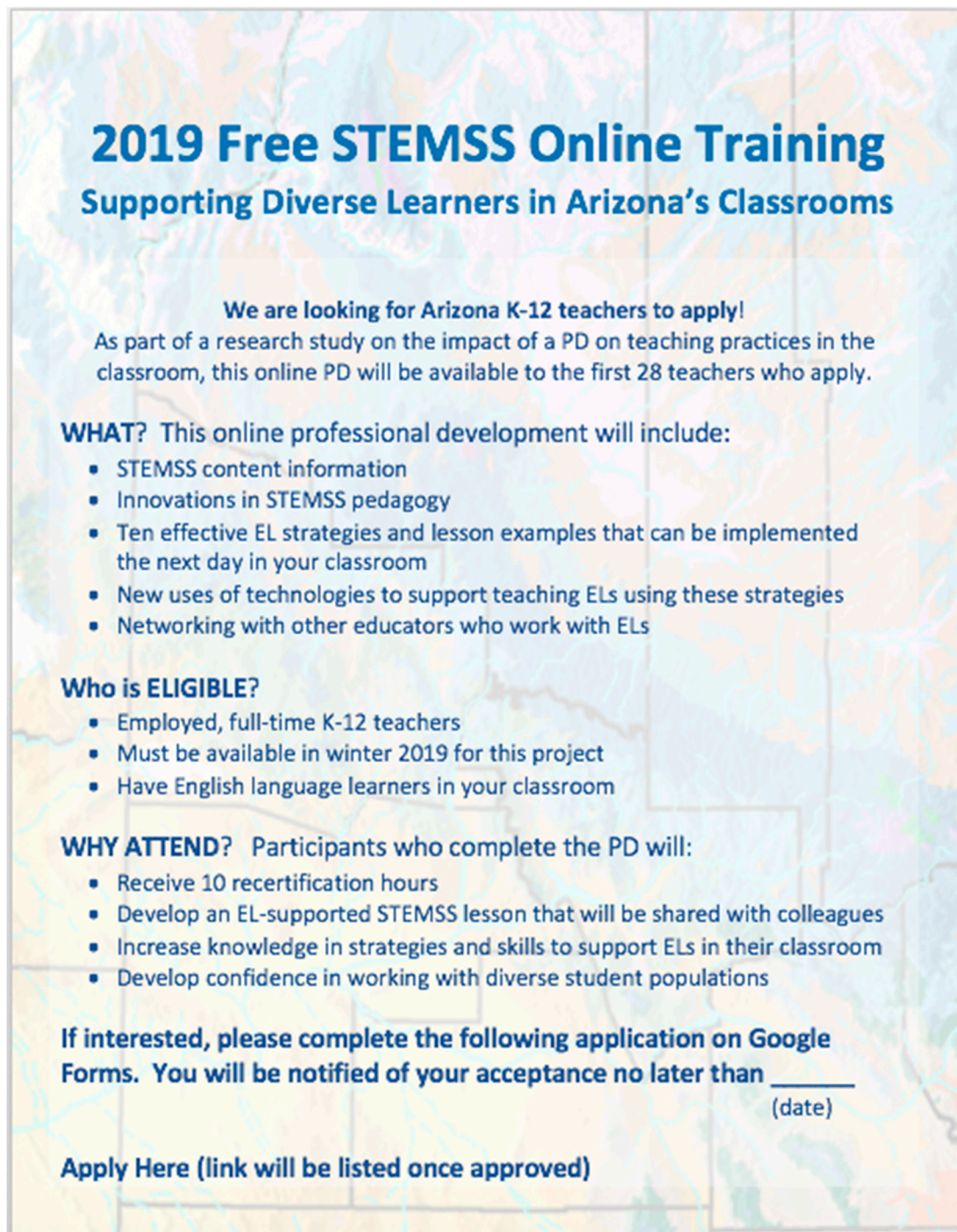
Pre-determined Codes (may add additional codes as data is collected):
Constructs:
Knowledge/knowledgeable
Use/useful/usefulness
Self-efficacy/confidence/confident
Strategies:

Sentence Frames/Stems
 Quick Chat/Quick Write
 Word Walls
 Big Books
 10 Important Sentences
 Color-coding
 Graphic Organizers
 Interactive Notebooks
 Murals/Graphic Input Charts
 Songs/Chants
 Research Question Focus:
 Academic language/vocabulary
 Increase
 Change
 Develop
 Noticed
 Learned
 Gained
 Identify
 Use
 Support
 Apply
 STEMSS/Science/Technology/Engineering/Math/Social Studies

