Fostering Emotional Well-being and Resilience through Knowledge Building

Leanne MA[a*] &, Darlene MARTIN[b], & Patricia BERRONES[c]
[a]*OISE/University of Toronto, Canada*
[b]*Halton Catholic District School Board, Canada*
[c]*Colegio San Francisco Javier, Mexico*
*leanne.ma@mail.utoronto.ca

Abstract: Now more than ever, schools need to provide safe and supportive learning spaces that promote all students' socio-emotional development and well-being. The current study investigates how Knowledge Forum can be used to extend classroom learning beyond school walls to enable asynchronous collaboration between two classrooms to foster digital citizenship and intercultural communication skills. Using sentiment analysis, we assessed students' online discussions about family traditions during Christmas and their experiences during the Covid-19 quarantine in the spring. As expected, the Christmas discussion was generally more positive than the Covid-19 discussion, however, the Covid-19 discussion evolved from more negative to more positive. Additional analyses are underway to explore the extent to which magnitude of emotions travel within the community. Preliminary findings are interpreted within the context of designing socio-emotional learning assessments and computer-supported collaborative learning environments as schools move toward a hybrid model for the upcoming school year.

Keywords: Knowledge Building, Knowledge Forum, sentiment analysis, socio-emotional learning, emotional well-being

1. Introduction

Fostering mental health and emotional well-being in schools is a global educational priority (UNESCO, 2016). Consequently, educational researchers and policymakers have developed programs for educating the "whole child" in an effort to simultaneously support the academic, cognitive, psychological, social-emotional development of students (Darling-Hammond & Cook-Harvey, 2018). Such programs recognize that cognition and emotion work in tandem and highlight the importance of developing skills, habits, and mindsets that enable students to successfully self-regulate, engage in interpersonal interactions, persevere in face of challenges, and become resilient to adversity. For example, the Collaborative for Academic, Social, and Emotional Learning (2018) defines socio-emotional learning as "the process through which children understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions." A recent review by Durlak and colleagues (2011) reinforces the notion that socio-emotional learning supports gains in academic achievement.

Despite existing resources and curricula for integrating socio-emotional learning into classroom practices, challenges exist with regards to assessment, including coordinating educational standards, balancing psychometric rigor with practical relevance, and integrating data-informed decision-making into professional learning programs (McKown & Taylor, 2018; McKown, 2019). Because there is no standardized approach for assessing socio-emotional learning, teachers are currently using a variety of methods, including self-report, rating scales, and direct observation. More recent work in the learning sciences point to the potential of machine learning and analytics for assessing the emotional tone and social presence of students in online communities (Zhu et al., 2020). More specifically, sentiment analysis, which uses natural language processing to detect the semantic orientation of written text, has been used to facilitate interpretation of student experiences as means to improve teaching and learning (Munezero et al., 2013; Rani & Kumar, 2017; Hew et al., 2020).

The current study is exploratory in nature and uses sentiment analysis to assess the emotional valence of online discussions between students in Knowledge Forum as means to visualize socio-emotional learning processes that took place before and during the Covid-19 pandemic. Because this work is part of a larger ongoing collaboration between two classrooms to foster digital citizenship through Knowledge Building in the social studies curriculum (Martin & Ma, under review), we focus our analyses on two specific discussions about students' personal experiences – one about family traditions during Christmas and one about their experiences during the Covid-19 quarantine. Knowledge Building (Scardamalia & Bereiter, in press) has been shown to support students' socio-emotional development and well-being. Recent work from Milinovich and Ma (2018) and Zhu and colleagues (2020) demonstrate that there is a strong culture of trust and psychological safety in Knowledge Building classrooms – students' ideas are at the center of social interactions; students' thoughts and experiences are validated by their peers; students take ownership of their learning by taking risks with ideas; and all are invited to extend ideas and integrate diverse perspectives towards deeper understandings. Within the context of social distance education, Knowledge Building pedagogy and Knowledge Forum technology offer a promising way for students to sustain meaningful relationships with their peers by sharing their experiences, empathizing with others' experiences, and rising above superficial differences to acknowledge their shared humanity.

