Promoting Student Engagement and Well-being through Community Knowledge Advancement

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Abstract: Promoting student engagement and well-being in schools is a perennial educational challenge. One of the greatest challenges for classroom teachers is to nurture students' intellectual engagement – to help them develop a serious emotional and cognitive investment in their learning. This paper highlights the potential of Knowledge Building – a pedagogical approach that puts students' ideas at the center of classroom activities – to enhance students' intellectual engagement, epistemic agency, and sense of well-being. Over the span of three years, a teacher-researcher team co-designed classroom interventions to advance these goals. In Year 1, we explored how to create a Knowledge Building culture through idea-centered discourse. In Year 2, we explored how to make Knowledge Building pervasive through complex, real-world problems. In Year 3, we are exploring ways to support symmetric knowledge advancement through cross-class collaborations. We conclude by discussing the importance of Knowledge Building for empowering learners' active participation in today's Knowledge Societies.

Introduction

Student engagement is the central driving force of the intellectual life in a classroom. Student engagement can be conceptualized along three dimensions (Dunleavy, Milton, & Willms, 2012): 1) social engagement as meaningful participation in school life through positive connections and relationships, 2) institutional engagement as participation in school activities in order to meet completion requirements, and 3) intellectual engagement as serious emotional and cognitive investment in one's own learning. According to Dunleavy and colleagues (2012), "All types of engagement — social, institutional and intellectual — contribute to valued developmental outcomes for [our] learners. However, when students have opportunities to describe their experiences of engagement, we see that the percentage of students who are intellectually engaged is significantly lower than the percentage of students who are socially and institutionally engaged" (p. 2).

One way to foster intellectual engagement in the classroom is through a culture of sustained inquiry. Inquiry-based learning is a dynamic and emergent process wherein students conduct "open-ended investigations into a question or a problem, requiring them to engage in evidence-based reasoning and creative problem-solving… [with] personally meaningful content and ideas" (Ontario Ministry of Education, 2013, p.2). Research on inquiry-based learning shows that honouring students' questions and ideas increases their motivation, leading to higher levels of engagement, improved understanding, and a love of learning (Chiarotto, 2011).

Knowledge Building represents a community-oriented form of inquiry-based learning. Similar to inquiry-based learning, it starts with students' natural tendency to ask questions and generate theories, but extends to the difficult part of contributing ideas and theories that will advance collective understanding (Scardamalia & Bereiter, 2014). One key principle for fostering a Knowledge Building community is *collective responsibility* for knowledge advancement (Scardamalia, 2002). When students are building community knowledge, their ideas are the main objects of inquiry. The principles of *real ideas, authentic problems*, *idea diversity*, and *improvable ideas* help teachers keep students' ideas at the center of classroom interactions and activities. The principle of *epistemic agency* gives students ownership of their learning so that they themselves are initiating conversations and investigations to test and improve their theories rather than the other way around, which is often the case in inquiry-based learning. Students' ideas can also be improved through *Knowledge Building discourse,* which occurs in both face-to-face and online contexts (e.g., Knowledge Forum). During Knowledge Building discourse, students examine ideas from different perspectives by posing questions, generating theories, and deconstructing assumptions in order to negotiate fit between contrasting ideas and ultimately, convert these tensions into *rise above* theories that hold greater explanatory power. Knowledge Building scaffolds (see Figure 3a) help sustain the discussion so that students are continually building on each other's ideas and improving the coherence of their community knowledge. Additional principles of Knowledge Building include *democratizing knowledge* and *symmetric knowledge advancement*, which aim to facilitate the flow of ideas within and across communities (Scardamalia, 2002).

This paper follows the 3-year journey of Suzana Milinovich, a Knowledge Building teacher in Hamilton, Ontario, dedicated to exploring new classroom practices to enhance her grade 5, grade 6, and grade 7 students'

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intellectual engagement, epistemic agency, and sense of well-being. In each subsection, we provide an overview of the classroom context before describing the pedagogical and technological intervention. We conclude each subsection with student and teacher reflections on how Knowledge Building and Knowledge Forum has transformed their learning experiences.

