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Learning Elapsed Time through Afterschool Activities

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Abstract: A teacher in an urban school designed culturally and linguistically relevant lessons on measurement by utilizing students’ timelines on evening activities. The lessons opened up multilayered learning. Students learned about measurement, language and also about their classmates. The lessons also facilitated English language learners’ participation in mathematics lessons.

Teaching in Linguistic Diverse Classrooms

Many schools in North America are becoming linguistically diverse. In Canada, 17.5% of the total population (5.8 million people) reported speaking at least two languages at home (Statistics Canada, 2011). In the United States, 21% of households reported using languages other than English (United States Census Bureau, 2013). With a vision of providing high quality mathematics instruction to all the learners, the National

Council of Teachers of Mathematics (2014) states: "Our vision of access and equity requires being responsive to students' backgrounds, experiences and knowledge when designing, implementing, and assessing the effectiveness of a mathematics program" (p.60). *Culturally relevant pedagogy* is a pedagogical approach where cultural practices of students' community and home are meaningfully embedded in mathematics learning (e.g., Leonard & Guha, 2002; Torres-Velasquez & Lobo, 2004). Under Ontario's Equity and Inclusive Education Strategy (2009), culturally relevant pedagogy has been embraced in Ontario to set high academic expectations for all learners (Literacy and Numeracy Secretariat, 2013).

The lessons we introduce here stem from a teacher's efforts to make mathematics curriculum culturally relevant, in one of the most linguistically diverse schools in an urban city of Canada. The lessons were also guided by the idea of *identity texts*. The term, identity texts, is defined as "the products of students' creative work or performances carried out within the pedagogical space orchestrated by the classroom teacher. (...) The identity texts then hold a mirror up to students in which their identities are reflected back in a positive light " (Cummins & Early, 2011, p. 3). This idea of identity texts has been used to enrich classroom practices especially for students whose identities tend to be historically undervalued.

Like many classrooms in urban cities in North America, the classroom we introduce here is linguistically and ethnically diverse. In this Grade 5 classroom, the majority of students were English Language Learners (ELLs), either the children of immigrant families whose home language was not English or the children who grew up in non-English speaking countries. The students' home languages included

Bengali, Cantonese, Farsi, French, Mandarin, Romanian, Russian, Spanish, Tamil, Urdu, and Vietnamese. This diversity of students' language background presented a unique challenge to teachers because bilingual teaching could not be directly applied.

Making Measurement Lessons Culturally and Linguistically Relevant

As a teacher of an urban classroom, I (Robin) have been trying out various teaching strategies to maximize students' backgrounds and their languages. Some of the effective teaching strategies are to pair up students who share the same language, and to create a sharing time for various computation strategies (for example, Bengali students introduced their unique use of body parts for counting). In order to foster a sense of community in the classroom, I use community circles as a routine activity, where students and the teacher share stories about themselves and come to know each other better. Mathematics talk in each unit is typically organized in the following forms: 1) checking students' prior knowledge and understanding, 2) sharing learning goals, 3) checking students' strategies during problem solving, and 4) sharing various strategies and consolidating students' understanding. Daily mathematics talk serves as formative assessment where the teacher offers linguistic support, when ELLs are struggling to express their ideas. Models and diagrams are effective tools for ELLs to communicate their thinking processes.

In reaching ELLs in mathematics classrooms, one of the challenges that many teachers can face is a lack of teaching materials that are carefully designed for learning both the language and mathematics simultaneously. For example, available

textbooks are often not relevant to many ELLs' lives outside the school and their linguistic density can be an obstacle for mathematical learning. In order to make mathematics learning relevant and meaningful to students, collegiality at the school is essential. For this project, an ESL teacher at the school brought the idea of identity texts.

The curriculum strand chosen was measurement, on the topic of calculating elapsed time. In the province of Ontario, Canada, the topic of elapsed time is addressed in Grade 4 and Grade 5 (Ontario Ministry of Education, 2005). By the end of Grade 4, students are expected to solve word problems that involve time intervals. By the end of Grade 5, students are expected to learn how to estimate and determine elapsed time, given the duration of events expressed in minutes, hours, days, weeks, months or years. In the curriculum, using various tools (including a time line) and strategies are expected.