2. Data Sources and Analysis

During the 2019-2020 school year, 51 students in grade 6 (Ontario) and grade 7 (Mexico) studied human impacts on the environment using Knowledge Forum. Working asynchronously online, students wrote over 400 notes across 10 views on plastic pollution covering topics such as, "uses of plastics", "advantages/disadvantages of plastics", "thermoplastics", "bioplastics", and "government legislations for preventing plastic pollution". On average, each student wrote 7 notes and read 27 notes, suggesting they were actively engaged in online discussions in Knowledge Forum. Social network analyses revealed a dense build-on network, with each student holding multiple ties, suggesting that the two classes had formed a cohesive community. For the current study, we conducted sentiment analyses then content analyses on student notes in two views – "Christmas experiences" (53 notes) and "Covid-19 experiences" (28 notes) – using the open-source Text2Data tool, which runs NLP on a pre-trained model based on online product reviews and service feedback. To our knowledge, this is the first time the Text2Data tool is being applied in an educational context, so we will also reflect on the strengths and weaknesses of this tool for educational purposes, especially with young children, in sections to follow.

Figure 1. Knowledge Forum a) view and b) word cloud of discussion about Christmas experiences.
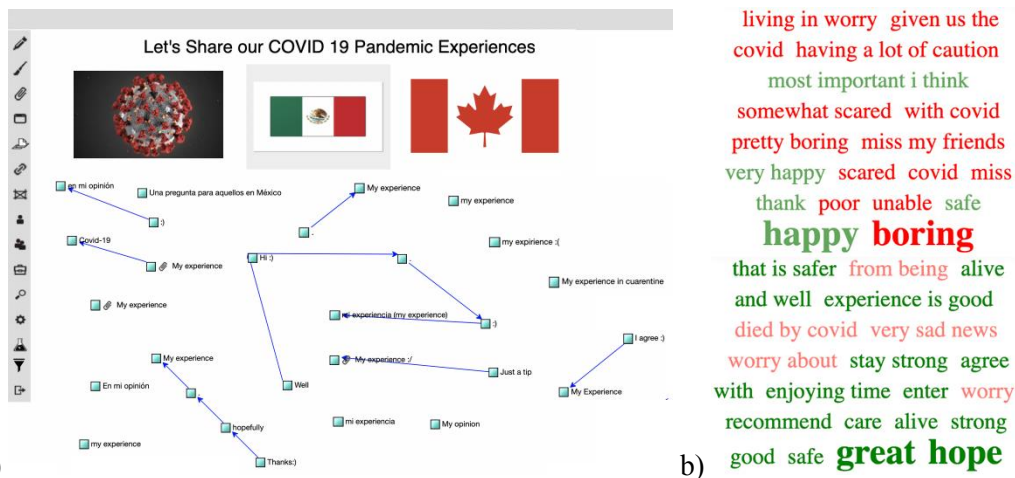
Figure 2. Knowledge Forum a) view and b) word cloud of discussion about Covid-19 experiences.

3. Preliminary Findings

Figure 1 a) shows the Knowledge Forum view about Christmas experiences and Figure 2 a) shows the Knowledge Forum view about Covid-19 experiences. Figures 1b) and 2b) show automated word clouds generated by the sentiment analysis tool, which provide a visualization of the emotional contour for each view based on the distribution of positive sentiments (green) and negative sentiments (red). As expected, it can be seen that the Christmas view was generally more positive than the Covid-19 view because it has a larger proportion of green words than red words, with the opposite being true for the Covid-19 view. The word cloud also visualizes the evolution of emotions within a view (from top to bottom). Therefore, it is interesting to note that while the Covid-19 discussion was initially dominated by negative sentiments, such as fear (i.e., scared), toward the end of the discussion, there was an emergent sense of hope.

