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Migrant and Refugee Background Students Learning Through Play

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Abstract:	With the unprecedented increase of forced displacement in recent years, there has been a growing concern with how children from migrant and refugee backgrounds adjust to resettlement in Western schools. Adopting a sociocultural approach to science education, the authors explore how scientific concepts related to the water cycle and practices such as modelling are realized multimodally through play. By means of two constructive and imaginative play activities, block building and scrapbook making, illustrative examples showcase how four children from migrant and refugee backgrounds repurposed various multimodal resources to make sense of scientific concepts, use scientific language, and problem solve in relation to their life experiences beyond the classroom. Implications encourage teachers to consider designing content-area language instruction infused with play-based activities to give rise to alternative avenues through which emerging bi/multilingual learners can take risks, be engaged cognitively, and apply their new knowledge creatively.

Migrant and Refugee Background Students Learning Through Play

TEASER

While engaged in play, children from migrant and refugee backgrounds repurposed various meaning-making resources and practices to make sense of science concepts multimodally.

Armed conflicts, racial, gender, social group, political and religious persecution have recently forced millions of children under the age of 18 to flee their home countries (UNHCR, 2020). After varied migration experiences and while resettling in a new country, these children must adjust to a new language and culture and deal with unresolved emotional issues associated with displacement and trauma (Bajaj & Suresh, 2018).

Too commonly, these recent newcomers are stigmatized by their 'refugee' status rather than characterized by their potentials and unique life experiences. In the school system, their struggles to adapt to Western-style models of education and overcome gaps in content-area knowledge may be perceived as deficiencies, disability, or family neglect (Shapiro & MacDonald, 2017).

Despite this tendency to label these learners based on an overemphasis on hardship, recent studies have shown that, by creating spaces where learners can share their lifeworld experiences, it is possible to design strengths-based pedagogies and foster a sense of belonging in the new country (see e.g., Kennedy et al., 2019).

Specifically in content-area instruction, Lemke (2001) proposes a sociocultural shift to science education to afford students less fluent in English more opportunities to learn by drawing on their cultural and social backgrounds. Essentially, he urges educators to diversify the range of meaning making resources available in content-area classrooms so that culturally and linguistically diverse students can understand and appreciate science "by looking within and beyond the classroom" (p. 305).

Additionally, Lemke (1998) has long argued for a focus on language in science education since learning science is realized *through* the medium of language. As he explains, this is "because language is not just vocabulary and grammar: Language is a resource for meaning making" (p. ix), which recognizes that for centuries science has not only used verbal language to make meaning but also "…mathematical, graphical, diagrammatic, pictorial, and a host of other modalities of representation" (p. 248). This view aligns with the understanding that "communication always draws on a multiplicity of modes, all of which have the potential to contribute equally to meaning" (Jewitt, 2009, p. 14). From a multimodal perspective, verbal language is but one of the many resources available to make, distribute, and interpret meanings (Grapin, 2019).

Play is a context where scientific concepts can be articulated through verbal language and other multiple modes. Genishi and Dyson (2014) claim that play should be a standard and not just as a fun activity at the end of the school day. They argue that play can make learning dynamic and accessible because it enables children to "transform the symbols at their disposal into movements, facial expressions and eventual dramas with or without words" (p. 238). They can create, problem solve, take risks, and collaborate by traversing and translating fluently back and forth across multiple modes of communication.

In this article, we demonstrate through two vignettes how scientific language and practices can be realized multimodally through play. This qualitative study, carried out in a Western Canadian province that has recently welcomed more than 12,000 refugee claimants (BC Refugee Hub, n.d.), showcases illustrative examples of how four children from migrant and refugee backgrounds repurposed various multimodal resources to develop scientific practices and make sense of abstract concepts in English in relation to their life experiences beyond the classroom. Specifically, we address the question: How does play enable children to communicate their understanding of scientific concepts (e.g., related to the water cycle) and practices (e.g., scientific modeling)? In the following section, we outline theoretical perspectives that help explain the potential role of play in science learning.

PAUSE AND PONDER

- What do you see as some of the language and literacy demands with respect to vocabulary, language features and textual genres for migrant and refugee background students in a science classroom?
- How might you design tasks that afford these students opportunities to make meaning of scientific concepts through all the languages they use and other modes of communication?
- How might you help these students build on their interests and life experiences for learning scientific language and meeting curricular competencies?

Science Learning Through Play: Linking Theories and Classroom Practices

Lemke's (2001) sociocultural approach to science education challenges the view that scientific learning is disconnected from social institutions, their politics, and wider cultural beliefs and values. He argues that scientific concepts should be learned in the same way as community languages, and belief and value systems. Drawing on sociocultural perspectives of literacies (Street, 1984), Lemke argues that science learning is context-dependent and embedded in sociocultural practices that cannot be isolated or treated as neutral or merely technical.