Typical word problems used in the unit of measurement, attempt to connect to students' everyday lives but often are generic, as seen in the following problem.

If you wake up at 7:30 a.m., and it takes you 10 minutes to eat your breakfast, 5 minutes to brush your teeth, 25 minutes to wash and get dressed, 5 minutes to get your backpack ready, and 20 minutes to get to school, will you be at school by 9:00 a.m.? (Ontario Ministry of Education, 2005, p. 69)

Although this kind of problem may have relevance to students' lives, it does not offer students the necessity to measure elapsed time using a relevant tool (e.g., analog and digital clock, stopwatch) and also to estimate elapsed time. In addition, especially in a

classroom with students from diverse backgrounds, there is no single “normal” everyday activity that students engage in outside the school.

The topic of elapsed time can be mathematically challenging for students because they have to coordinate hierarchical units such as hours and minutes (Kamii & Russell, 2012). When identifying the duration between 8:30 am and 11:00 am, children have to understand that hours are at a higher hierarchical level and minutes are at a lower hierarchical level. In addition, students can experience difficulties because hours and minutes do not follow a base ten system.

After determining prior knowledge of reading time and calculating elapsed time, the students engaged in generic time problems involving the relationship between units of time and solving elapsed time in a variety of ways. If students were struggling with understanding a hierarchical relationship between hours and minutes, I (Robin) revisited the concept by using a clock model with five-minute intervals and one-minute intervals. The culminating lesson began about half way through the unit. As a first step, the students brought a worksheet home and recorded their Wednesday evening activities in a table format, as a preparation for the upcoming lesson on elapsed time. They were asked to record the time that they arrived home and the start time and end time of each activity that they engaged in until bed time (by using the unit of hours and minutes). How to use analog and digital clocks and stopwatches were introduced in prior lessons. In order to record elapsed time of each activity, students chose to use tools that were available at home. Once students completed a table, they created a timeline to represent their evening activities. The idea of an interval and an open number line were introduced and modeled in previous lessons. Diverse representations of time intervals (e.g., a number line with

intervals and an open number line) and supporting students to measure elapsed time of each evening activity were one of the most effective pedagogical tools. In the class, students identified how long each of their evening activities lasted and how much time passed from the time they arrived home and to the time they went to bed.

Students' Learning through the Lessons

Students' timelines showed not only their typical Wednesday evenings but also portraits of their identities. Everyone spent the evening differently. The timeline depicted how and when they ate dinner, what kinds of hobbies they had, and how religion was significant to some students' daily lives. Once students completed their timelines, with the help of an ESL teacher in the school, a book titled "*A collection of timelines and reflections on when we get home*" was created. The book is a collection of students' photos, their timelines, and their reflections. In the book, every student is smiling and proudly holding up their completed timeline with the calculated elapsed time. Student's report of their evening activities uniquely represented a part of who they are. This book became community identity texts in which students projected their identities and, through which teachers and other students could learn more about who those students are.

One of the successful aspects of the lessons was to highlight various strategies to calculate elapsed time. Many students were successful in showing their understanding of hierarchical relationships between hours and minutes. One common strategy was to write down all the time intervals between the starting time and the ending time of each activity (e.g., homework, eating dinner, video game)

and added the elapsed times of each activity as seen in Figure 1 Fariha’s work (all the students’ names are pseudonyms). Another strategy was to use different sizes of intervals (or “jumps” as students called) to visualize the hierarchical relationship between hours and minutes. After calculating hours (bigger jumps) passed from the start time to the end time, minutes (smaller jumps) were calculated (as seen in Figure 2 Jessica’s work). Some students rounded up minutes to the unit of 15 minutes (e.g., 12 minutes were rounded up to 15 minutes), in order to estimate and determine elapsed time.

