

Board 252: Elementary Teacher Professional Learning in Equitable Engineering Pedagogies for Multilingual Students

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Jessica Swenson is an Assistant Professor at the University at Buffalo. She was awarded her doctorate and masters from Tufts University in mechanical engineering and STEM education respectively, and completed postdoctoral work at the University of Michigan. Her research work aims to improve the learning experience for undergraduate students by examining conceptual knowledge gains, affect, identity development, engineering judgment, and problem solving.

Dr. Mary McVee

Elementary Teacher Professional Learning in Equitable Engineering Pedagogies for Multilingual Students

Abstract

This paper provides an update on progress within our National Science Foundation project creating an engineering professional development model for teachers of multilingual students. The multi-year, design-based iteration research study aims to produce a model for teachers and schools in similar multilingual elementary schools and communities. Currently in year one, we provide an update of our activities thus far and the theoretical background of our project. We hope this model will advance linguistic equity by creating space for more multilingual and multimodal activities in elementary school classrooms.

Introduction

The number of elementary school students designated as English learners has increased and will continue to increase in U.S. schools. In schools emergent bilingual students are often subjected to low-level content and lower expectations than their monolingual English-speaking peers. For example, school leaders may believe that multilingual children need to learn basic English language skills first before they can engage in science inquiry and engineering design. In contrast, other approaches position multilingual and emergent bilingual students in light of their assets [1]. Our project, thus, views multilingual learners as holding significant assets to help solve engineering problems, especially local problems in their communities.

In the Western New York region, where this study takes place, school leaders and teachers report that engineering is not being explicitly taught in elementary school classrooms. School districts have adopted New York State Science Standards based on the Next Generation Science Standards (NGSS) [2]. Local professional development opportunities have focused on science inquiry and science phenomena without specific focus on engineering. Our project aims to serve school districts in local communities, especially those with linguistically diverse classrooms. We hope to then build a model of professional development that may be applicable to similar districts.

To accomplish the goal of including emergent bilingual students in engineering activities, we are employing a design-based research approach with a participatory framework [3] to design, implement, and investigate a standards-aligned professional learning model for monolingual teachers. School leaders, principals, and teachers are working with the research team to co-construct and iterate a model of professional learning. This model introduces teaching to engineering design along with *translanguaging* (i.e., using all the linguistic resources in any language that a student brings to the classroom within their engineering work). Our model also

asks teachers to reflect on their language ideologies, or beliefs and conceptions of how language is used in the world. As we engage in this process, we aim to answer several 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 professional learning experience?
- 3) How do teachers' language ideologies, and possible shifts in language ideologies, map onto teachers' engineering pedagogies?

Background

In the last three decades significant work has been carried out to introduce engineering to elementary school classrooms. Significant progress includes the addition of engineering standards to the Next Generation Science Standards (NGSS) [2] and lessons specifically designed for the elementary school classroom such as Engineering is Elementary [4] and Novel Engineering [5][6][7]. Engineering Education researchers have worked to create professional development for teachers [8][9] or integrate engineering into science methods courses [10]. Yet many experiences are brief workshops with little to no follow-up. Our goal within this project is to build off this prior work, especially those experiences that focus on engineering design at the elementary level, and create a sustained professional development experience for teachers of English learners.

Translanguaging and Language Ideologies

Our research team aims to incorporate the theories of language ideologies and translanguaging into engineering lessons in elementary classrooms with language learners. Language ideologies are beliefs, values, and attitudes about how and where language can be used in certain spaces. For example, a teacher may display in their classroom how each child in the class says hello in their native language, communicating to the students and any visitors how they value the rich diversity of languages in their classroom and celebrating each students' background.

Translanguaging is a practice of welcoming students to utilize all their linguistic resources, those of their home language as well as the dominant language in the classroom (in this case English) [11], [12], [13], [14], [15]. For example, a teacher may encourage the use of words from the students' home language when speaking and writing in the classroom, such as when they are tasked to explain their engineering design. Our professional development weaves these constructs in with learning engineering design into the teacher professional learning community.