Appendix D. Interview Questions

- Interview Questions (based on KUSE, PD, and Research Questions):
- What impact did the online PD module have on your knowledge in developing ELL's academic vocabulary? How?
- What new strategy(s) did you learn and/or were you reminded of to support academic vocabulary development while teaching STEMSS? How did you or will you apply this new knowledge in your teaching? Provide examples
- What impact did the online PD module have on your self-confidence in teaching ELLs both language and content in the classroom? How?
- How confident are you in using the strategy(s) you described above in your classroom to support academic vocabulary development? Has this increased? How? Why/why not?
- What did you like or dislike about the strategies? Provide examples.
- How was the PD helpful in supporting your learning about the strategies and their effectiveness?
- What was challenging in implementing the strategies into your lesson?
- Did the challenges discourage or encourage your use of the strategies?
- What strategies did you implement into your teaching pedagogy? Why did you select those and not others?
- Did you see an improvement in ELL student learning of academic language using the strategies? How might this improvement (if any) increase your confidence and knowledge in using these in the future?
- How can the strategies or the online PD to increase your knowledge, use, and confidence in supporting ELLs be improved?

Appendix E. Sample Flyer for Recruitment of Participants



2019 Free STEMSS Online Training
Supporting Diverse Learners in Arizona's Classrooms

We are looking for Arizona K-12 teachers to apply!
As part of a research study on the impact of a PD on teaching practices in the classroom, this online PD will be available to the first 28 teachers who apply.

WHAT? This online professional development will include:

- STEMSS content information
- Innovations in STEMSS pedagogy
- Ten effective EL strategies and lesson examples that can be implemented the next day in your classroom
- New uses of technologies to support teaching ELs using these strategies
- Networking with other educators who work with ELs

Who is ELIGIBLE?

- Employed, full-time K-12 teachers
- Must be available in winter 2019 for this project
- Have English language learners in your classroom

WHY ATTEND? Participants who complete the PD will:

- Receive 10 recertification hours
- Develop an EL-supported STEMSS lesson that will be shared with colleagues
- Increase knowledge in strategies and skills to support ELs in their classroom
- Develop confidence in working with diverse student populations

If interested, please complete the following application on Google Forms. You will be notified of your acceptance no later than _____ (date)

Apply Here (link will be listed once approved)

Appendix F. Permission to Use KUSE



Malissa Thibault

to me ▾

10:27 AM (1 hour ago)



Hi Karen,
 Congratulations on pursuing your doctorate.
 Such a long but rewarding journey.
 You are welcome to use the survey as long as it is cited.
 Do you have a copy of my dissertation?
 I think I have both validity and reliability outlined in it.
 Wishing you the very best.

Respectfully,

Malissa Chavez-Thibault, Ed.D.
 Early Childhood Instructional Coach
iTeachELLs | Mary Lou Fulton Teachers College



