Refugee Youth, Critical Science Literacy, and Transformative Possibilities

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Abstract: This study reports on engagement of resettled refugee teens in science learning in a community-based afterschool program, drawing on the theory of critical science literacy. Our analysis of video recordings show the teens engaged in critical science literacy through connecting climate topics with their personalized international experiences, positioning one another as productive scientific sense-makers with multilingual competence, and discussing how climate questions impact underprivileged people. Rich experiences and linguistic resources they bring to their learning helped them engage in CSL and make science learning more democratic, inclusive, and just. Based on the findings, we suggest implications for science education in superdiverse societies in the era of global migration.

The major issue addressed and potential significance of the work

With increasing refugee resettlement, research to examine and support resettled refugee youth's learning of science becomes a high priority. We explore how educators can engage resettled refugee youth in science learning. Drawing on the idea of *critical science literacy* (hereafter CSL), we designed and provided an afterschool program for resettled Chin refugee high school teens and examined how these teens enacted CSL. Chin is one of the major ethnic nationalities in Myanmar (also known as Burma) mostly living in Chin State, the northwestern mountainous region of the country (Authors, 2018). Chins are made up of over 20 ethnic groups that have developed their own, but related, languages and traditions. Chins are persecuted in Myanmar on the grounds of their ethnicity and religion (mainly Christianity). The teens who participated in our afterschool program were resettled in the United States after living in their first asylum countries. In the U.S. schools, they were placed in classrooms along with native English-speaking students and English learners of other backgrounds, who bring their own histories, cultures, and practices. CSL is particularly important in the era of ubiquitous global migration that results in multiracial, multicultural, and multilingual classrooms given that a plethora of studies illustrates how students with migration backgrounds have difficulties in participating and learning in science classrooms. Through this work, we are hoping to suggest insights about approaches to engage learners in science learning in increasingly superdiverse societies of a globalized world (Blackledge & Creese, 2014).

Theoretical approach

Several scholars have articulated motivations for pursuing CSL drawing on feminism, antiracism, and social activism. The first motivation concerns by whom science has been done and whose perspectives it represents. Science traditionally has been representing perspectives of White Western male, which have suppressed knowledge, experiences, and values from others (Letts, 2010). Moreover, since science became a school subject in 19th century, school science curricula have been largely influenced by Western corporate culture, capitalism, and nationalism (Hodson, 2003). This influence shapes science to represent the views of people with power and resources. The second motivation comes from the criticism that modern day science education does not often intend to help solve global challenges, such as poverty and environmental crisis (Hodson, 2003). Rather, it prioritizes training a high-quality science workforce for economic growth of a nation or corporations (Sengupta-Irving & Vossoughi, 2019). These two factors have marginalized some students from school science.

CSL instead foregrounds that science is an integral part of people's everyday lives, tightly entangled with and dialogically related to other dimensions of human life (Tan, Barton, Turner, & Gutiérrez, 2012). Thus, science is shaped by our experiences, intuition, imagination, and cultural and sociopolitical values, and takes various forms of practices, including lab-based experiments, reasoning based on everyday experiences, and engagement with communities (Medin & Bang, 2014; Roth & Barton, 2004). In this regard, CSL is less about achievement in school science tests and more about the relationship that students agentively build with respect to science, people around them, and the world.

Aligned with these previous studies, we operationalize CSL as *a dialogic reading and composition of multimodal and multilingual texts of science for transformative purposes*. By saying reading and composition, we

hope to convey that CSL is engagement in practice itself, rather than retained knowledge or skills after the engagement. This practice-focused perspective also implies that CSL is a collective act rather than an individual one (Roth & Barton, 2004). In saying *dialogic* reading and composition, we borrow Bakhtian (1981) ideas of dialogue to acknowledge that specific meaning of a word (concept and idea) is always (re)shaped through the interaction between an alien word and one's own intention. Thus, scientific ideas would not have the same meaning in varying contexts, but new meanings would emerge depending on learners and learning contexts. *Multimodal and multilingual texts* refer to not only the written texts, but also spoken texts accompanied by various nonverbal meaning units (e.g., gesture, eye gaze), visual media such as video and pictures, and material artifacts that learners interact with for meaning-making, all in multiple languages in interactions with various audiences (Pacheco & Smith, 2016). Multimodality and multilingualism not only maximize the use of resources having any meaning potential, leveraging learners' diverse cultural and linguistic resources, but also empower users of them.