In the first Knowledge Forum view, students discussed family traditions during Christmas, which included visiting family and relatives, preparing special meals, decorating Christmas trees, exchanging gifts, playing games, and going to church. Students in Canada and Mexico were equally curious about the winter weather in each other's countries and whether or not it was common for them to have a White Christmas like in the movies. Students in Mexico were especially drawn to this topic because they had never experienced snow before (e.g., "I wish to see a falling snow", "I think that it is so beautiful!"). It is interesting to note, however, that while students were very enthusiastic about this topic, the sentiment tool picked up related keywords as indicating a negative sentiment (e.g., "cool but cold, "cold in Canada"). In the second Knowledge Forum view, students discussed their experiences while in quarantine, which included spending time with family, cooking, exercising, playing games, watching television, and taking online classes. As expected, the discussion in this view was more emotionally charged, as students expressed that they were feeling stressed, sad, and/or scared, bored at home, missing their friends, and generally concerned for their family members – some of which were essential workers and others who were laid off from work. While some students tried to be pro-active by sharing health tips like "wash our hands often", "don't touch our faces often", and "use moisturizer to prevent your hands from being dry", others tried raising morale by saying things like, "Stay safe and stay strong", "It is good that you care about your mother", "I am very happy for the family I have", and "Hopefully this will all be over soon."

Additional analyses are underway to explore the extent to which emotions travel within the community to support learning. Table 1 shows excerpts of student notes from both views as well as their corresponding sentiment scores and magnitude of emotionality. Whereas sentiment scores indicate the overall emotional leaning of the note, ranging from positive (1.0) to negative (-1.0), magnitude indicates the overall strength of emotion within the note (ranging from 0 to infinity). For example, while the sentences "In Canada we celebrate with family and gifts." and "MERRY CHRISTMAS

EVERYONE!" have the same sentiment score (0.58), which suggests that they are equally positive, the magnitude of the first sentence is higher, suggesting that it conveys a stronger amount of emotion than the latter sentence. In a similar way, the sentences "It is good that you care about your mother." and "I'm really starting to miss my friends." have the same magnitude score (0.70), which suggests that they are equally emotional despite conveying opposite sentiments. We hypothesize that magnitude of emotionality in different contexts may demonstrate students' growing ability to express their emotions and regulate socio-emotional processes. To address this, we are developing student profiles based on sentiment analyses and qualitative assessments of emotions using the CASEL (2018) framework for socio-emotional learning.

Table 1. *Excerpts of Students' notes, Sentiment scores, and Magnitude*

Notes about Christmas Experiences	*Sentiment*	*Magnitude*
In Canada we celebrate with family and gifts.	0.58	0.90
How I celebrate Christmas is to be with my family and celebrate the birth of Jesus Christ.	0.54	0.81
I think that it is so beautiful!	0.62	0.81
One of my family's traditions is on Christmas Eve we do a scavenger hunt on Christmas Eve to find clues that will lead to a gift for each of us me and my three sisters that we can open that night.	0.54	0.76
MERRY CHRISTMAS EVERYONE!	0.58	0.73
Christmas in Canada is cool but cold.	-0.51	0.83
One of my Christmas traditions is not eating meat on Christmas Eve so my grandmother makes fish and seafood and it's really good.	-0.56	0.81
With the family of my mom, they do like a dance, and they light fireworks, but I don´t like it.	-0.54	0.66
Here in Mexico it's cold because it's winter but I think it's not so cold like there in Canada.	-0.57	0.75
We have been getting snow for like the past two months, but it has been coming and going.	-0.49	0.58
Notes about Covid-19 Experiences		
I am also really enjoying time with my family and we are spending more time together than ever.	0.54	0.77
I hope we go back to school soon.	0.53	0.74
It is good that you care about your mother.	0.52	0.70
I also always thank for everything I have.	0.57	0.68
I am very happy for the family I have.	0.52	0.60
My experience with this pandemic is that I only stay in my house and I try to do a lot of things to not be bored like exercise.	-0.53	0.85
Hearing about this very sad news makes me sad.	-0.50	0.77
And I am living in worry for my Grandpa, aunt, stepdad, and dad, since my dad and stepdad are police and experiencing COVID 19 first hand.	-0.47	0.76
I'm really starting to miss my friends.	-0.51	0.70
I also worry about her.	-0.54	0.64