To close the existing gap between students fluent and less fluent in English or users of a nonstandard variation, Lemke (2001) asserts that science education should not be trying to either ignore language differences or homogenize them in favour of a dominant culture. Instead of a one-size-fits-all approach, a sociocultural perspective encourages educators "to discover the best ways to integrate science teaching that is responsive to different needs with teaching that address the challenges of a heterogeneous and diverse classroom community" (p. 306).

Following Lemke's (2001) assertion that communication in science is fundamentally multimodal, Siry and Gorges (2020) reinforce the pivotal role non-verbal modes of communication (e.g., gestures, eyesight, sounds) play in multicultural contexts where bi/multilingual children often rely on body language, images, and other modes to communicate their understandings.

In addition, we draw on Dyson's (2003) play-based approach to children's multimodal meaning making practices. The affordances of play-based activities in children's learning have long been documented by Dyson, who has examined childhood cultures and their relationship to school learning (see e.g., Dyson, 2020).

Dyson (2003) argues that all children engage in complex transformative, recontextualization processes, "borrowing, translating, and reframing media material from the communicative practices – the varied kinds of voices – that filled the landscape of their everyday lives" (pp. 329-30) regardless of historical times, spaces, and cultures. These recontextualization processes shape children's entry into academic literacies such as science learning because they encourage experimentation with various signs, tools, and modes, as the children playfully move across different ways of making meaning of abstract concepts, representing and communicating their understandings.

Through play, children can think, make hypotheses, and anticipate solutions that they immediately verify through a trial-and-error method. Specifically, in experimenting with building objects, learners can engage in scientific modeling, a practice which allows them to generate new understandings or communicate their ideas to others; models can also showcase explanations of behaviour or future predictions (see e.g., Samarapungavan et al., 2015).

Play may be particularly important for students from migrant and refugee backgrounds because it encourages risk taking. In other words, “play offers unique opportunities for experimentation with different modes and communicative practices in a protected space of learning whereby performance precedes competence” (Kendrick, 2016, p. 52).

Portier et al. (2019), however, observe that regardless of the affordances of playful learning, play in early childhood education has been hindered by an emphasis on teaching the basics of literacy and a focus on standards-based education. They claim that early-years teachers feel strained and struggle to integrate play into pedagogical practices that emphasize more teacher structured approaches to academics to meet curricular expectations.

Having discussed the theoretical perspectives underpinning this study, we describe next the context of our study.

Linking Research and Classroom Practices

The classroom practices described in this article were part of a larger project focusing on the language and literacy education of children and youth from migrant and refugee backgrounds. All three authors have extensive experience as researchers or teachers working with students in under-resourced contexts in Canada, Brazil, Uganda, and the United Kingdom.

For almost a year, we volunteered at New Vista Elementary School (a pseudonym), a school in Metro Vancouver (Canada) with a long history of providing services to families from migrant and refugee backgrounds. While volunteering, we spent a lot of time with Mr. Samuel (all names are pseudonyms), a first-year teacher who made a particular effort to promote active learning and the principles of respect and responsibility through experiential learning and multimodal resources. He became our primary collaborator for this project.

Mr. Samuel’s Classroom

There were 21 students in Mr. Samuel's classroom, 11 consented to participation (2 girls and 9 boys). It is noteworthy that when conducting research with newcomers, written consent can sometimes be challenging. For families who have been oppressed by government systems in international contexts, there can be issues of trust and fear of consequences when asked to sign letters of an official nature.

Most students were from migrant and refugee backgrounds including countries such as Afghanistan, Eritrea, Iran, and Syria. A few of these learners were born in Canada with their families arriving earlier as migrants; some had been in the country for two or more years, while others had recently arrived and had less than one year of schooling experience in their new country.

As volunteers in his classroom, we observed how effective Mr. Samuel's practices were to include every child and promote collaboration, self-regulation, connectedness, and a sense of place. Every student had an assigned role (e.g., librarians, teacher helpers, timekeepers) and reciprocally supported each other's learning, whether spelling out a word, translating instructions, or simply being there for one another.

Mr. Samuel's classroom dynamics were most evident during the "choices" period or the play time at the end of the school day. During this time, some students would play with building blocks or cards; others would choose a spot in the room to read a picture book, draw, or chat with their peers.

The Water Cycle Unit

Building on Mr. Samuel's classroom practices and to help his bi/multilingual students thrive academically, we co-designed and co-taught a science unit on the water cycle. The unit revolved around two guiding questions: 1) Why is water important to all living things? and 2) What is the water cycle and what are the different forms of water in the environment?

We designed five play activities through which students could develop a deeper understanding of scientific concepts by flexibly translating the key features of a concept (e.g., evaporation, runoff, or condensation) from one multimodal resource into another (e.g., from action to text).

The two vignettes presented in this article showcase two play activities that were part of this curricular unit: 1) block building during which students created scientific models to represent a contribution to their real and imagined communities and 2) creating scrapbooks where students could imaginatively communicate their scientific knowledge by repurposing various multimodal resources.

