Embodied and emplaced mathematical literacy: A refugee family's funds of knowledge toward regenerative farming

Miwa A. Takeuchi, University of Calgary, ✉ miwa.takeuchi@ucalgary.ca
Raneem Elhowari, University of Calgary
Jenny Yuen, University of Calgary

In this paper, we present our preliminary findings from our ongoing ethnographic study on out-of-school mathematics learning for refugee families. Our paper provides a glimpse of embodied and emplaced mathematical literacy exercised by a Syrian refugee family engaging in intergenerational, small-scale farming practices, during the pandemic. Aligned with the funds of knowledge framework, we depicted a sketch of mathematical literacy that the family, including young learners, competently engaged. Our analyses call for the discussion on mathematical literacy that could challenge the hegemonic and normative relationships between body and place, and could lead us to the liberating interanimated relationships between body and place.

Conceptualizing embodied and emplaced mathematical literacy

Previous studies on non-dominant (im)migrant families' out-of-school practices have demonstrated funds of knowledge, which is "historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" (Moll et al., 1992, p. 133). Funds of knowledge relevant to mathematical literacy include sophisticated geometric thinking in the practice of sewing (Gonzalez et al., 2001), the multiplicative thinking exhibited in gardening (Civil, 2007), and the proportional reasoning in calculating international currency conversions (Takeuchi, 2018). The funds of knowledge perspective have challenged the deficit views toward non-dominant, working-class families and demonstrated the possibility of transforming the school practice and curriculum, where teachers maximize the bodies of knowledge and skills that are embedded in family practices.

Such funds of knowledge are simultaneously embodied and emplaced. Interanimated relationships between a place and learners as agents are key in our inquiring into the family's knowing that is inextricable with the land that they are cultivating. In the recent scholarship (as seen in Krishnamoorthy & Ma, 2021; Marin et al., 2020; Takeuchi & Aquino Ishihara,

Please cite as: Takeuchi, M. A., Elhowari, R., & Yuen, J. (2021). Embodied and emplaced mathematical literacy: A refugee family's funds of knowledge toward regenerative farming. In D. Kollosche (Ed.), *Exploring new ways to connect: Proceedings of the Eleventh International Mathematics Education and Society Conference* (Vol. 1, pp. 235–238). Tredition. https://doi.org/10.5281/zenodo.5392987

2021), emplacement and embodiment have been synthetically analyzed. Learners are actively making places as they imagine new mobilities of bodies in the places salient to them (Marin et al., 2020). Embodied and emplaced mathematical literacy can thus be intertwined with social changes that the learners desire to envision (Takeuchi & Aquino Ishihara, 2021).

Methodology

Our ethnographic study focuses on a Syrian refugee family who has been engaging in small-scale farming after their resettlement to Canada in 2016, without the use of any pesticide or herbicide. The family used to engage in traditional farming in Deer al-Fardees village near the city of Hama in Syria. As the attacks on civilians in the city of Hama and Deer al-Fardees village escalated, the family evacuated to Lebanon and then moved to Canada as refugees in 2016. The family participants include three of the five siblings in early elementary years (age 6 years old to 9 years old at the time of the study in 2020), Aisha (9 years old), Rabih (8 years old), and Abir (6 years old), and the mother (Nahima) and father (Mohamed) of these children. The family lived in an inner city and commuted daily to a land located approximately 15 km away. Our ethnographic fieldwork was accompanied by video recordings to allow us to engage in the repeated and collective viewing of video data. We also used photographs and drawings that were produced with the children to understand the lived experiences on the farm. We conducted verbal interviews to understand the histories behind their farming practices. We also collected policy and media documents relevant to urban farming practices by this family. Emplacing our dialogues, together with the family participants, we engaged in a *shared* walk that "walkers have a particular way of being together that is more than just co-presence because it has sociability as the basis for bodily movement" (Lee & Ingold, 2006, p. 83). By walking together on the farm with each member of the family, we came to understand emplaced and embodied knowing of Science, Technology, Engineering, and Mathematics (STEM) enabled through their physical interactions with soil, plants, and animals on the farm.

Data and analysis

The data analyzed for this article includes video/audio recorded interactions collected over seven visits to the farm (each visit lasted 60 to 150 minutes) in the summer and fall of 2020. This ethnographic study is still ongoing for analysis of longitudinal development and program design for bridging informal and formal STEM epistemologies. Our analysis in this article focused on the embodied and emplaced mathematical literacy unveiled through the process of shared walks. For the analysis, we first created content logs of all the video/audio data and completed analytic memos for each data. For the parts of the interview conducted in Arabic, translations to English were completed by Author 2 (Raneem). Based on analytical memos, we inductively coded data (video/audio data) focusing on the participants' emplaced and embodied knowing of mathematics.

Findings

As we walked around on the land, the conversation went into the differences and similarities between the farm they had in Syria and the farm in Canada. Mohamed said they grew the same variety of plants that we saw on the farm: kouza, fava beans, parsley, chickpeas, beets, carrots, and so forth. Mohamed explained:

> The difference is… here is a short summer season while in Syria it is a longer summer season. The summer season is 4 months from when we plant till the end of the season. But we cannot forget that the daylight is twice as long here during the summer season (compared to Syria) and the sun is closer to us therefore the plants will grow faster. For example, Zucchini, we pick it every 3 days in Syria while here we have to pick it every day and sometimes twice a day because it is very quick to grow.