Previous studies show that *transformative purposes* can manifest in several different forms. The target of transformation may include policies and practices related to global problems like environmental issues (Hodson, 2003), science discourse itself that has represented perspectives of those with power (Letts, 2010), and individuals' identities and empowerment in science (O'Neill, 2011). While learners can aim to make changes at the global scale (e.g., impacting policies to mitigate climate change), they can also focus on the issues of their local communities (e.g., water pollution in the local river, Roth & Barton, 2004) and classroom (e.g., creating inclusive science classroom practices, Upadhyay, & Albrecht, 2011). A transformative act has potential to shift a community toward a democracy, inclusion, and justice, affording members opportunities to equitably and collectively take into consideration experiences, values, and knowledge of individuals.

Methods

The afterschool program was provided throughout a year. In the program, the participants learned about climate change and created a video about it at the end of the year. Each participant in our program typically spoke three or more languages, including English, Hakha, and Falam. The research team implemented the program and collected data through recordings of the sessions (total 24), interviews of participants, and taking field notes. Drawing on the techniques of video analysis and ethnography (Derry et al., 2012), we watched the unedited videos individually and discussed our initial insights as a team with respect to CSL. Based on the discussion, also informed by field notes and interviews, we then selected events that appeared to illustrate CSL; transcribed them to capture spoken words, non-verbal and para-verbal features of speech, and their interactions with artifacts; micro-analyzed them with respect to the participants' moment-to-moment interactions and sense-making; and generated keywords for each event and upper-level themes. In generating keywords and themes, we considered in what ways the teens' practices could transform science discourses and practices, individuals, and local and global communities toward democracy, inclusion, and justice. When utterances were in Chin languages, a Chin community member to transcribe and translate those data.

Major findings

Our analysis showed that the youth participants engaged in critical science literacy by 1) connecting to a wide range of experiences and knowledge, which are not typically valued in formal education settings, for new learning, 2) skillfully positioning themselves and others as valuable members of the sense-making community using multiple languages; and 3) demonstrating their desire for social changes that support lives of underprivileged people. Here, we briefly discuss each theme with data excerpts.

Connecting to a wide range of knowledge resources for new learning

On the first day of the program, we engaged participants in discussing how to describe weather and why it is important. Participants discussed pictures that depict different weather phenomena, watched weather forecasts from different countries (U.S., Philippines, Myanmar), and analyzed differences in weather between Myanmar and the Midwest U.S. city where the program was situated. The third author who had learned a Chin word Rial (hail), asked, "Rial, you've experienced rial? Hail." Teens became animated and explained that they played with hail and even ate it. As the facilitators were surprised by their response, a girl joked "It's our dinner" and a boy added "Basically, we eat everything we see," causing everyone to laugh out loud. Then, the first author said, "Oh, I've heard there is some kind of bug that comes out when it rains." Some teens first expressed confusion on what bug she was referring to, but other teens explained it in Chin languages to those who were confused. Then, participants excitedly talked about the bug, such as "They (bugs) are everywhere," "They come out when it rains," "We use it for fishing," "It's like grasshopper," and "They (Chin people) eat it." Then, a boy said, "We sing a song to call them" and sang the song in his home language. Teens laughed heartily and explained what the lyrics

mean in English ("come out, if you don't come out, we will kill you"). Then, they talked briefly about how to eat them (either frying or eating them raw).

The participants were engaged in and excited about the discussion as evidenced in their overlapping speech, giggles and laughter, use of English and Chin languages, and singing. By utilizing such multilingual and multimodal means, they talked about cultural norms (eating bugs, singing a song to the bugs), biological phenomenon (bugs come out when it rains), and local economic norms (use of the bugs for fishing) which are directly related to local weather phenomena (frequent hail storms, rain). There were several disagreements among the teens with respect to whether they eat the bugs, what is the use of the bugs (fishing versus human consumption), and how to eat them (frying versus eating raw). This disagreement indicates richness and heterogeneity in their experiences. By using pronoun "we" to refer to people who engage in these weather-related practices, the teens positioned themselves as Chins who have maintained these practices for generations.

We view this moment as evidence of CSL as it posits a potential for transforming science discourses of and participants' relationship with science. The teens drew on their prior experiences and knowledge developed from their lived experiences. Despite the call for drawing on students' everyday experiences and knowledge, those of non- dominant students are not utilized frequently. This moment bears potential for transforming science discourses to better include multiple and under-utilized science-related personal experiences. By explaining phenomena related to rain and hail to the facilitators, the teens took the lead of the discussion and positioned themselves as knowledgeable individuals in relation to the adult facilitators. This shift temporarily transforms the relationship between more knowledgeable (often adults and teachers) and less knowledgeable (often teens and students) in normative discourse and opens up new possibilities of participation.

