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Title: “Talking to people in the community who know about issues”: Understanding community through data investigations

ABSTRACT: This proposal addresses how high school statistics teachers understand their local community during a specific segment of a week-long professional development focused on data investigations and local food insecurity during the summer of 2024. As part of a larger design-based research study, this proposed presentation foregrounds a set of design principles that guide the development of learning activities with teacher-participants. Data was analyzed using the design principles, focusing specifically on how the community-based data investigation required participants to engage in iterative cycles of reflection and action. Our findings reveal that engaging with community-based data investigations motivates teachers to address local problems by integrating them into their statistics curricula.

Purposes

In line with this year’s conference theme of justice education renewal, this proposed presentation aims to address how high school statistics teachers learn about their local community during a professional development (PD) focused on teaching statistics through a data investigation on food access. We chose this topic because one of the teacher-participants suggested our professional learning community (PLC) explore it after a discussion with her

students. The learning experience occurred during a week-long summer PD in 2024 and included a presentation by a local non-profit focused on food access and data exploration using local grocery store data and census tracts. Our research addresses the following research question: "How can learning experiences be designed to support teachers' development of reading and writing the world with spatial data?"

Perspective(s)

Our project takes a sociopolitical lens on learning where knowledge, practice, identity, and agency are intertwined in the learning process. We use recent research in designing learning environments in statistics education (Bakker, 2018; Cobb & McClain, 2004) to guide the theory of change in this design research project. We also use Freire's ideas of generative themes and critical literacy (Freire, 1970; Freire & Macedo, 1987) to spark learning through dialectic tensions. This project extends previous theoretical work considering the intersection of critical and statistical literacy in teaching statistics in school mathematics (Author 3, a; Author 3, b).

Social justice curricula on local food access is not new to mathematics education. Harper (2017) found that as students engage in social justice learning around the issue, they need continued exposure to complicated topics to make sense of the math content and social context. Willey and Pinheiro (2019) found that supporting teachers new to community-based mathematics requires re-positioning the local community as a mathematical space, with participants identifying the mathematical possibilities in places their students frequent outside of school. These findings indicate that re-narrating the community as an academic place for social and mathematical problem solving made teachers more competent in community-engaged and culturally relevant mathematics teaching (Rubel et al., 2016; Willey & Pinheiro, 2019).

Design Principles as Conceptual Framework

Our project is derived around a set of design principles that shape the design of learning experiences. Participants are part of a three-year professional learning community (PLC), derived from Lave and Wenger's (1991) concept of communities of practice (CoP). In CoP, learning develops through engagement in community practices in cycles of reflection and action (Lave & Wenger, 1991). The process of learning Freire described is often encapsulated in the phrase "reading and writing the word and the world" (Darder, 2014; Freire & Macedo, 1987). The design principles for this study are illustrated in Figure 1. Given space constraints in this proposal, we will describe reading the word and the world as it pertains to ongoing cycles of reflection and action – depicted in Figure 1. Beginning with people's reading of the world, Freire worked to build technical understandings of reading the written word, becoming attuned to the practices of the community, beginning with easier practices. From learning how to read the word, people can reflect on their reading of the world. Reflection comes with action though, and that action initially takes the form of writing the word, building from peoples' reading of the word. Action in literacy also leads to people's writing the world transforming it for a more just future connecting to their agency and its role in the learning process.

Modes of Inquiry

The series of activities that this proposal focuses on is part of a larger design-based research (DBR) project aimed at understanding the ways high school mathematics teachers develop critical statistical literacy (Author 3, a). DBR is iterative in nature using cycles of design, implementation and refinement. One of the hallmarks of DBR is the purpose of using it, which is to develop "humble" theories focused on local learning environments (Cobb & McClain, 2004). In the case of this project, the "humble" theories focus on change for

mathematics teacher's use of their local community knowledge as a springboard for developing statistics curricula situated in their local contexts. Our decision to focus on the teacher-participants' local community stems from Gutiérrez and Jurow's (2018) approach to DBR wherein social justice topics are centralized within the learning experiences, and the design of the projects focuses on assets, knowledges, and strengths within the community with the goal of social transformation. Our research project mirrors these aims, especially as our design positioned "participants to think about themselves, their circumstances, and their future actions in ways that are deeply contextualized" (Gutiérrez & Jurow, 2018, p. 4).