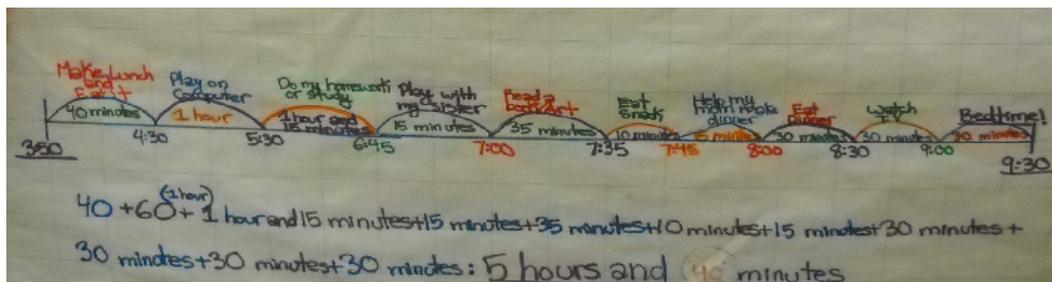


Figure 1. Fariha’s Timeline

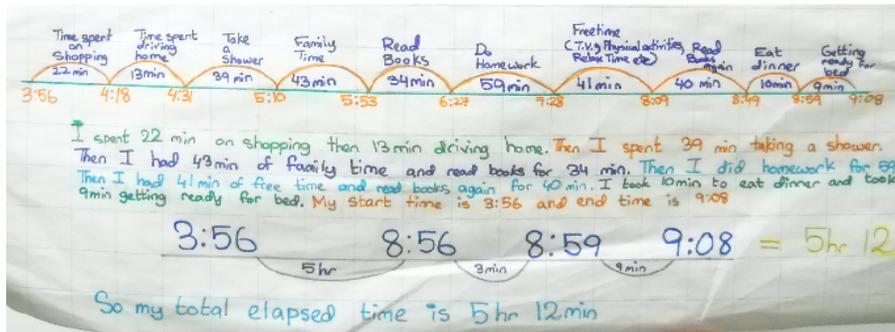


Figure 2. Jessica’s Timeline

All students, including newly-arrived ELLs, participated in this activity. For example, Hassan was one of the newly-arrived ELLs. With the help of a time line, he grappled with the terms and concepts of elapsed time and wrote: “elapsed time: 6 hours 30 minutes - it took me 6 hours 30 minutes to come home and to go to bed”.

The sentence he wrote is not extensive but showed his use of key grammatical rules including tense, use of the to-infinitive (to come home, to go to bed) with a formative subject, “it.” These grammatical rules were acquired along with his emerging understanding of elapsed time. In the book we created, we included all the students’ works. Other students’ works gave ELLs an opportunity to see a variety of how to express elapsed time, which helped expand their linguistic repertoire (e.g., “I spent 39 minutes taking a shower.” “I did my homework for 59 minutes.” as seen in Jessica’s timeline).

In their reflections, students expressed how helpful this lesson was for them. For example, Afra wrote, “making this timeline helped me with adding time and I used to have trouble adding time, thanks to the timeline I don’t have trouble adding time now!” For students, a metaphor of “jumps” in time intervals helped them understand the difference in units of elapsed time. Eila wrote, “I have learned that the jumps in a timeline depend on how much time has passed from one time to another.”

Students also described the importance of estimation. Faced with computational complexities of adding time, students can face difficulties to grasp a realistic sense of elapsed time. To make a complex computation easier, some students started with estimating or computing rounded-up numbers. Ipsa said, “I learned to round it to the nearest tens to make it easier for me.” Considering students were initially facing a challenge in understanding and computing elapsed time, students’ works and their reflections demonstrated their developed understanding on this topic.

