BOARD # 425: Preliminary Results from the Elementary Teacher Professional Learning in Equitable Engineering Pedagogies for Multilingual Students Project (DRK12)

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Abstract

This paper reports on some initial results from our National Science Foundation (NSF) grant entitled Elementary Teacher Professional Learning in Equitable Engineering Pedagogies for Multilingual Students. This project works with third grade teachers of emerging multilingual students to integrate translanguaging practices into their classrooms as well as engineering lessons. Preliminary results of our teachers' learning and growth as teachers of engineering can be found in other papers [1], [2], [3]; this paper focuses on a major goal of our project, a sustained professional learning experience model for elementary school teachers.

Introduction

The United States has and will continue to have an increase of English language learners, or emerging multilingual students, in elementary school classrooms. Typically, these students are not given the same access to science and engineering lessons as their English speaking peers, as some argue they do not have the lingual resources, or enough English, to participate in these activities.

Despite the introduction of engineering into state and national standards through the Next Generation Science Standards (NGSS), professional development in engineering education for elementary teachers has not typically focused on engineering. This grant 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.

Our National Science Foundation Discovery Research PreK-12 funded project (grant # 2300766) 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. Our project integrates translanguaging, or using all the language resources in any language that a student brings to the classroom, into engineering design activities. As we document our teachers learning to teach engineering with translanguaging, we examine their shifts in beliefs, values, and attitudes about how and where language can be used in the classroom, or their language ideologies. Currently in our second year of the project, our partner teachers have increased from two to ten in total. A majority of project participants are third grade classroom teachers. The project's research questions are:

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 Professional Learning Experience (PLE), a sustained year-long professional development for upper elementary teachers with a focus on translanguaging along with engineering.

Background
Our project, along with a growing number of scholars in science education and engineering education, posits that students can bring all their linguistic and cultural resources, including their home languages, to their engagement in engineering work through the use of translanguaging [4], [5], [6]. Translanguaging is one of many stances teachers can take to communicate and enact certain language ideologies, or beliefs about how and when language can or can't be used. For example, two opposite language ideologies are English should only be spoken in schools in contrast to all languages are welcome in schools (the belief these authors ascribe to). The research team of this project works with participant teachers to implement translanguaging within their classrooms, especially during engineering design lessons.

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 [10], [11], [12], [13], [14], [15]. 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 [16] and integrate engineering with literacy [17] and community based problems [18], [19], [20]

Methods
Our project is based on a sustained professional learning experience [21], [22], [23], [24]. Teachers begin their experience with a pre-interview to benchmark their understanding and experience with engineering, language ideologies, and translanguaging. We then host 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.

As teachers begin engineering lessons in their classroom, our team records their teaching and some students' conversations and engineering activity, typically followed by teacher debriefing conversations. Completion of multi-day units, are also followed by 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 on Emma [2] and Sarah [1] can be found at this and previous conferences.

Our project also uses research-based instruments to measure the shifts in teacher beliefs (language ideologies) [25], [26], [27], [28], and knowledge about engineering [29].

Results
Current preliminary results include case studies of third grade elementary teachers [1], 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 begins with three full-day meetings in the summer where we introduce engineering, engineering design, translanguaging, and language ideologies. An outline of the activities and their sequence in the PLE can be found in Table 1.

Table 1: Summer PLE Activities

Day 1	Day 2	Day 3
Introduction to the Project	Translanguaging and mind map	Article discussion

Collection of Instruments KH(H)LAQ Engineering Chart Engineering Mystery Bag Novel Engineering: Snowy Day and reflection Introduction of Engineering Design Process Introduction to Translanguaging and Mindmap Assignment of Reading	(cont.) Article discussion Introduction to language ideologies Cohort 1 Teacher share* Community-based Engineering Connecting Translanguaging and Engineering Assignment of Reading	Introduction to multimodality Community-based Engineering (cont.) Reflection on learning and future planning Communication of project expectations Planning of future PLE days

*Only included Year 2 and onward

Introducing Engineering

Our introduction of engineering and the engineering design process builds on the expertise of researchers before us [17], [18], [19], [26]. During the PLE, we ask teachers to put on their "student hat," engaging in engineering activities and explorations for the first time as their students will, and to put on their "teacher hat" to engage in reflections on their learning and planning activities for their students. Our model introduces engineering to teachers as they might also introduce engineering to their students. For example, in the Engineering Mystery Bag activity, teachers examine objects and think about their function and the features engineers designed in them. Typical objects include a mechanical pencil or pen, a bandaid, floss, and headphones.

We introduce engineering through a Novel Engineering [17] activity with a book teachers might use in the classroom, *The Snowy Day*, a context familiar to both our teachers and students who live in blizzard rich Western New York. After asking our teachers to create and test a snowball keeper, we ask them to reflect on their process, and then compare that process to models of the engineering design process. We also compare and contrast the scientific inquiry and engineering design processes. Our second engineering challenge is an example of community-based engineering [18], [19], and revolves around a real-life context in the area. The research team distributes news articles (non-fiction texts) and information about local community organizations to help frame the problem, and provide teachers with an example of how to integrate other kinds of texts in their engineering lessons.

Translanguaging and language ideologies are introduced through videos [30], [31], [32] , assigned readings [26], [33], [34], and discussion. One of more memorable video and discussion pairs includes a clip from the movie *Akeelah and the Bee* [35] in which Akeelah and her prospective spelling tutor dispute the differences in pronunciation, and why one is more accepted in a white dominated culture.

Reflective activities also include asking the teachers to articulate what they know, want to know, how they want to learn, what they learned, actions they are going to take, and questions they have (KH(H)LAQ) about engineering. Similarly, we ask teachers to create a mind map of what they know about translanguaging and iterate on the map as they read and discuss during the three day PLE.

During the school year, we also have half-day workshops once or every other month, and offer 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, recognizing an increased need for understanding and introducing testing as a key phase of engineering design,one PLE session reviewed and explored ways to test and revise engineering designs. Another request revolved answering the question which teachers raised 'How do I do translanguaging?' We had noticed a

pattern of teachers developing engineering lessons first and later integrating the translanguaging once they feel more stable in their engineering teaching [2], [3].

Discussion and Conclusions

Our PLE model builds upon previous work on elementary engineering teachers by creating a longer sustained professional learning experience [24], [36] and a focus on emerging multilingual students. Thus far, teachers seem to begin their school year with multiple lessons on engineering and when they feel comfortable, ask more questions about integrating translanguaging as well as different subjects besides those modeled in the PLE. For example, a few of our teachers, after teaching initial introductory lessons we have modeled, have integrated engineering into social studies units. Our first cohort of teachers, in reflecting upon their experiences, created a menu of engineering lessons by duration and concept to help future teachers of engineering plan their lessons that we will continue to iterate on based on reflections and feedback. We are excited to present this menu soon.

Future Work

Currently in Year 2 of our project, our team will continue to listen to teacher participants for their ideas on how to improve our PLE model and use our data to understand the strengths and weaknesses in the PLE model. We also aim to add more expert teachers from our first and second cohorts as well create a collection of videos from our classroom data to show teachers engineering lessons in action. We will further consult our advisory board for feedback. We hope to present another iteration of the model in a longer format soon.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 2300766. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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