Supporting students' language, knowledge and culture through science (LaCuKnoS)

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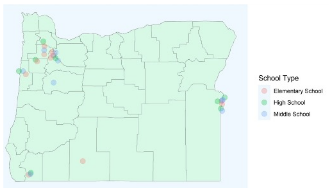
Context

The Language, Culture, and Knowledge-building through Science (LaCuKnoS) project seeks to better understand three related constructs for supporting a vision of justice centered science education: (1) Language Development for Science Communication; (2) Mapping Culture & Community Connections to Science; and (3) Knowledge Building for Informed Decision Making.

This DRK-12 project engages science teachers from across Oregon in design work to create and test tools, practices & model lessons that support the three strands of the LaCuKnoS framework. We engage in development work to provide ongoing professional learning & resources to science teachers in rural and remote parts of Oregon to support enactment of contemporary perspectives on science, language, and culture. We conduct research on our pedagogical model and professional learning framework using a design based research (DBR) approach.



Our research questions explore how the LaCuKnoS model influences teachers' knowledge and practices, students' science communication and aspirations to pursue and succeed in STEM academic and occupational pathways, and families' engagement in science learning, with particular attention given to multilingual learners and their families.

Research Questions

RQ1. In what ways does engagement in the LaCuKnoS project ***change teachers' practices*** to support all their students': (a) language development; (b) cultural & community connections; and (c) knowledge building in science?

RQ2. In what ways does engagement in the LaCuKnoS project ***change teachers' conceptual understanding*** of how and why to support all their students': (a) language development; (b) cultural & community connections; and (c) knowledge building in science?

RQ3. In what ways does engagement in the LaCuKnoS project ***change students' practices*** of: (a) science communication; (b) cultural & community connections to science; and (c) social problem solving?

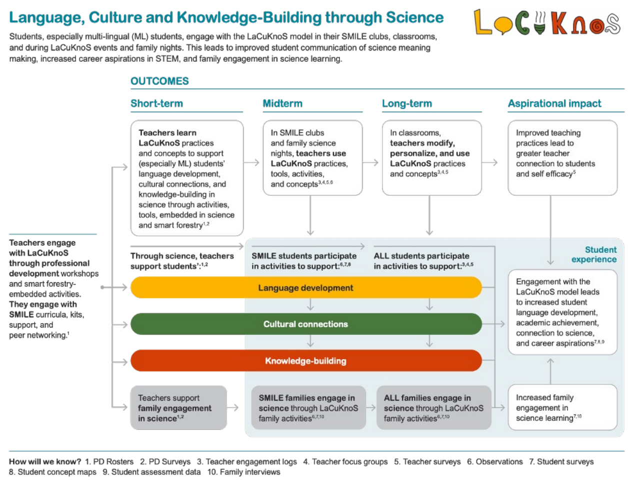
RQ4. In what ways does engagement with the LaCuKnoS project ***change students' aspirations*** to pursue academic & occupational pathways: (a) in STEM generally; and (b) in specific STEM fields?

RQ5. In what ways does participation in the LaCuKnoS project ***change families' engagement*** in science co-learning to support their familial: (a) science communication; (b) cultural & community connections to science; (c) social problem solving; and (d) STEM aspirations?

RQ6. What ***archetypal personas of teachers*** emerge that allow us to propose differentiated professional learning to support teachers' understanding and practices related to (a) language development; (b) cultural & community connections; and (c) knowledge building?

RQ7. What ***archetypal personas of students*** emerge that allow us to propose connections between teachers' practices and students' personas to support students': (a) language development; (b) cultural & community connections; (c) knowledge building in science; and (d) STEM aspirations?

Logic Model



Data collection and analysis

To answer our research questions, the study uses the following approaches to data collection and analysis.

Data Source	Analytic Approach to be Used	Participants	RQs addressed
Teacher engagement logs (weekly)	Linear mixed-effects models; Persona analysis	Teachers	RQ 1, 6
Teacher focus group protocol (annual)	Qualitative coding of traditional and contemporary practices	Teachers	RQ 2, 6
Student concept maps (annual)	Mixed methods analysis based on Legitimation Code Theory and visualization of patterns	Students	RQ 3, 7
Student STEM aspirations survey (bi-annual)	Linear mixed-effects models; Persona analysis	Students	RQ 4, 7
Family conversation game (bi-annual)	Qualitative coding of traditional and contemporary practices	Families	RQ 5
Flipped observation protocol (periodic)	ANT analysis; Qualitative coding of traditional and contemporary practices	Teachers; Students	RQ 1, 2, 6
Demographic survey (annual)	Descriptive statistics	Teachers	RQ 1, 2, 6

Language development for science communication

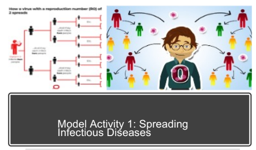
Example practice: Make intentional language choices based on topic, purpose, & audience
Example tools: Language Boosters; Concept Cards; Investigation Summary Templates
Example model lessons: If I was a tree; Cartesian diver; Learning with data

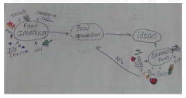
Cultural & community connections to science

Example practice: Engage families together in science co-learning
Example tools: Family home learning kits; Family conversation cards; Family workshop guide
Example model lessons: Changing climate in my community; My family STEM story

Knowledge building for informed decision making

Example practice: Exploring place-based STEM careers
Example tools: Walking field trip guide; Scientists stories; Claim investigation guide
Example model lessons: Cross laminated timber; Natural disasters & food innovations





Initial Findings (Emergent Design Principles)

1. Principle 1 – STEM content with a justice-centered focus designed around community based social challenges can engage teachers, students, and families in robust science communication (e.g., model lessons; SMILE challenge events).
2. Principle 2 - COVID-19 impacts have magnified the need to differentiate professional learning based on teachers' backgrounds and teaching contexts (e.g., assets of multilingual teachers; virtual & district-based PD).
3. Principle 3 - With experience, teachers are encouraged to adapt project tools, practices and lessons to better meet the needs of their students and communities (e.g., tracking multiplicities of engagement and enactment).
4. Principle 4 - Teachers need explicit support to understand and differentiate between traditional and contemporary practices for science, language and culture before their practices begin to reflect contemporary perspectives.
5. Principle 5 - Creative uses of concept maps can provide students with a multimodal way to refine their science communication while providing teachers with insights into their students' sense making.
6. Principle 6 - Family STEAM engagement events, when intentionally structured to do so, can promote rich family conversations about science in our lives and communities.

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