4. Discussion

Now more than ever, schools need to provide safe, supportive, and equitable physical as well as digital learning spaces that promote all students' socio-emotional development (CASEL, 2020). The reopening of schools during the Covid-19 pandemic represents an opportunity to adopt evidence-based practices from the learning sciences to redesign schools toward more equitable outcomes. Recommendations include (but are not limited to): ensuring supports for social and emotional learning, strengthening relationships between students, teachers, and parents, and emphasizing authentic, culturally responsive learning (Darling-Hammond et al., 2020).

Digital technologies, like Knowledge Forum, will also continue to play a critical role in extending the classroom beyond school walls so that students may engage in sustained interactions with their teachers and peers over time. For example, asynchronous online learning environments will allow students who are not able to attend school to participate in discussions. Additionally, analytic tools, such as social network analysis and sentiment analysis, can be used to support socioemotional learning through the development of positive peer relationships and a sense of community. In the current study, Knowledge Building/Knowledge Forum was used to connect two classrooms – one in Canada and one in Mexico – to foster digital citizenship and by extension, intercultural communication. By inviting students to share their personal experiences and read about other student's experiences, students came to realize that they had many commonalities despite their age, language, and geographical differences. Although fostering digital citizenship may not be an immediate educational priority during a global pandemic, this study suggests there is possible overlap with socio-emotional learning. Future work can explore how the designs of asynchronous online learning environments can support the coordinated development of these 21st century competencies toward shaping students' identities as engaged, global digital citizens.

The current global pandemic also offers new opportunities for learning scientists to work with teachers and students around the world to re-design online interactions and structures toward productive forms of engagement around ideas and emotions in ways that empower students to take on higher levels of agency for their learning. Design research in classrooms illustrate that grade 3 and grade 6 students can use analytic tools in Knowledge Forum with ease to engage in self-regulation and co-regulation of group processes during Knowledge Building (Ma, Akyea, & Martin, accepted). For example, word clouds that visualize the most common words, have been used by students to promote reflections about "big ideas" in their community knowledge. This study adds that word clouds that visualize positive and negative sentiment have the potential to provide teachers and students with just-in time feedback about their socio-emotional learning processes. For example, notes with high magnitude of emotionality can be used to prompt discussions around empathy and perspective-taking, as well as effective communication and emotional regulation strategies. Additional design research is needed to understand how teachers and students interpret sentiment analysis in meaningful ways, including discussions surrounding its limitations (e.g., How do positive/negative sentiments help us learn? What do neutral sentiments mean? What other emotions have been expressed but are not represented in these visualizations?).

While sentiment analysis offers a promising way to trace the evolution of the socio-emotional dynamics in online discussions, it should be used with caution, especially with young students and students in marginalized groups. McKown (2019) warns that "Any tool, including SEL assessment, can be assimilated into in ill-conceived or harmful purpose, such as inappropriately attributing inequity to the skill deficits of a group". For example, Figure 1b) marks "spoke Spanish" as a negative sentiment even though there was no negative perception of these words from students in Ontario or Mexico. In fact, students in Mexico were teaching students in Ontario certain family traditions and taught them a few Spanish words, such as "abuela" (grandma), "regalos" (gift), and "navidad" (Christmas). Therefore, if sentiment analysis is to be used to support assessment of socio-emotional learning and student well-being in classrooms, NLP models will need to checked for biases and retrained on more representative corpora. Given the rising priority of fostering student well-being and emotional resilience in social distance education, more research is needed at the intersection of the design of socio-emotional learning assessments and computer-supported collaborative learning environments.