We categorize both block building and scrapbook making under the umbrella of constructive and imaginative play. By play we mean activities with different materials "that stand for other things and that develop in complex ways when controlled by children" (Genishi & Dyson, 2014, p. 229). The activities showcased in the two vignettes offered distinct challenges, activated creativity, language, and knowledge processes, and afforded the students opportunities to repurpose various semiotic resources and reimagine new worlds, stories, and possibilities.

Taking an Up-Close Look at Classroom Practices

We looked up-close at how students in a Grade 2/3 classroom used multimodal resources during play to make sense of scientific concepts related to the water cycle and to engage in scientific practices, such as problem posing, hypothesizing, problem-solving and modeling.

We used field notes, photos of in-class activities, artifacts (e.g., block models and scrapbooks), and interviews with the students, Mr. Samuel, and the ELL (English Language Learning) specialist to document classroom practices daily during the time when the water cycle unit was taught.

We collaboratively and thematically examined (Saldaña, 2011) students' building block designs and scrapbooks to better understand their engagement in scientific practices and how they were making sense of science concepts multimodally through play. To confirm our interpretations, we turned to interview transcripts to identify students' intended meanings and gain insights into their design processes in creating their representations in the play-based activities.

Our analysis was driven by Agar's concept of rich points, which he argues are "those surprises, those departures from an outsider's expectations [...] that give direction to subsequent learning" (Agar, 2006, p. 2). In other words, we looked for actual examples of rich points of science learning infused with play that implied possibilities for sensemaking and multimodal communication for bi/multilingual students. Examples of these rich points may include students' science practices and unique representations of their understanding of science concepts during imaginative or constructive play (e.g., block play and designing scrapbooks). The identification of rich points in students' learning influenced the selection of four focal participants, introduced in the next section.

Focal Students

We selected four focal students, Felicity, Hassan, Yusef, and Reem, because they represent varied backgrounds and life experiences. While Felicity was a Canadian-born student with a single mom who arrived earlier in Canada as a migrant, the three boys (Hassan, Yusef, and Reem) experienced migration and were in the process of social integration in their new country.

All four students received extra support in learning English at some point in the past two years. Their literacy, numeracy and content-area competencies were considered emerging relative to grade level expectations, which is understandable given the number of years that it takes for students who are learning English as an additional language to catch up to their same-age peers.

Felicity

At the time of the study, Felicity was a Grade 2 8-year-old girl. Her single mom arrived as a migrant from an African nation. However, her country of origin and migration path were not well known in the school, which is not uncommon for many families who flee under difficult political conditions. Felicity was part of the support network in Mr. Samuel's classroom, welcoming newcomers to the school and being ready to assist.

Hassan

Hassan was 8 years old and in Grade 2 when the study began. He had more than two years of schooling in Canada, and, when he arrived from Afghanistan, he had emerging proficiency in English. He was a highly motivated student who showed great passion for Afghani culture. In Mr. Samuel's cohort, Hassan supported recent newcomers by translating instructions, playing with them, and welcoming new learners to the classroom.

Yusef

Yusef was 9 years old and enrolled in Grade 3. He arrived from Eritrea as a refugee-claimant and was born in Ethiopia. In class, he actively participated in activities and was particularly engaged in whole-group discussions. Yusef was also one of the teacher's helpers and a cafeteria assistant serving peers during lunch time.

Reem

Reem was also a 9-year-old learner enrolled in Grade 3 whose family had migrated from Afghanistan. In Mr. Samuel's class, he played a significant leadership role and, at the beginning of the school year, had been assigned as a special helper who supported students who could not yet fully communicate in English.

Rich Points of Science Learning Through Play

The examples in the following two vignettes – Building Blocks and Making Scrapbooks – showcase how the four participants used multimodal representations to engage in scientific practices and make sense of science concepts related to the water cycle. For each of the vignettes, we provide a table with a step-by-step sequence followed by our analysis of student's literacy engagement and scientific meaning making through play.

Vignette 1: Building Blocks

After learning about the water cycle and different bodies of water through manipulative and dramatic play, students read aloud the picture book *The Boy Who Harnessed the Wind* (Kamkwamba et al., 2012) and watched an excerpt from the movie adaptation. The story is about a teenage boy who built a windmill to irrigate his community's plantation devastated by one of the worst droughts in Malawi in recent years. Table 1 shows our step-by-step sequence for the building blocks activity, followed by our analysis of rich points in science learning.

Table 1

Step -by-Step sequence for building blocks activity

1. Contextualize	- Activate students' previous knowledge about another picture book previously read in class – *The Water Princess* (Verde & Reynolds, 2016).
2. Reflect	- Inquire about the issues the main character's community faced – water scarcity – and how she helped her community. - Present images of recent natural disasters (e.g., the Australian wildfires and a snowstorm on Canada's east coast) to discuss the causes of these events and their effects.
3. Focus on language	- Present some specific vocabulary, namely irrigation, infiltration, and windmill. - Students practice this language in dialogue.
4. Propose a problem-solving project	- Taking inspiration from the story, propose a problem-solving project. Students use building blocks to design a model representing a possible solution to a problem affecting their own real or imagined community. - Provide examples such as planting trees or collecting food and warm clothes to donate to shelters. - Allow time for students to brainstorm ideas with peers.