DBR is an iterative, intervention-based methodology. The interventions (in our case, learning experience embodiments), their purposes, and the desired outcomes are mapped with the design principles to track the design over time (Sandoval, 2014). The intervention in this study is a series of learning experiences where teacher-participants engage in a data investigation about food access in their community. The design of the intervention in this project was based on conjecture maps that our research team developed before the week-long summer PD. Our conjecture map for the food access learning activities is depicted in Figure 2.

As seen in Figure 2, our research team carefully tracked embodiments to the design principles, learning experience outcomes, and project outcomes. After the learning experiences are completed with the teacher-participants, we met as a team to check that the outcomes match embodiments and to map the embodiments to the design principles to ensure we are staying true to the project's goals. For this proposal, the conjecture map serves as our connection between the methodology and the conceptual framework because the data were analyzed to identify the design principles in action.

Learning Activities Sequence

In this proposal, we are focusing on a specific segment of our PD where we aimed to deepen teachers' understanding of local food insecurity issues (an issue that one of the teachers had brought to our attention based on their students' interest) and how to investigate these issues using data. The learning sequence was designed to build contextual knowledge about the community and food insecurity and ensure meaningful engagement with local data.

In the learning sequence, we invited a guest speaker from the High Point Food Alliance, who provided a strong overview of food insecurity and food access issues through local data and relevant stories. Following the guest speaker's presentation, Author 1 presented the datasets we had designed for teachers to use in a data investigation on the issue. Using CODAP, we provided a workspace that included a map of spatial data layers showing the locations of grocery stores, overlaid on census tracts, which allowed teachers to visually connect the two datasets and better understand the local food insecurity landscape. Teachers were then given time to explore the data, formulate investigation questions, and the sequence concluded with one group presenting their findings from their investigation to the rest of the PLC for feedback on their work.

Data Sources

To understand how relevant data investigations build on teachers' understanding of their community, we collected data from multiple sources throughout the food desert data investigation. Each activity was video recorded and transcribed, and Author 1 collected field notes during the activity. In addition to the transcripts and field notes, we analyzed the teacher-participants' written reflections at the end of Thursday and Friday and their work products to explore the dataset and connect it to their teaching practice.

Analysis

We used our previously created conjecture maps to trace how the design of the learning experiences supported teachers' development of reading and writing the world with spatial data. Our analysis began as the research team collectively reflected on each embodiment listed in the conjecture map and mapped it to the design principles and learning outcomes while discussing the evidence for each (see Fig. 2). These reflections were used to develop deductive codes to track our descriptions of the design principles in action (Saldaña, 2009). Then, using the design principles as a deductive coding scheme, authors 1 & 2 engaged in coding to trace our design principles across the data. Author 3 then reviewed the data separately to confirm our findings.

Results

Due to space constraints, we will focus on one theme as it relates to our design principle of ongoing cycles of reflection and action. Our data strongly shows that relevant data investigations like the one with food insecurity can motivate teachers to engage in actions to improve their community. Based on our analysis, the teachers showed this process in three stages. At the initial stage, teachers' awareness and understanding of the issue increased through learning activities together and with the guest speaker. They appreciated the importance of the local data they could analyze with and from the community. For instance, Sarah explicitly highlighted this phenomenon in her written reflection: "The emphasis is on talking to people in the community who know about issues and not just to people in charge who are separated from the issue." Sarah's reflection indicates that she sees food insecurity being something that should be solved in a grassroots manner so that the community oversees the changes that are proposed. This is likely due to the guest speaker's grassroots approach to leading the community-based nonprofit as he talked about letting community members lead the organization's efforts to collect data.