References

Blyth, D. A., Jones, S., & Borowski, T. (2018). *SEL Frameworks – What Are They and Why Are They Important?*. Chicago, IL: Collaborative for Academic, Social, and Emotional Learning.

CASEL (2020). *Reunite, Renew, and Thrive: Social and Emotional Learning (SEL) Roadmap for Reopening School*. Chicago, IL: Collaborative for Academic, Social, and Emotional Learning.

Darling-Hammond, L., & Cook-Harvey, C. M. (2018). *Educating the whole child: Improving school climate to support student success*. Palo Alto, CA: Learning Policy Institute.

Darling-Hammond, L., Schachner, A., & Edgerton, A. K. (with Badrinarayan, A., Cardichon, J., Cookson, P. W., Jr., Griffith, M., Klevan, S., Maier, A., Martinez, M., Melnick, H., Truong, N., Wojcikiewicz, S. (2020). *Restarting and reinventing school: Learning in the time of COVID and beyond*. Palo Alto, CA: Learning Policy Institute.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A metaanalysis of school-based universal interventions. *Child Development, 82*(1), 405-432.

Hew, K. F., Hu, X., Qiao, C., & Tang, Y. (2020). What predicts student satisfaction with MOOCs: A gradient boosting trees supervised machine learning and sentiment analysis approach. *Computers & Education, 145*, 103724.

Ma, L., Akyea, T., & Martin, D. (accepted). Students taking charge at the highest levels: Cross-community Eegagement in design mode with Knowledge Forum Analytic Tools. Paper to be presented at 2020 Knowledge Building Summer Institute.

Martin, D. & Ma, L. (under review). Fostering student agency and digital citizenship through knowledge building. Paper submitted to the 2021 Annual Meeting of the American Educational Research Association.

McKown, C. (2019). Challenges and opportunities in the applied assessment of student social and emotional learning. *Educational Psychologist, 54*(3), 205-221.

McKown, C., & Taylor, J. (2018). Introduction to the special issue on social-emotional assessment to guide educational practice. *Journal of Applied Developmental Psychology, 55*, 1-3.

Milinovich, S. & Ma, L. (2018). Promoting student engagement and well-being through community knowledge advancement. In Cukurova, M., Hunter, J., Holmes, W., & Dimitrova, V. (Eds.), *Rethinking Learning in the Digital Age: Making the Learning Sciences Count, Practitioner and Industrial Track Proceedings of the 13th International Conference of the Learning Sciences (ICLS) 2018* (pp. 14-20). London, UK: International Society of the Learning Sciences.

Munezero, M., Montero, C. S., Mozgovoy, M., & Sutinen, E. (2013, November). Exploiting sentiment analysis to track emotions in students' learning diaries. In *Proceedings of the 13th Koli Calling International Conference on Computing Education Research* (pp. 145-152).

Rani, S., & Kumar, P. (2017). A sentiment analysis system to improve teaching and learning. *Computer, 50*(5), 36-43.

Scardamalia, M., & Bereiter, C. (in press). Knowledge building: Advancing the state of community knowledge. In U. Cress, C. Rosé, A. Wise, & J. Oshima (Eds.), *International Handbook of Computer-Supported Collaborative Learning*. Cham, Switzerland: Springer International Publishing.

UNESCO (2016). *UNESCO strategy on education for health and well-being: contributing to the Sustainable Development Goals*. Paris: UNESCO Publishing.

Zhu, G., Teo, C. L., Scardamalia, M., Badron, M. F., Martin, K., Raman, P., Hewitt, J., Teo, T. W., Tan, A. L., Ng, A., Nazeem, R., Donoahue, Z., Lai, Z., Ma, L., & Woodruff, E. (2020). Emotional and Cognitive Affordances of Collaborative Learning Environments. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinarity of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020, Volume 1* (pp. 382-389). Nashville, Tennessee: International Society of the Learning Sciences.