5. Connect with the community	- Ask about the problems students observe in their community and how their design models can benefit themselves and other citizens.
6. Gallery walk	- Upon completion of their projects, students go on a gallery walk to showcase their artifacts.

Block Models: Rich Points of Science Learning

Felicity's and Yusef's models focused on supplying their imagined communities with fresh water. Felicity transformed the approach taken by the main character in *The Boy Who Harnessed the Wind* to supply proper drinkable water (see Figure 1). She explained: "I kinda had my own idea, but it's kinda copying the boy who harvest [harness] the wind. But I added a few of my touches. I put a windmill like he did, and it [Felicity's windmill] was blowing the waterfall down because the water was stuck between rocks." When asked how she could help the community, she asserted: "By pushing the water [over the rock] so that they can plant some food and make the water clean."

Figure 1 [insert here]

In this activity, Felicity explains that her problem-solving idea involved "a few of her touches." She recontextualized elements of the two narratives read in class to propose an explanation of how she would resolve a lack of drinkable water, the main conflict in *The Water Princess*, and water scarcity, the conflict in *The Boy Who Harnessed the Wind* in her imagined community.

Felicity also recontextualized meaning from objects and given narratives to recreate it in an imaginary situation as part of a scientific modeling practice. In this account of playful action, we want to underscore Felicity's language use. She utilized cause-effect conjunctions (i.e., because and so that) to provide an explanation of how and why she designed her windmill to solve the water shortage problem. While navigating across different genres of school (Gibbons, 2015) – a narrative and an explanation – she used comparative conjunctions (i.e., "like he did" but "I added a few of my touches") to communicate how she recontextualized the available cultural resources from the texts (and movie) to realize her intentions as a meaning maker and problem solver. Furthermore, within the play realm, Felicity, in assuming a problem-solver role, took up an active voice and articulated a responsible action to support her imagined community.

Felicity's reinterpretation of how windmills work is a particular rich point of science learning through play. Rather than an energy generator, the windmill in her model acted as a fan "blowing the waterfall down because the water was stuck between rocks" (Felicity). Through her creative rationale she was able to construct an explanation and design a solution for a problem. As we consider possible classroom follow ups to her response, we imagine other scientific practices such as observation or play-based trial and error investigations enhancing her understanding of how windmills work. She could then compare her understanding with other windmills and see the differences. Testing her solution would offer another way of advancing her scientific knowledge.

Yusef's example resonates with Dyson's (2003) assertion that children bring relevant resources from popular media texts to school literacy. He leveraged his knowledge of space exploration to create provisions for his imagined community (see Figure 2).

Figure 2 [insert here]

Building on his interest in *Star Wars* movies, he designed his spaceships to "explore space to see if there is any water." As he described one of the crafts, "This one is a *Star Wars* spaceship because of the top."

Yusef repurposed materials to enact his intentions as a meaning maker and problem solver. For instance, he gathered blocks of different sizes to construct spaceships designed according to his *Star Wars* knowledge. Specifically, the third and smallest spacecraft that he presented is in fact a toy car that he redefined its original meaning to represent his intentions.

In this activity, Yusef also strengthened his problem-solving skills and language competence. For example, he used a cause-reason conjunction to explain that his spacecrafts would "explore space to see if there is any water." He also utilized the language of explanation (i.e., because of the top) to justify his classification of his craft design as a "*Star War* spaceship".

While not directly related to the water cycle, we see Yusef's spaceship models as another rich point of science learning because they represent the scientific practice of modeling. Through play, Yusef constructed a model to explain a solution to a real-world issue. This rich point demonstrates that, when teachers infuse science learning with play, learners can draw on their popular culture knowledge and communicate their understandings more authentically.

Whereas Felicity and Yusef were concerned about water scarcity, Reem addressed the problem of food insecurity. In designing his model of a flowerpot, he gathered blocks of similar sizes and shaped them into a coherent ensemble (see Figure 3).

Figure 3 [insert here]

When presenting his project in class, Reem explained he wanted to support his community by addressing food insecurity: "I made a plant and then after when it's growing you could pick up the seeds and maybe make food out of it." Interestingly, the community school where we developed our study also offers affordable meal plans, and a food bank is located on the premises to support families struggling with financial difficulties and disruptive changes.

This rich point once again exemplifies the complex language of explanation (i.e., conjunctions to sequence events that result in food production) that the students were able to produce. It is noteworthy that Reem used a modal adverb 'maybe' to indicate the degree of probability attached to his statement. This is sound practice in reporting science.

Reem's rich point of learning reinforces Lemke's (2001) sociocultural approach to science learning. Through play, Reem foregrounded known problems in his community and designed a model to explain his solution to food insecurity. His flowerpot demonstrates how opening doors to students' lived experiences in a science classroom can shed light on some of the issues that newcomers face, and how teachers can develop responsive pedagogical approaches to address them.