Karen Guerrero <klinsle@asu.edu>

to Malissa, me ▾

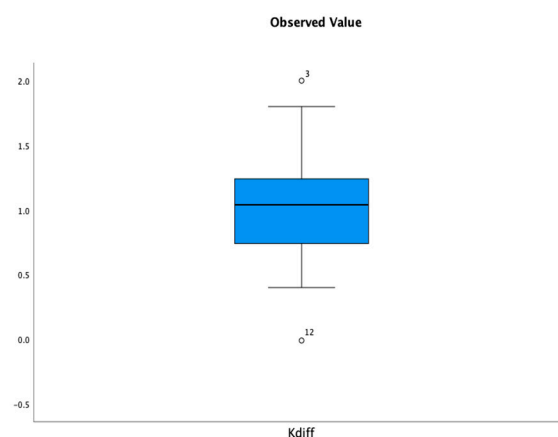
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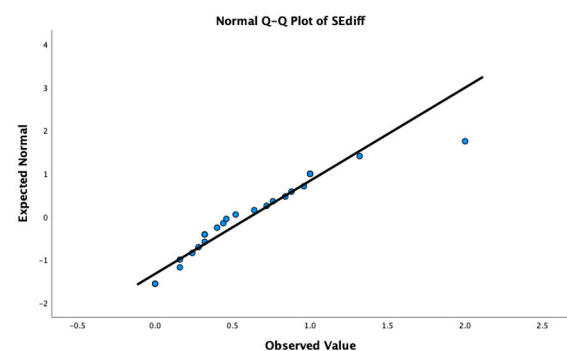
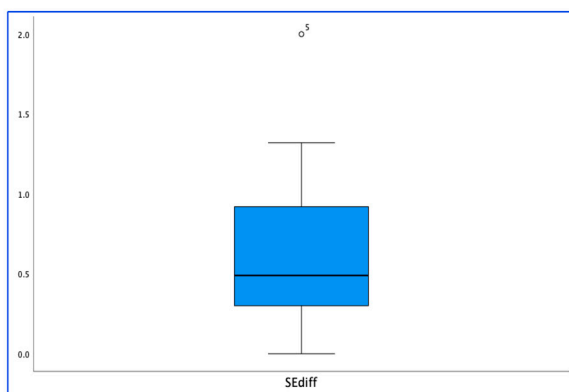
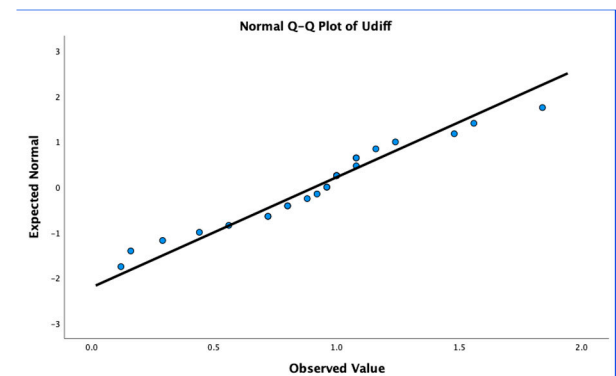
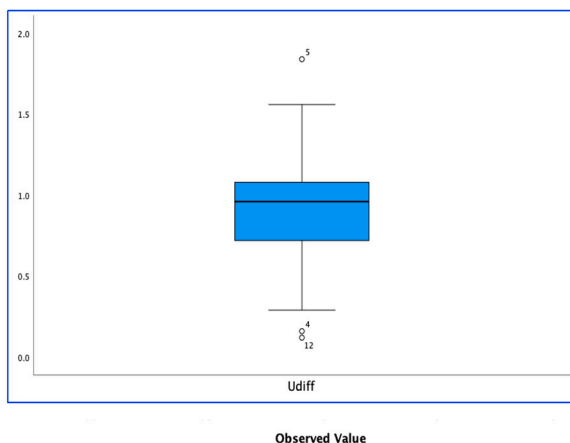
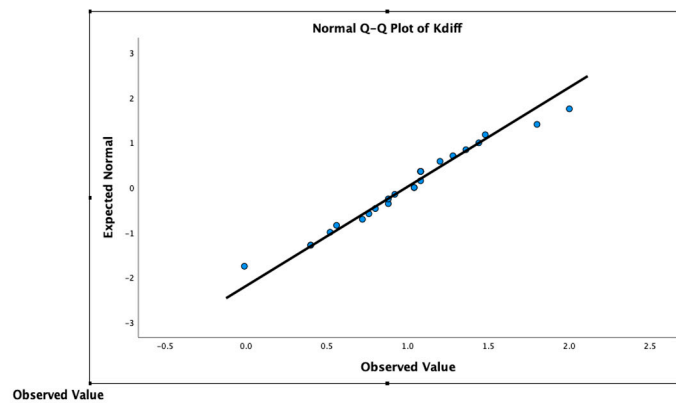


Hi Malissa.
 I am currently working on a PhD in Online Learning at Northcentral University in Prescott, AZ. The focus of my research is to assess an online STEMSS (STEM+Social Studies) professional development module and its impact on teachers of language learners (TLLs) knowledge, use, and self-efficacy of using strategies to support academic vocabulary development for ELs.

I wonder if you would give permission to use the KUSE survey you used with adaptations to align with the strategies in the online STEMSS PD? Also, I would love it if you could provide any data or information you have on the survey such as validity. I would be glad to share my results with you when completed. I plan to try to do an online pre and post KUSE survey using Google Forms and make it open to all TLLs who sign up to complete the online PD module. Your research has been invaluable in my dissertation development to this point and I would very much appreciate your permission and any other information you may have to support my work.
 Thank you for your consideration!

Appendix G. Normality Box and Q-Q Plots





References

- Archerd, E. (2013). An idea for improving English language learners' access to education. *Fordham Urban Law Journal*, 41(2), 351–401. [CrossRef]
- Arizona Department of Education. (2019). *Accountability and research*. Available online: <https://www.azed.gov/accountability-research> (accessed on 16 January 2025).
- Arizona Department of Education. (2020). *Arizona OELLAS office*. Available online: <https://www.azed.gov/oelas> (accessed on 16 January 2025).
- Beijaard, D., Meijer, P., & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education: An International Journal of Research and Studies*, 20(2), 107–128. [CrossRef]
- Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *Nursing Plus Open*, 2(1), 8–14. [CrossRef]
- Berg, H., Petrón, M., & Greybeck, B. (2012). Setting the foundation for working with English language learners in the secondary classroom. *American Secondary Education*, 40(3), 34–44.
- Bergman, M. M. (2008). *Advances in mixed methods research*. Sage Publications. [CrossRef]
- Brinson, D., & Steiner, L. (2007). *Building collective efficacy: How leaders inspire teachers to achieve (issue brief)*. Center for Comprehensive School Reform and Improvement.