Executive Summary

This study takes place in partnership between a large research university in the northeast and two local school districts that have recently received an influx of newcomer students, many of whom are emergent bilingual students. These two school districts are often referred to as "first ring suburbs" located just outside the major city in the region. Each district reports approximately 30

different languages spoken and newcomer students from 30 different countries. Rates for free and reduced lunch are 40-50%, indicating that families are economically challenged. Our partner districts indicated in their first year it would be best to work with third grade teachers. Through district leaders and principals, we invited three teachers to participate in year one. Our intention in this first year is to develop a professional development model and respond to our teachers' needs as they develop and implement their first engineering lessons.

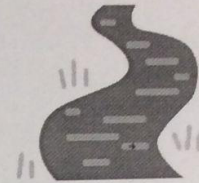
We launched our professional learning community with a three-day professional development in the summer 2023. We introduced the teachers to engineering and the engineering design process through activities, including Novel Engineering [5] and community-based engineering [16][17]. We also introduced and discussed the constructs of language ideologies and translanguaging through videos and readings [18], [19], [20], [21]. Throughout the school year, we are continuing half-day professional development sessions and beginning classroom data collection.

This study is using a mixed-methods approach that includes interviews, observations, validated instruments [22], [23], [24], [25], and recordings of discussions and teaching. As we collect interview and discussion data, our current analysis is examining the language ideologies of different members of the school community and understanding the different structures each school employs on teaching other NGSS standards within science curriculum. Through interviews and observations of teaching and with our teacher partners, we have noted that the teachers are primarily focused on how to integrate and teach engineering in their classrooms. We conjecture that this is due to engineering being viewed as more difficult to comprehend and integrate than translanguaging practices.

Preliminary Results

Thus far one of the teacher participants, Emma (a pseudonym), has taught two engineering challenges in her classroom. As she had an additional number of Spanish speaking students join her class, she created a group with all the Spanish speaking students to work together and appointed the bilingual student as a leader and facilitator of the group. Emma designed a Spanish language version of the English language brainstorming sheet used by the rest of the class (Figure 1). During testing, Emma also asked the students questions in Spanish using the Google translate app and listened to the students answers in Spanish.

Nombre: _____



El río Amarillo: imagina

¿Cómo podemos ayudar a que el río Amarillo de China esté menos contaminado?

¿Podemos diseñar y crear una solución?

Prueba cuatro: dibuja y etiqueta cuatro diseños a continuación. ¡Ser creativo!

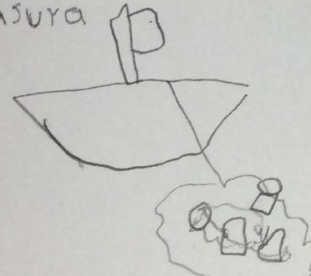
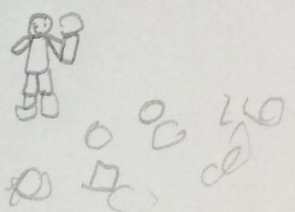
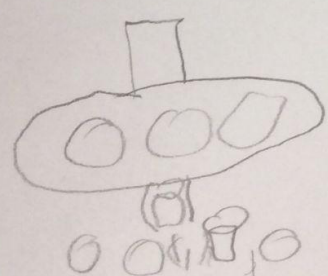
<p>IDEA 1 Tiene que estar un barco para que tire una red al agua y recoja la Basura</p> 	<p>IDEA 2 las personas de china Tienen que recoger Basura</p> 
<p>IDEA 3 Tiene que estar un submarino para que recoga la Basura</p> 	<p>IDEA 4</p>

Figure 1: A brainstorming template for an engineering project with Spanish language prompts

Our teachers have also used translanguaging practices learned in our professional learning community in their classrooms related to non-engineering activities. Another participant, Sara,

has created a word wall with new vocabulary for her classroom with English, Urdu, Arabic, Spanish, and other languages present in her classroom. Emma also has a map of the world (Figure 2) that shows where each student has heritage and a greeting in their home language which she indicated was a result of reading and discussing translanguaging and language identities. We are excited our professional development lessons are extending outside of engineering and into other activities in the classroom.