Hassan showed concern about the safety of his compatriots in Afghanistan. As he explained, "I wanted to build a big house that is super invincible because they still have wars in Afghanistan." To protect his people, Hassan searched for material resources to build a haven or which could serve as weapons (see Figure 4).

Figure 4 [insert here]

As he elaborated, "I kept looking for pieces that can connect, I had some swords to protect the people. And I got a van and a house for free." Whether he experienced armed conflicts in the past or knew of those in his home country, Hassan foregrounded this knowledge to direct attention to the importance of feeling safe.

Clearly, Hassan's production wanders away from the theme of the water unit. However, Dyson (2003) justifies such disconnections by claiming that learning is a process of pursuing alternatives to respond to the symbolic, social, and ideological complexities of written texts and social worlds. To design his scientific model, he "called upon familiar frames of reference and well-known materials" (p. 333) to propose a way to protect his compatriots. In doing so, Hassan prioritized what was of importance to him over simply following the assigned curricular activity.

In the building blocks activity, the four students, engaged in science practices, imagined better possibilities for their real or imagined communities, where resolving real-world issues such as contaminated water, water scarcity, food insecurity and family and community safety is a priority. While representing solutions to these problems, they directed attention to their popular media references, and their sense of belonging and lived experiences beyond the classroom. Ultimately, they were active community members who capitalized on their problem-solving scientific practices and language competencies, with respect to explanation genres, and corresponding language features, to communicate their intentions as meaning makers.

Vignette 2: Scrapbooks

The next play activity was to create scrapbooks that represented their science learning (e.g., their understanding of the water cycle). As Mr. Samuel had been running a writer's workshop with the ELL school specialist before our research began, designing multimodal scrapbooks afforded learners an opportunity to explore a combination of their writing skills and multimodal resources to authentically communicate scientific knowledge. Table 2 illustrates the steps we took to engage students in producing their multimodal artifacts.

Table 2

Step-by-step sequence for scrapbooks activity

1. Provide resources	- Provide resources such as beads, stickers, pebbles, ribbons, felt tip pens and other resources for students to freely design scrapbooks. Do consider recyclable materials as an eco-friendly and low-cost alternative.
2. Model	- Place illustrative models around the classroom to serve as inspiration or a more guided instruction. Examples may include general information about water, produced diagrams of the water cycle, wrote captions for photos of their block models, and decorated the pages freely.
3. ELL and peer support	- As part of the writer's workshop, have the ELL specialist in the classroom to support students' writing. - Encourage learners to support each other by, for example, clarifying spelling questions. - Pair up more proficient learners who share a common language other than English with newcomers to leverage peer support.
4. Gallery walk	- Allow time so that students can share their productions with peers, the school community, and caretakers.

Scrapbooks: Rich points of science learning

In her scrapbook, Felicity demonstrated the importance of water to all living things (see Figure 5). As she elucidated: “This one I just did. Mr. Samuel gave me this idea of we need water to survive, and I put someone drinking water and she’s saying – I love water. And the little bee saying me too. And I put a shark and two turtles.”

Figure 5 [insert here]

This example from Felicity’s scrapbook reveals how she fit scientific concepts into her media influenced cartoon-like narratives with talking animals. By combining multiple semiotic resources, she followed her teacher’s recommendation to direct attention to the importance of water to all living things (i.e., humans and bees). At the same time, she created unique imaginary situations where meeting curricular expectations would be meaningful to her.

On one of his scrapbook pages, Hassan created a narrative while including concepts studied during the water unit to combine his scientific knowledge with his appreciation for Afghanistan. In Figure 6, he portrayed a waterfall in his home country.

Figure 6 [insert here]

He captioned this image as *The waterfalls in Afghanistan is beautiful. If boat fall down they will be died*. Yusef also revealed a sense of belonging in his scrapbook. Although he was born in Eritrea, Yusef claimed to be Canadian during our interview. Upon his arrival, he lived in Chilliwack (Canada) and, according to the ELL specialist, Yusef often reminisced about his experiences in nature and the friends he made there.

In his scrapbook cover, he may have connected his lived experiences in Chilliwack and his understanding of the importance to water and its cycle through the environment. Yusef captioned his drawing of a waterfall as *Waterfall is important because people and animals can drink*. In describing his artifacts, he shared a hiking adventure when he came across a waterfall: "When I went to Chilliwack, I used to live there, and then there was a big waterfall, we went hiking and there a big waterfall."

Meanwhile, Reem situated the water cycle on a deserted island (see Figure 7). As he explained, "I *kinda* made the water cycle. Evaporation, precipitation, condensation, and this is runoff. This is an island with a map and treasure down into the water."

Figure 7 [insert here]

For this production, Reem merged an element of an explanatory text (a diagram) and one of a narrative (a setting) to apply his new knowledge creatively. He manipulated a variety of materials to denote evaporation (blue beads moving up), condensation (blue dots on clouds indicating water droplets), precipitation (larger blue beads descending from clouds), and collection (blue woven fabric strips and sea-animal stickers). To situate his production, he placed a round-shaped cotton strip on the bottom right corner representing an island. His use of scientific terms, "Evaporation, precipitation, condensation", in his oral account, mixed with this treasure hunt 'adventure' is striking.

