Engineering for Translanguaging within Elementary Classrooms (DRK12)

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Preliminary Results from the Elementary Teacher Professional Learning in Equitable Engineering Pedagogies for Multilingual Students Project (DRK12)

Introduction

Given the shifting demographics of the US population, particularly within elementary schools [1], [2], there is an increased need to empower teachers to facilitate effective learning with all students. Additionally, since many of these students are multilingual, increasing in both number of languages and proportion of the population, this need is accentuated. Furthermore, the implementation of the Next Generation Science Standards (NGSS) and infusion of engineering for elementary populations [3] can be challenging for teachers. We see this as a unique opportunity to integrate the two challenges together with a mutually beneficial solution approach; translanguaging [4], [5], [6], [7], [8], [9] through engineering projects. Our project aims to serve the increasingly diverse school districts in our geographic region, and to develop a model for incorporating engineering into local classrooms, especially those with linguistically diverse students. These students are often not given the same access to science and engineering lessons as their English speaking peers, due to arguments that they do not have enough English fluency to participate in these activities [10], [11].

Background

Our National Science Foundation Discovery Research PreK-12 funded project works with local elementary school teachers to create a sustained Professional Learning Experience (PLE) for teachers of multilingual students to learn how to incorporate engineering lessons into their classrooms. This work is designed around the power of engineering projects for multilingual students in elementary contexts. Given that the NGSS [12] calls for the introduction of engineering to every grade level and has been widely ratified by US states, there is need to provide training for elementary teachers in this area as most are content generalists who report barriers to their ability to teach this area, such as a lack of confidence [13] or a perceived lack of content preparation [14]. A disciplinary area where teachers and students are equally unfamiliar, such as engineering, is an excellent opportunity for creation of a more equitable learning environment. Engineering design has been widely studied at the elementary school level [7], [8], [9] and a significant amount of work has been done to examine in-service and pre-service teachers learning to teach engineering [14], [15], [16], [17], [18], [19]. Our study extends this work in two ways, first with the integration of a focus on multilingual learners and their teachers, and second with a focus on a sustained professional development. Like most work at the elementary level, we examine teachers engaged in the engineering design process. Our study builds off previous work to meet Next Generation Science Standards [12] and integrate engineering with literacy [20] and community based problems [21], [22], [23].

One useful method to facilitate this is translanguaging, or the active engagement of all of a student's linguistic repertoires. This is an example of a more inclusive language ideology. Language ideologies are the beliefs, values, and attitudes that surround language structures and practices in classrooms and society. This project leverages participatory collaboration, design-based iterative active learning techniques to facilitate a teacher community of practice centering the (co)development of engineering lessons with translanguaging. Our work aims to develop a model of teacher PLE which facilitates their productive pedagogical developments for elementary engineering while leveraging translanguaging to provide equitable learning experiences for multilingual populations.

Our project seeks to answer the following questions:

1. Do the teachers' language ideologies shift, and if so, how?
2. How do teachers' language ideologies, and possible shifts in language ideologies, map onto elements of the PLE?
3. How do teachers' language ideologies, and possible shifts in language ideologies, map onto teachers' engineering pedagogies?

In this paper we will not examine the answers to these questions, as our analysis of teacher data is ongoing. Instead, we will present the preliminary model of the PLE, a sustained year-long professional development for elementary teachers with a focus on translanguaging along with engineering.

Methods

Our project is based on a sustained Professional Learning Experience to develop a supportive learning community. As this is the third year of our project, we are continuing work with the same teachers. We hosted the teachers for a three day summer PLE experience and half-day PLE sessions throughout the school year. More details of our current PLE model are provided in the results. Our project also uses research-based instruments to measure the shifts in teacher beliefs (language ideologies) [24], [25], [26], [27], and knowledge about engineering [28].

As teachers facilitate engineering lessons in their classroom, our team records their teaching alongside some students' conversations and engineering activity. We facilitate teacher debriefing conversations after the lesson whenever possible. As teachers often conduct multiple lessons during multi-day units,we also follow these units with teacher debriefing interviews. Currently our team is using these interviews to build cases of teachers' growth and evolution in engineering instruction and translanguaging practices. Preliminary cases [29], [30], have been presented at previous conferences.

Findings

Current preliminary results include case studies of third grade elementary teachers [29], [30], a menu or introduction to engineering lessons, and the sustained PLE model. In this paper we will share our current PLE model. Our preliminary PLE model initiates with three full-day meetings in the summer where we present engineering, the engineering design process, translanguaging, and language ideologies. Our current activities from the PLE are outlined below in Table 1.