- Chavez-Thibault, M. (2017). *Instructional coaching in higher education: Partnering to infuse ELL instructional practices into social studies courses* [Ph.D. dissertation, Arizona State University].
- Collier, V. P., & Thomas, W. P. (2014). *Creating dual language schools for a transformed world: Administrators speak*. Fuente Press.
- de Jong, E., Arias, M. B., & Sanchez, M. T. (2010). Undermining teacher competencies: Another look at the impact of restrictive language policies. In P. Gandara, & M. Hopkins (Eds.), *Forbidden languages: English learners and restrictive language policies*. Teachers College Press.
- Dorn, R. I., Douglass, J., Ekiss, G. O., Trapido-Lurie, B., Comeauz, M., Mings, R., Eden, R., Davis, C., Hinde, E., & Ramakrishna, B. (2005). Learning geography promotes learning math: Results and implications of Arizona's GeoMath grade K-8 program. *Journal of Geography*, 104(4), 151–160. [CrossRef]
- Echevarria, J., Vogt, M., & Short, D. J. (2008). *Making content comprehensible for English language learners: The SIOP model*. Allen & Bacon.
- Estapa, A. T., & Tank, K. M. (2017). Supporting integrated STEM in the elementary classroom: A professional development approach centered on an engineering design challenge. *Open Access Research*, 4(6), 1–16. [CrossRef]
- Fanni, F., Rega, I., & Cantoni, L. (2013). Using self-efficacy to measure primary school teachers' perception of ICT: Results from two studies. *International Journal of Education and Development Using Information and Communication Technology*, 9(1), 100–111.
- Fore, G. A., Feldhaus, C. R., Sorge, B. H., Agarwal, M., & Varahramyan, K. (2015). Learning at the nano level: Accounting for complexity in the internalization of secondary STEM teacher professional development. *Teaching and Teacher Education*, 5(1), 101–112. [CrossRef]
- Garcia, E., & Weiss, E. (2017). *Reducing and averting achievement gaps. Economic policy institute executive summary*. Available online: <https://www.epi.org/publication/reducing-and-averting-achievement-gaps/> (accessed on 16 January 2025).
- Garcia, E., Lawton, K., & Diniz de Figueiredo, E. (2010). *The education of English language learners in Arizona: A legacy of persisting achievement gaps in a restrictive language policy climate. The civil rights project*. Available online: <https://www.civilrightsproject.ucla.edu/research/k-12-education/language-minority-students/the-education-of-english-language-learners-in-arizona-a-legacy-of-persisting-achievement-gaps-in-a-restrictive-language-policy-climate> (accessed on 7 July 2017).
- Greenleaf, C. L., Litman, C., & Marple, S. (2018). The impact of inquiry-based professional development on teachers' capacity to integrate literacy instruction in secondary subject areas. *Teaching and Teacher Education*, 71(1), 226–240. [CrossRef]
- Hagler, G. M. (2015). 21st century skills. In *Salem press encyclopedia*. Salem Press Publishing.
- Heflin, H., Shewmaker, J., & Nguyen, J. (2017). Impact of mobile technology on student attitudes, engagement, and learning. *Computers and Education*, 107, 91–99. [CrossRef]
- Hinde, E. R., & Ekiss, G. O. (2005). No child left behind Except in geography? GeoMath in Arizona answers a need. *Social Studies and the Young Learner*, 18(2), 27–29.
- Hinde, E. R., Osborn Popp, S. E., Dorn, R. I., Ekiss, G. O., Mater, M., Smilth, C. B., & Libbee, M. (2007). The integration of literacy and geography: The Arizona GeoLiteracy program's effect on reading comprehension. *Theory and Research in Social Education*, 35(3), 343–365. [CrossRef]
- Honigsfeld, A. (2009). ELL programs: Not "One Size Fits All". *Kappa Delta Pi Record*, 45(4), 166–171. [CrossRef]
- Kan, A., & Murat, A. (2018). Investigation of prospective science teachers' 21st century skill competence perception and attitudes toward stem. *International Online Journal of Education Sciences*, 10(4), 251–272.
- Karabenick, S. A., Noda, P. A., & Clemens, P. A. (2004). Professional development implications of teachers' beliefs and attitudes toward English language learners. *Bilingual Research Journal*, 28(1), 55–75. [CrossRef]
- Kaveh, Y. M., Bernstein, K. A., Cervantes-Soon, C., Rodriguez-Martinez, S., & Mohamed, S. (2022). Moving away from the 4-hour block: Arizona's distinctive path to reversing its restrictive language policies. *International Multilingual Research Journal*, 16(2), 113–135. [CrossRef]
- Kim, J. I., & Viesca, K. M. (2016). Three reading-intervention teachers' identity positioning and practices to motivate and engage emergent bilinguals in an urban middle school. *Teaching and Teacher Education*, 55(1), 122–132. [CrossRef]
- King, F. (2016). Teacher professional development to support teacher professional learning: Systematic factors from Irish case studies. *Teacher Development*, 20(4), 574–594. [CrossRef]
- Lam, P., McNaught, C., Lee, J., & Chan, M. (2014). Disciplinary difference in students' use of technology experience in using e-Learning strategies and perceptions towards e-Learning. *Computers & Education*, 73(1), 111–120.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press. [CrossRef]
- Li, N. (2016). *Teaching ELLs across content areas: Issues and strategies*. Information Age Publishing.
- Lucas, T., Strom, K., & Bratkovich, M. (2018). Inservice preparation for mainstream teachers of English language learners: A review of the empirical literature. *Educational Forum*, 82(2), 156–173. [CrossRef]
- Matuk, C. F., Linn, M. C., & Eylon, B. (2015). Technology to support teachers using evidence from student work to customize technology-enhanced inquiry skills. *Instructional Science*, 43, 229–257. [CrossRef]
- Miles, R., van Tryon, P. S., & Mensah, F. M. (2015). Mathematics and science teachers' professional development with local businesses to introduce middle and high school students to opportunities in STEM careers. *Science Educator*, 24(1), 1–11.