Play, Dyson (2020) illuminates, "allows children to enter the realm of abstract thought and, in the process, to gain some measure of freedom from the everyday, even as they follow the rules of their worlds" (p. 4). When choosing from an array of materials to communicate their understandings, the four students followed teachers' instructions or referred to the available scrapbook models. They leveraged scientific content and practices such as observation, describing, explaining, generalizing, problem solving, and inquiry to draw attention to real-world issues.

Lemke (2001) urges educators to devote more explicit attention to teaching students how to read a hybrid text. He asserted that students should talk and write science in words, but also explore the affordances of drawings, tables, graphs, and other multimodal resources in all possible combinations. What our findings suggest is that play can be a feasible alternative to accomplish this feat. The four children disrupted the set structure of scientific texts (i.e., informational reports) to design authentic hybrid texts. Their scrapbooks illustrate how they transformed an explanation of how water cycles through the environment into narratives featuring cartoon characters, deserted islands with hidden treasures, and waterfalls with turtles being chased by sharks.

Lastly, the four students' multimodal artifacts reiterate how uniquely hybrid the language of science is. When teachers allow time for students to play with materials of different sizes, textures, and shapes to represent scientific understandings, diverse forms of common genres of school and linguistic awareness can emerge. Activities such as designing scrapbooks can also foregrounded students' voices, popular cultures, and their sense of belonging to Canada or their home countries.

Concluding Remarks

We used our analysis of rich points to illustrate that actualities can demonstrate possibilities. Our findings should encourage teachers to design content-area language instruction infused with play-based practices. The two vignettes in this article demonstrate how bi/multilingual children can have an authentic learning experience in a science classroom by repurposing available meaning-making resources that do not necessarily depend on verbal language. Their block models and scrapbooks reveal that playfulness and multimodal resources can give rise to alternative and non-threatening avenues through which bi/multilingual learners, whose English language proficiency is still emerging, can take risks, be engaged cognitively, and apply their new knowledge creatively.

Our play-based approach to sociocultural science education also challenges deficit views of the language and literacy learning of children from migrant and refugee backgrounds. Through their engagement in play, the four children demonstrate that, despite adverse circumstances, they can and will find a means to learn, make sense of challenging science concepts, apply, and innovate with their new understandings, contribute, belong, and leave their legacy of transformation in the world.

TAKE ACTION!

1. Find hybrid texts (e.g., informational texts within a narrative) that contextualize abstract concepts and scientific knowledge to help learners draw connections with their home literacies and lifeworld experiences. An example includes *The Great Big Water Cycle Adventure* (Barnham, 2018).
2. Design play-based activities that trigger distinct cognitive processes so that learners can experience, conceptualize, and apply new language and science knowledge in authentic and creative ways. For instance, have students perform the water cycle (i.e., a water cycle tableau) or enact stages of the cycle with their favourite toys.
3. Propose activities through which students' lived experiences and popular culture knowledge can be integrated into content-area instruction. For example, utilize scenes from animation movies when stages of the water cycle occur, or have your students draw comic strips describing processes such as evaporation or precipitation.
4. Propose problem-based science projects that encourage learners to take part in caring for themselves and their community while engaging in problem-solving scenarios. As an example, students could investigate the quality of their school water fountains or the historical background of nearby bodies of water (see e.g., Early & Kendrick, 2017).

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MORE TO EXPLORE

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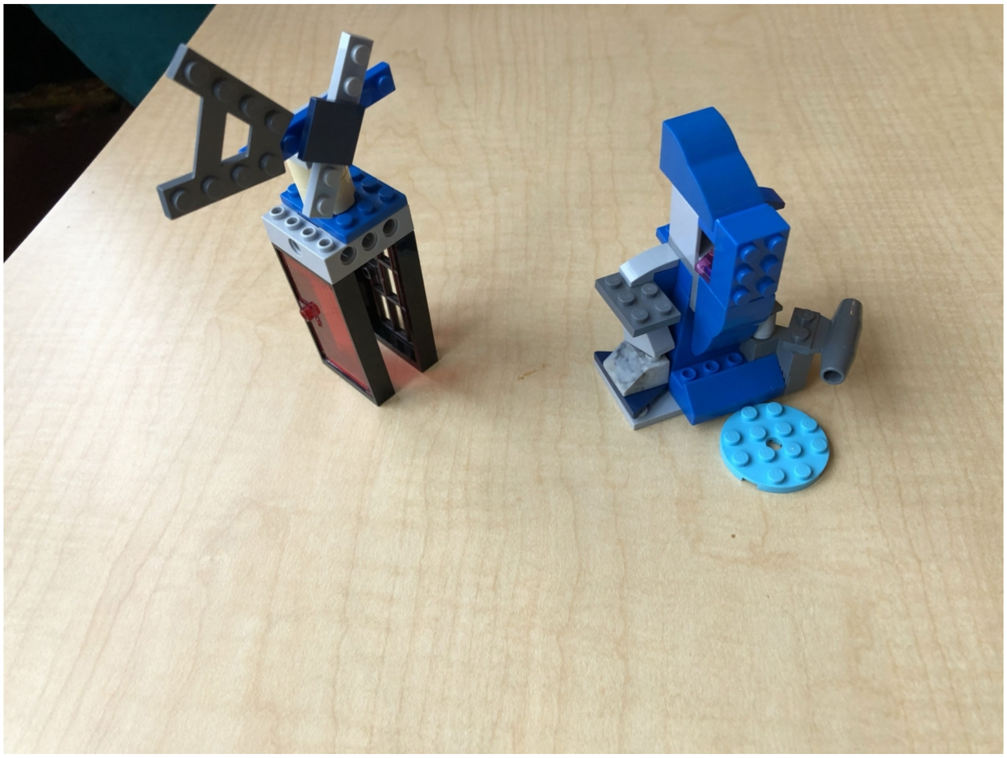