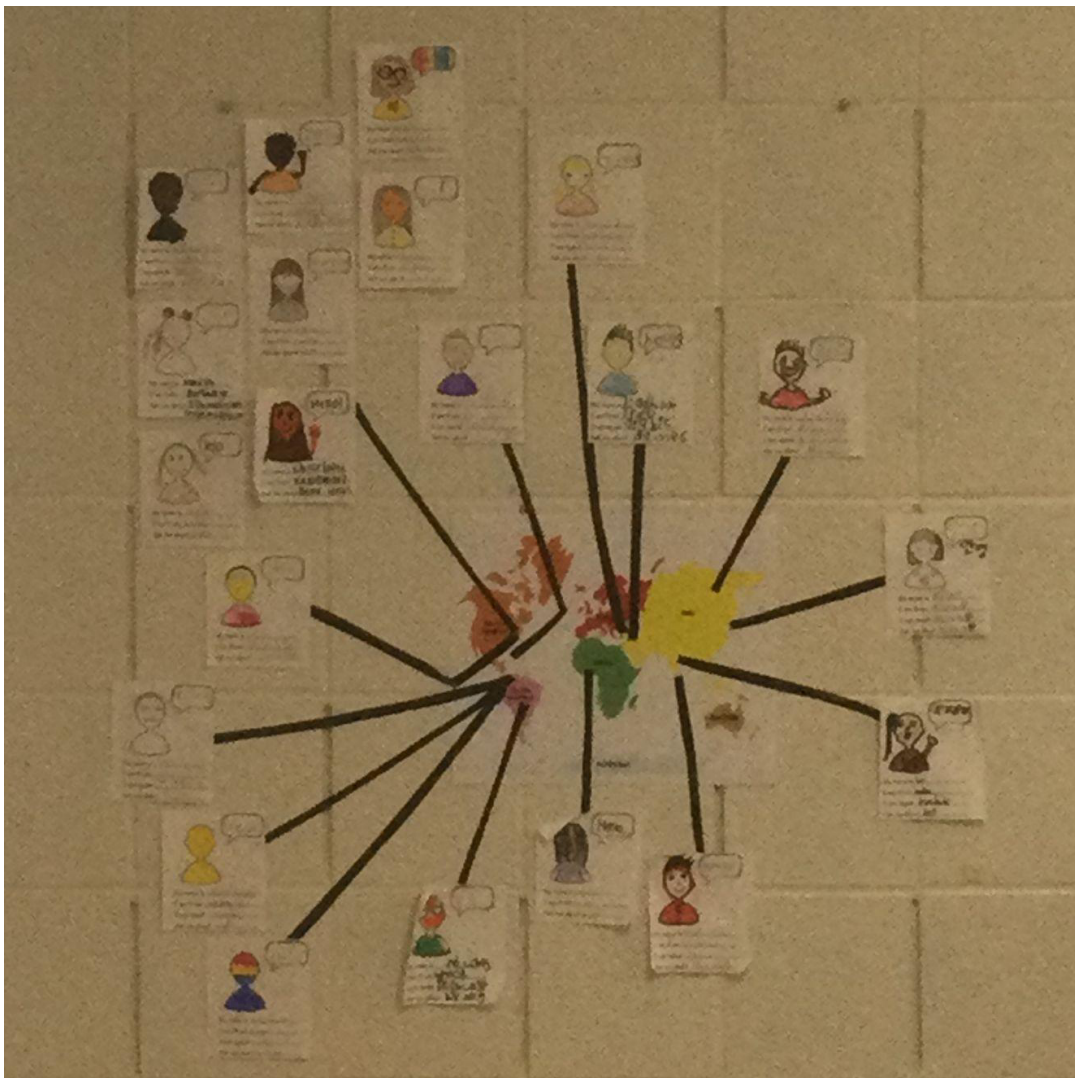


Figure 2. A world map of home countries and heritage languages identified by students in Emma's class.

Conclusions and Implications

We are excited by the work with our partner teachers and school districts thus far. Our research team looks forward to the implementation of the teachers' designed lessons this spring. We now look to creating a model that can be replicated and expanded to include more teachers. The

second iteration of our professional learning experience will take place in Summer 2024 with eight teachers, and we look forward to what we can learn from them.

Acknowledgements

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Bone Pile

Our research uses a design-based iterative research (DBIR) approach to design our model of professional development. This year we are working with three teachers: Sarah, a third grade classroom teacher in the XX district, Emma, a third grade classroom teacher in the XX district, and Lena, a librarian and media specialist who is responsible for the makerspace in Emma's school. Lena previously worked on the pilot study with the second author and PI of this project.