Positioning each other as valuable members of the sense-making community

When encountering new ideas, the teens often struggled. Ideas related to climate change are difficult to learn, particularly in a language in which one is still developing proficiency. We tried to facilitate the teens' learning by encouraging them to talk to each other in the languages that are most useful in each moment. Gradually, the teens switch between multiple languages to communicate with different members of the setting. Our analysis showed that through this translanguaging (García, & Wei, 2014), the teens positioned themselves and others with respect to each other and science.

In one of the selected events during Week 16, teens were asked to share their learning from the prior week with their group members to inform those who were absent. One group was composed of four teens (Kevin, Jon, Joshua, and Victor), amongst whom Kevin's English appeared to be most proficient. The first author, facilitating this group's work, said, "Your job is to make sure everyone understands what you said. You can speak in English or any other language." Kevin immediately switched to Hakha, which is his most comfortable language, and then again to Falam, which is Jon's most comfortable language. Upon the change to Falam, however, the group members laughed out loud and Joshua said, "Just say in Hakha" in Hakha. Later, it became known to the research team that the teens laughed because Kevin spoke Falam with a strong foreign accent. To Joshua's playful objection, Kevin said, "I want him [Jon] to understand a little better," and Joshua reassured that he did not need to use Falam. Then, Kevin explained in Hakha why the earth's temperature rises, to which Jon and Joshua attentively listened, evidenced in their gaze, nodding, and rhythmic alignment of their bodies.

This event illustrates how the teens' translanguaging could transform their relationship with each other and science. By translanguaging, the teens reconfigured participation structures in which all teens are equitably engaged in sense-making. Youth were also playful and enacted their identities that are related to science learning. On the part of Jon and Joshua, this event allowed them to re-establish their relationship with science, from science being inaccessible to them to something of which they can be part. On the part of Kevin, it allowed him to invite his peers in the science discourse and reposition them as science learner and himself as a facilitator for peers' learning. While Kevin seems to be more knowledgeable and helping others, the teens very carefully negotiated their positions so as not to fixate differential statuses among them. Joshua, by arguing that Jon and himself can understand Hakha, pushed against a potential positioning of being an incapable receiver of peers' help and claimed his multilingual competence in Hakha as a valuable resource he could bring to the team's learning. Therefore, the teens negotiated their multiple identities and contributed to making the learning environment more inclusive.

Demonstrating a desire to support underprivileged

During Week 20, the participants estimated their carbon footprint and had free time to complete their video production project. One group (Nwe, Apple, and Dorothy) was researching online about deforestation and recognized a dilemma. While deforestation is devastating to the environment, cutting down trees is a crucial means to meet the basic needs for people who do not have other technology. Nwe said, "Without it [cutting down trees for firewood], they don't have any electricity for cooking, so they have no choice but cut that tree. But we want

them to stop that. So how, I mean they don't have to stop completely, but how can they reduce cutting trees but still can cook it?" Nwe had this insight because she had seen people living in the mountains of Chin State, heavily relying on trees for survival. After a short discussion, the group then used search terms like "how to survive without fire" and "solution of not cutting down trees." Their video reflected the complexity of the problem. In the video that took a format of conversation between the three teens, Dorothy narrated, "People are cutting down trees for their own benefit," Nwe rebutted, "It's not our own benefit. It's everyone's benefit. For example, you can make money from tree, and you can make books and pencil from tree, and it's benefit for education," and Apple concluded, "So basically, if we cut too many trees, it's going to be harmful for our human society."

This group practiced CSL through demonstrating their understanding that environmental issues have different impacts on people around the world depending on their socioeconomic contexts and thus one single solution cannot be applied to everyone equally. They tried to accommodate multiple perspectives, reveal experiences and voices of people without resources, and find solutions that do not further deprive those who are already underprivileged. The group members indicated their desire for building a democratic and just society that takes into account unique situations and perspectives of individuals in making public policies.

Discussion and implications

Several ideas emerged from investigating how to engage learners in science in superdiverse societies. First, we argue that science learning environment should resemble the linguistic diversity of society wherein people choose, mix, and switch multiple languages for particular communication and sense-making purposes. We certainly agree that translanguaging helps English learners learn advanced science ideas. However, going beyond this functional benefit, translanguaging practices prepare young learners to become healthy citizens in multiracial and multilinguistic societies. Second, youth from migration backgrounds, especially those from regions of conflicts, bring rich experiences and knowledge about injustice and experiences of people without power and resources. Such experiences and knowledge help themselves and others to contextualize global issues in specific contexts, compare experiences across regions, and expand inclusivity for science learning.

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