Figure 1 - Felicity's Windmill and a Waterfall

1422x1066mm (72 x 72 DPI)

Figure 2 - Finding Water in Space

1422x1066mm (72 x 72 DPI)

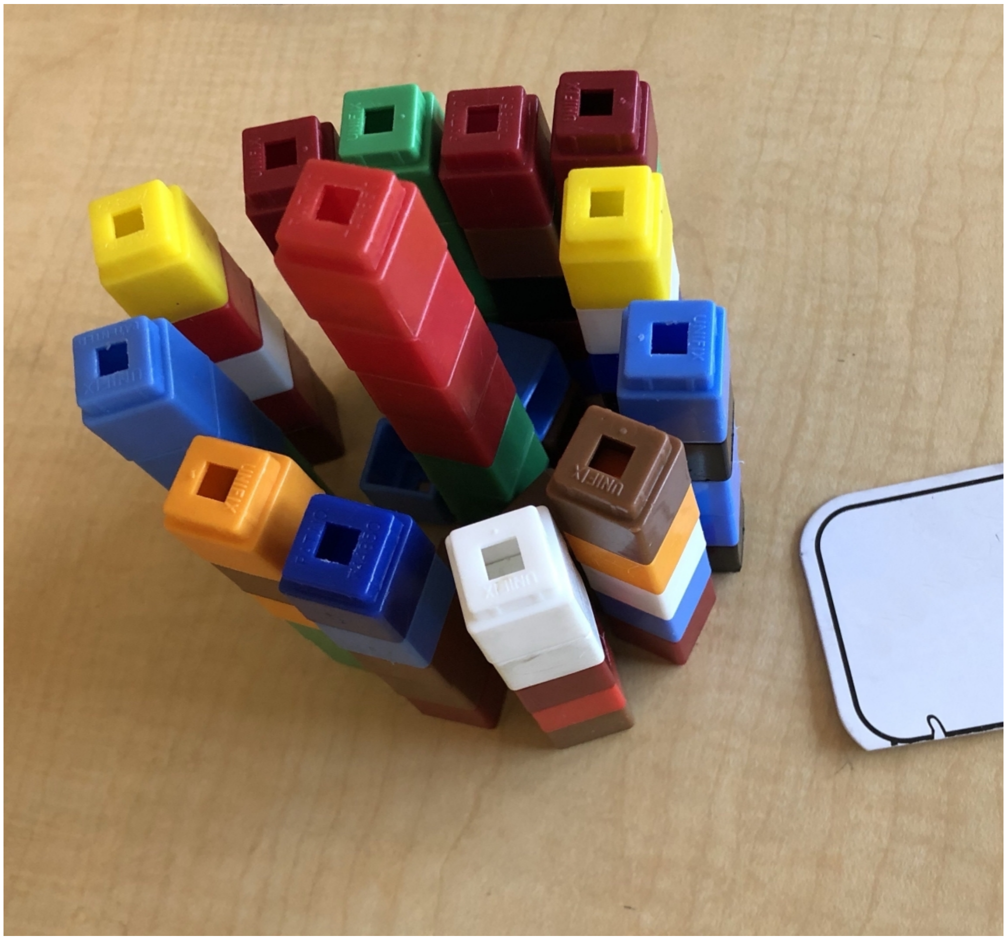

Figure 3 - Seeds to Feed the Hungry

217x203mm (300 x 300 DPI)

Figure 4 - A Safe Haven in Afghanistan

341x256mm (300 x 300 DPI)