For the second stage, our data shows that as teachers' understanding deepened, they demonstrated a commitment to take action in their classrooms so students experiencing hunger know about available resources. The design of the learning experiences supported this sense of responsibility by actively engaging teachers in discussions with guest speaker and their community through storytelling about students facing food insecurity. This approach helped teachers connect emotionally with the issue and see the direct impact on their students. For example, in her comment, Nancy feels a need to be sensitive towards students who are facing this issue saying, "There are students that are without food access, and we should be sensitive about how that affects their ability to learn." Also, Leona says, "as teachers, we need to advocate more for students who are displaying signs of hunger." These quotes indicate the learning experiences made them feel empathetic toward students experiencing food hardship and motivated them to help change the problem.

Finally, in the third stage, teachers discussed practical steps to address the issue by integrating similar data investigations on food deserts into their statistics curricula. The design of the learning experiences facilitated this by providing opportunities for teachers to explore food insecurity using spatial data in CODAP. This approach allowed teachers to recognize the potential ways to incorporate real-world problems into their teaching. For example, in their written reflections, Anna states: "I plan to use this information in lessons I teach my students." and Nancy says “I think we are learning useful and meaningful statistics that can translate well into the classroom. Not just for the purpose of teaching math/statistics but to help generate a more informed generation that will one day be the ones making these very decisions." These reflections indicate that community-based mathematics curricula can build students’ agency for social change.

Scholarly Significance

Because the teacher-participants' initially demonstrated a desire to increase awareness and ultimately wanted to incorporate their learning into their teaching practice and curricula, we posit the impact of this project goes beyond the participants and research team to the field of mathematics and teacher education research. Firstly, this project as exemplifies how DBR can be co-designed with teacher-participants and community-based organizations to ensure PD relevance to their needs and students. Secondly, our project demonstrates the importance of placing equal emphasis on contextual and content knowledge when engaging teacher-learners in social justice mathematics. Lastly, this study contributes to the literature on social justice mathematics by describing a learning trajectory where teachers become aware of a local issue like food deserts and then empowered to have their students to learn about it and engage in social change, thereby repositioning teachers and students as active members of their communities.

Appendix A: Acknowledgement

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References

Author 3 a

Author 3 b

Bakker, A. (2018). *Design research in education: A practical guide for early career researchers*. Routledge.

Cobb, P., & McClain, K. (2004). Principles of instructional design for supporting the development of students' statistical reasoning. In D. Ben-Zvi & J. Garfield (Eds.), *The challenge of developing statistical literacy, reasoning, and thinking* (pp. 375–396). Kluwer Academic Publishers.

Darder, A. (2014). *Freire and education.* Routledge.

Freire, P. (1970). *Pedagogy of the oppressed*. Continuum.

Freire, P., & Macedo, D. (1987). *Literacy: Reading the word and the world.* Taylor and Francis.

Gutiérrez, K. D., & Jurow, A. S. (2018). Social design experiments: Toward equity by design. In *Cultural-Historical Activity Theory Approaches to Design-Based Research* (pp. 79-112). Routledge.

Harper, F. K. (2017). Coming to understand the big issues: remaking meaning of social justice

through mathematics across the school year. *Mathematics education and life at times of crisis*, *513*.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Rubel, L. H., Lim, V. Y., Hall-Wieckert, M., & Sullivan, M. (2016). Teaching mathematics for spatial justice: An investigation of the lottery. *Cognition and Instruction, 34*(1), 1–26. https://doi.org/10.1080/07370008.2015.1118691

Saldaña, J. (2009). *The coding manual for qualitative researchers.* Sage.

Sandoval, W. (2014). Conjecture mapping: An approach to systematic educational design research. *Journal of the Learning Sciences, 23*(1), 18–36. https://doi.org/10.1080/10508406.2013.778204

Willey, C., & Pinheiro, W. A. (2019). *Supporting prospective urban teachers to access children's multiple mathematical knowledge bases: Community mathematics explorations.Transforming Mathematics Teacher Education: An Equity-Based Approach*, 57-76.

Images Referenced in Document

Figure 1.

Design Principles and Conceptual Framework

Figure 2.

Conjecture Map