This year, since we have continuing participants and are not admitting new members, we were able to center our activities on mutually deepening understandings of elementary engineering and translanguaging. Additionally, our teachers were particularly interested in developing their competence as practitioner scholars, so we facilitated two optional extra days during the summer where we focused upon action research principles and detailing our current analytic projects to demonstrate the breadth of typical research approaches. Details on our activity sequence from years 1 and 2 PLE are presented in our previous works for this same session [31], [32].

Table 1: Summer PLE Activities

Day 1	Day 2	Day 3	Day 4 (optional)	Day 5 (optional)
Revisited Assessments (TESS, LATS, ILS) Video Noticing and Responding Engineering Rubric	Article Discussion Translanguaged Engineering Lesson Birth of a Word Video Noticing	Article Discussion Translanguaging Primer Artifact Context Clarification Future Plans for the year Engineering Lesson Menu Mid-year PLE session Planning Teacher requested Resources Teacher friendly vocabulary list	Co-Reading article and discussion Example of conferences Introduction to research Coding activity Guess that code-using data artifacts Shared ideation of possible projects	Discussion on Practitioner article in review Detailed discussion of research project interests Plans for doing action research

Teacher Learning sequence

Teachers in the first cohort started by "getting the hang" of engineering lessons, increasing their sense of confidence while leaving translanguaging as a supplementary component rather than an infused approach. This changed over the course of the project, where the cohort two teachers were able to integrate translanguaging strategies better, based on the feedback and collaborative efforts of the research team with the cohort 1 teachers. During the most recent PLE, teachers reflected on their emerging understandings and expanding viewpoint as to counts as translanguaging, and further proposed tools and resources which they would have found helpful and might assist their peers.

Our teachers' favorite activity, and among the most impactful, was an engineering lesson which we facilitated with our year 1 teachers the previous summer to spectacular effect. We brought in a colleague who was a multilingual engineer, and taught an engineering lesson entirely in a language other than English. We did an introductory engineering project, "A Chair for Mr. Bear" which leverages Legos and is based upon 'Goldilocks and the Three Bears' which we were able to find a translated version of. Thus, we presented teachers the lesson 'Una Silla por Señor Oso' based on the reading 'Ricitos de Oro y los Tres Osos' by the Spanish Experiment [33]. For both years, we leveraged the same materials available and the lesson was taught in Spanish. Over the course of the lesson, we gradually implemented more inclusive translanguaging tools. Afterwards we facilitated a discussion with the teachers on what it was like being in their students' perspective. One common statement was the amount of cognitive exhaustion the lesson engendered. Teachers frequently made assertions like "I was so tired from trying to find a place to engage, to connect, or to figure out what was going on" and "at some point I just gave up and wanted the facilitator to leave me alone, so I just nodded when they asked me anything." In teacher interviews at the end of the year, fully half of our teachers reported this activity as their favorite from the PLE. Four teachers have demonstrated this impact by reproducing this language-focused activity in their classrooms for their own students, one of whom has done this lesson twice.

We presented several resources in development to the teachers to get their feedback and to ready them for being the pilot testing audience. These include a 'menu' of engineering lessons, a rubric to assist teachers in evaluating their (own and class) engineering lesson knowledge, and a preliminary conceptual survey designed to facilitate deeper understanding of translanguaging. The first two items are being developed by our curriculum specialist, a recent classroom teacher herself. Finally, we had curated clips of the teachers' engineering lessons from the previous year which were used to practice noticing and responding [34], [35], [36] to deepen their own praxis through intentional reflection as well as considering what their peers had done. We leveraged about 7-9 minutes of clips for each of the 6 classroom teachers participating, curated from over 120 hours of video data.

During the school year, we also have half-day workshops once or every other month, and offer on-request consultations with teachers as they plan their lessons. The half-day PLE workshops are responsive to what we see in the classroom or the teachers request. For example, we have included a check-in on the status of translanguaging initiatives or the action research projects teachers stated an intention to undertake during the summer PLE.

Implications and Conclusions

Implications of this work include techniques to help teachers with the difficult work uptaking new conceptual areas and techniques, such as engineering design or translanguaging. Further, this work demonstrates how to facilitate a community of supportive practice, developing tools and learning opportunities with the teacher participants as collaborative designers. This year our teachers are predominantly replicating their lesson sequence from last year, excitedly undertaking the chance to revise and re-teach, based on the reflective adaptations they made after our interviews about said lessons. Teachers are adding several engineering lessons, most of which were originally facilitated in other classrooms from the study, in addition to three different classrooms implementing 'Una Silla por Señor Oso' based on their own transformative experience. We are continuing to work with the teachers to collaboratively present their work and learning, continue development of the lesson of engineering menu, and further refine the practitioner focused engineering rubric. Finally, we are in the latter stages of a formal writeup of our PLE model for widespread dissemination as a journal article.

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