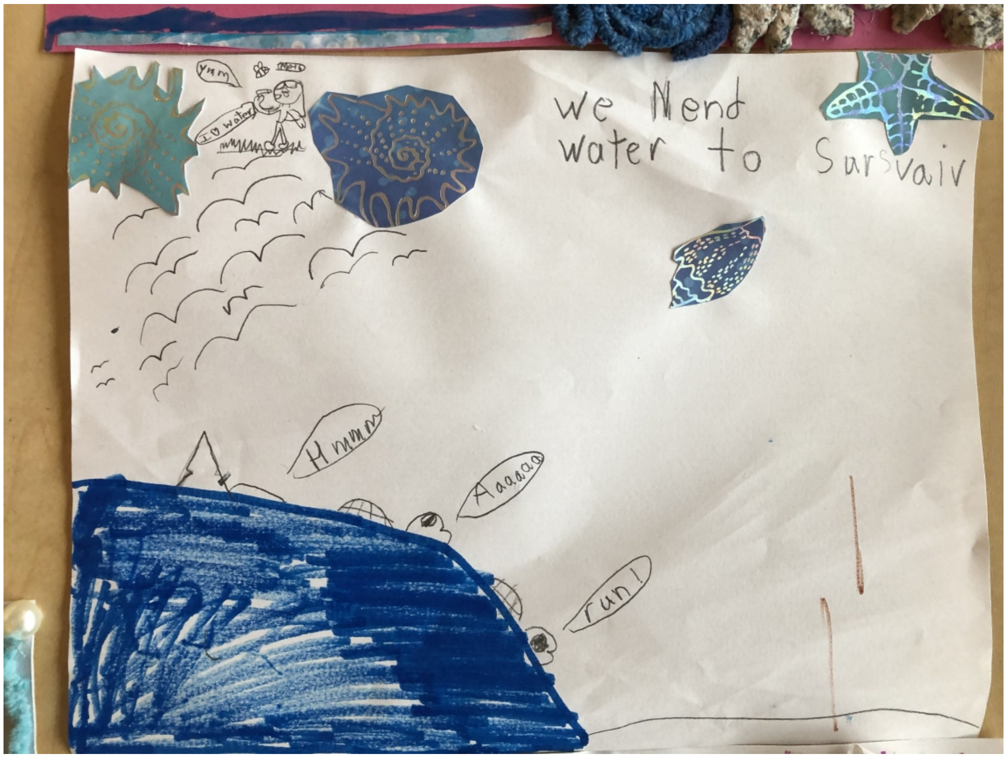

Figure 5 - Felicity's Scrapbook Page

1422x1066mm (72 x 72 DPI)

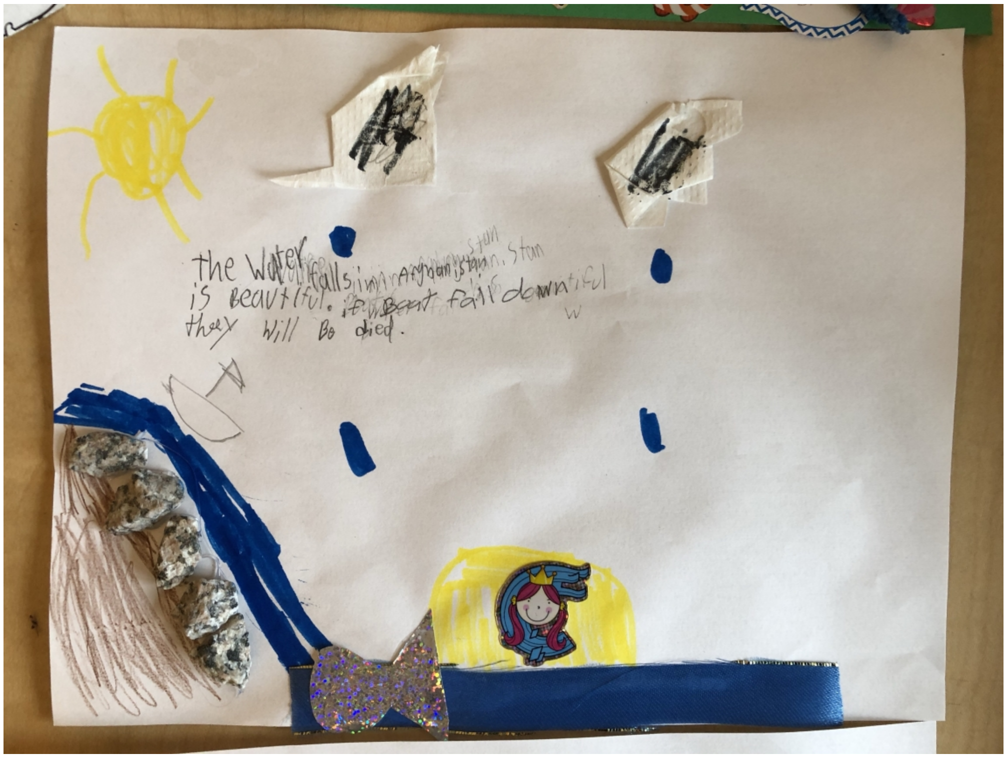

Figure 6 - Hassan's Waterfall

1422x1066mm (72 x 72 DPI)

Figure 7 - Reem's Deserted Island

341x256mm (300 x 300 DPI)