Then Mohamed grabbed soil from the ground and touched it with his hands to show us how much the soil can contain moisture. He added commentary about soil as follows:

> The land in Syria is a little hard to work with because there is no snow, therefore we are planting and planting every month of the year. We always need to add stabilizers to the soil in Syria. On the other hand, here we have about 6 months of snow/cold, which adds moisture to the soil which benefits us when we start planting in the summer. The soil in Canada generates around 200% more produces in the summer.

These excerpts from our dialogues demonstrate the proportional reasoning based on the relationships among the length of daylight, rate of plant growth, and length of a summer season between Syria and Canada. They came to notice that the same plant (kouza) produced "around 200% more produce" during the summer season in the Canadian city they were in, because of longer daylight. Based on such proportional reasoning, the family rationalized that shorter summer seasons in Canada would not be a disadvantage in the harvesting of produce.

During the pandemic, this urban farm attracted racialized families in an inner-city, especially those who live in the area of the city where many racialized immigrant and refugee people live. These communities are currently deprived of communal green spaces that served as a safer gathering space during the pandemic. This urban farm provided vegetables grown without the use of pesticides or herbicides with affordable prices or as donations for racialized immigrant and refugee families in need. Nahima explained, "I love the idea of how people come and pick vegetables by hand. Especially during the pandemic, we want people to be provided with fresh produce."

In the process of calculating the prices of vegetables, children, as early as 6 years old, were engaging in multiplicative thinking. As we walked on the farm together, we had conversations with Abir, Rabih, and Aisha about the quantity and weight of vegetables and their estimate of prices.

> Aisha said she'd take Author 1 and 2 to show the field of fava beans and we all walked together. Author 1 pointed at fava bean plants and asked how much it would be if you had a customer to sell. Aisha responded saying "1 kg is 5 dollars." Author 1 asked "okay, then what about if a customer takes 3 kg?" Aisha said, "20? No, 5, 10, 15."

A similar conversation happened when Author 1 asked Abir the price of 5kg of zucchini. Using skip counting, Abir said, "5, 10, 15, 20, 25. 25." Estimation of how much 1 kg of each vegetable would be and engaging in multiplicative thinking to calculate the price of vegetables were a layer of mathematical literacy that the children engaged in from the early years. Based on such experiences, Aisha surprisingly shared her observation on the affordability of fresh produces in the city, "do you know how much beets cost if you buy at a Superstore? So expensive!"

Discussion

Our paper provides a glimpse of embodied and emplaced mathematical literacy exercised by a Syrian refugee family engaging in regenerative farming practices. Aligned with the funds of knowledge framework, we depicted a sketch of mathematical literacy that the family, including young learners, competently engaged. Such embodied and emplaced mathematical literacy was "essential for household or individual functioning and well-being" (Moll et al., 1992, p. 133). However, the scope of this family's engagement in regenerative farming during the pandemic goes beyond the functioning and well-being of an individual household. The family was actively making a place for the collective good, by providing green spaces and making fresh produce free from pesticides and herbicides affordable to racialized refugee and immigrant communities in the city. Our preliminary analyses call for the discussion on mathematical literacy that could challenge the hegemonic and normative relationships between body and place in the discipline of mathematics.

References

Civil, M. (2016). STEM learning research through a funds of knowledge lens. *Cultural Studies of Science Education*, *11*(1), 41–59.

Gonzalez, N., Andrade, R., Civil, M., & Moll, L. (2001). Bridging funds of distributed knowledge: Creating zones of practices in mathematics. *Journal of Education for Students Placed at Risk*, *6*(1), 115–132.

Takeuchi, M. (2018). Conversions for life: Transnational families' mathematical funds of knowledge. In T. G. Bartell (Ed.), *Toward equity and social justice in mathematics education* (pp. 127–143). Springer.

Takeuchi, M.A. & Aquino Ishihara, V. (2021). Learning to assemble the hidden bodies: Embodied and emplaced mathematical literacy in transnational migrant activism. *Journal of the Learning Sciences, 21*(1), 103–124. https://doi.org/10.1080/10508406.2020.1820341

Krishnamoorthy, R., & Ma, J. (2021). *Memory cells are like the soldiers: Settler colonialism and the immune system* [Paper presentation]. Canadian Society for the Study of Education, Ottawa, Canada.

Lee, J., & Ingold, T. (2006). Fieldwork on foot: Perceiving, routing, socializing. In S. Coleman & P. Collins (Eds.), *Locating the field: Space, place and context in anthropology* (pp. 67–86). Berg.

Marin, A., Taylor, K. H., Shapiro, B. R., & Hall, R. (2020). Why learning on the move: Intersecting research pathways for mobility, learning and teaching. *Cognition and Instruction*, *38*(3), 265–280. https://doi.org/10.1080/07370008.2020.1769100

Moll, L., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice*, *31*(2), 132–141.