Many students reflected how this activity helped them understand their classmates better, including their similarities and differences. Students compared each other’s timelines and listed similarities and differences, using Venn diagrams. Diversity in afterschool activities was a big realization for students and the teacher. As represented in Malikah’s timeline (Figure 3), she devotes a significant amount of time for prayer. It is also noteworthy that her timeline showed that she spent substantial hours for academic tutoring outside the regular classes (she categorized it under “doing homework”). Looking at timelines of other students, I (Robin) wrote, “the timelines help us in the classroom community because we can know each other better and we will have better understandings of each other.” As a teacher, I also appreciated this activity for understanding my students better as stated in my reflection: “I learned so much about my children including recent immigrant students. I had no idea what time they were having a dinner and what their evenings were like – so it was a big ah-hah for me.”

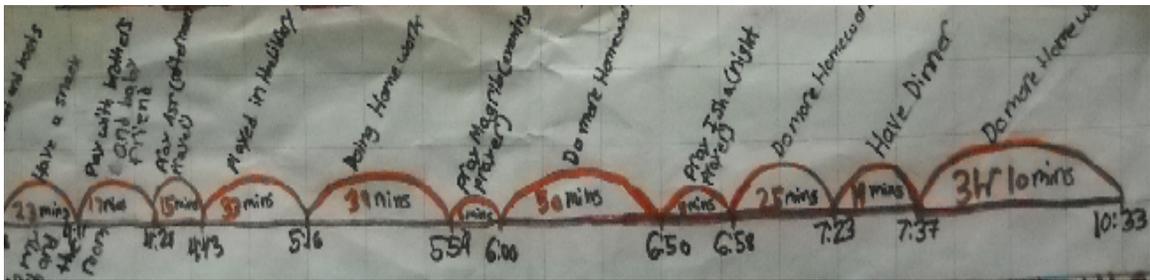


Figure 3. Malikah’s timeline

Conclusion

What we highlighted is how a measurement lesson can be enriched as a tool to promote students’ mathematical understanding and language development, while honouring students’ lives outside the school and their identities. Such pedagogical

approaches address multiple dimensions of learning simultaneously (Figure 4). In the lessons we introduced, students developed a deeper understanding of elapsed time, various strategies to determine elapsed time, along with a better understanding of their classroom community. Students' identities – the sense of who they are - were inscribed in the book created based on the students' time lines. Language learning opportunities were embedded in these measurement lessons. Students came to understand and use the term, elapsed time, and also the patterns of sentence structures used to describe elapsed time. Students described their evening activities in writing, read others' descriptions, and wrote reflections about what they learned through sharing each other's timeline. The seemingly simple question, "What did you do at home, yesterday evening?" can open up multilayered mathematics lessons.

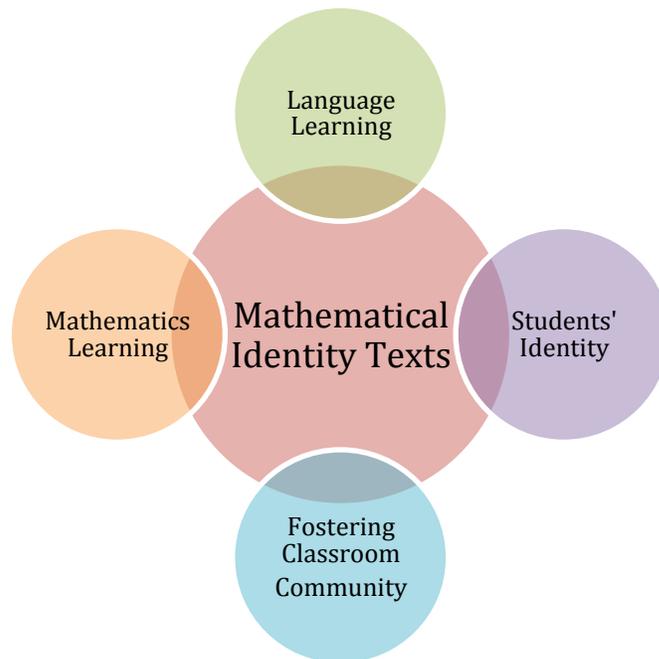


Figure 4. Multidimensional Learning through Creating Mathematical Identity Texts

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