- Newberry, M., Sanchez, L. O., & Clark, S. K. (2018). Interactional dimensions of teacher change: A case study of the evolution of professional and personal relationships. *Teacher Education Quarterly*, 45(4), 29–50.
- Oakes, W. P., Schellman, L. E., Lane, K. L., Common, E. A., Powers, L., Diebold, T., & Gaskill, T. (2018). Improving educators' knowledge, confidence, and usefulness of functional assessment-based interventions: Outcomes of professional learning. *Education & Treatment of Children*, 41(4), 533–564.
- Ovando, C. J., Combos, M. C., & Collier, V. P. (2006). *Bilingual and ESL classrooms: Teaching in multicultural contexts* (4th ed.). McGraw-Hill.
- Rubinstein-Avila, E., & Lee, E. H. (2014). Secondary teachers and English language learners (ELLs): Attitudes, preparation, and implications. *Clearinghouse*, 87(5), 187–191. [CrossRef]
- Rumberger, R. W., & Tran, L. (2010). State language policies, school language practices and the English learner achievement gap. In P. Gandara, & M. Hopkins (Eds.), *Forbidden language: English learners and restrictive language policies*. Teachers College Press.
- Szymanski, A., & Lynch, M. (2020). Educator perceptions of English language learners. *Journal of Advanced Academics*, 31(4), 436–450. [CrossRef]
- Tellez, K., & Manthey, G. (2015). Teachers' perceptions of effective school-wide programs and strategies for English language learners. *Learning Environments Research*, 18(1), 111–127. [CrossRef]
- Thacker, E. S. (2017). PD is where teachers are learning! High school social studies teachers' formal and informal professional learning. *Journal of Social Studies Research*, 41(1), 37–52. [CrossRef]
- U.S. Department of Education. (2019). *Teacher shortage areas nationwide listing 1990–1991 through 2015–2016*. Available online: <http://www2.ed.gov/about/offices/list/oep/pol/tsa.doc> (accessed on 16 January 2025).
- Vygotsky, L. (1978). La prehistoire du discours écrit. *Social Science Information*, 17(1), 1–17. [CrossRef]
- Weinstein, T., & Trickett, E. (2016). The development of an instrument to measure English language learner (ELL) teacher work stress. *Teaching and Teacher Education*, 55, 24–32. [CrossRef]
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education*, 8(1), 69–91. [CrossRef]
- Zawacki-Richter, O., & Latchem, C. (2018). Exploring four decades of research in Computers and Education. *Computers & Education*, 122, 136–152. [CrossRef]
- Zhang, X., dePablos, P. O., & Xu, Q. (2014). Cultural effects on the knowledge sharing in multi-national virtual classes: A mixed method. *Computers in Human Behavior*, 31(1), 491–498. [CrossRef]

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