Year 1: Creating a Knowledge Building Culture

Community knowledge, collective responsibility, Knowledge Building discourse, Democratizing knowledge

Design Challenge

In Year 1, Suzana was teaching a grade 6/7 class consisting 25 students, several with special needs (i.e., Individualized Education Programs). At the beginning of the school year, Suzana gave her students an informal survey which revealed that 88% of her students held a negative attitude towards math, and 85% of her students had low self-efficacy in math. Suzana identified this as her problem of practice and began to explore how to shift the negative learning attitudes and fixed mindsets of her students. Her goal was to use "Number Talks" in math class to "deepen [students'] conceptual knowledge of numbers, and number sense AND to intentionally create a Knowledge Building culture by teaching effective *Knowledge Building discourse* in mathematics."

Knowledge Building Intervention

Given the importance of discourse in collaborative learning (Koschmann, 2013) and knowledge creation (Bereiter & Scardamalia, 2017), Suzana felt that her students would benefit from engaging in "Number Talks" with one another. During the "Number Talks", which took place several times per week, she began to create the community norm that all members ideas would be valued. The whole class would gather at a center table for discussion. She encouraged students to share their math strategies and explain their thinking to one another while solving a number problem. As students discussed, she recorded their responses.

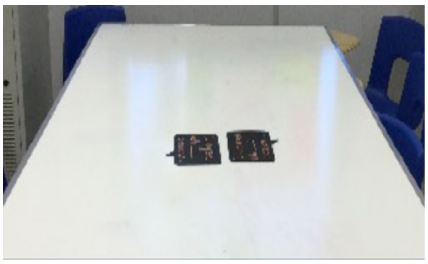
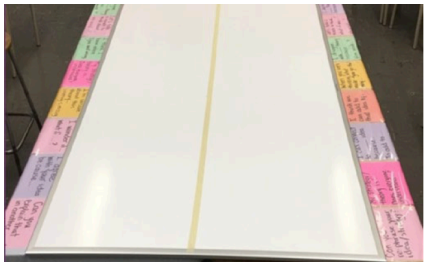
a)  b) 

Figure 1. a) T.O.G.A table before and b) T.O.G.A table after.

Suzana hypothesized that setting the conditions for *Knowledge Building Discourse*, would eventually lead to *Democratizing knowledge*. In order to test this hypothesis, she placed a whiteboard over the center table used for "Number Talks" so that students could make their thinking visible to one another. Little did she know that this small environmental change would lead to the transformation of her class into a Knowledge Building community: Students felt safe to share their ideas, respectfully question each other's ideas, and design KB scaffolds to support their discussions. The students even decided to name this space their "Table of Great Achievement" (T.O.G.A.) Figure 1a) shows the T.O.G.A. table at the beginning, with only two scaffolds: "I agree with [idea]" and "I disagree with [idea]". Figure 1b) shows the T.O.G.A. table at the end, with eight scaffolds added onto each side of the table to support their Knowledge Building discourse. Examples of the new scaffolds include: "My theory," "Can you explain [idea]", "I can add onto [idea]", and "I wonder…". Suzana encouraged her students to regularly reflect on the KB scaffolds that they used during the "Number Talks". Over time, students became increasingly confident with their math skills and empowered to contribute their ideas to the community knowledge. Eventually, Suzana turned over the discussion entirely to her students so that they could freely explore their ideas together. This was a huge turning point for Suzanna – when she finally released her responsibility to her students during the "Number Talks" – because students were taking *collective responsibility* for each other's learning.

Knowledge Forum Support

Knowledge Forum served as the online community space to make student thinking visible and sustain Knowledge Building discourse. Examples of KB scaffolds include: "My theory", "I need to understand", "New evidence", and "Putting our knowledge together" (see Figure 4b). Students contributed their theories into

Knowledge Forum during the day and continued discussions at home. Over the span of a few weeks, students wrote approximately 200 notes across 2 views to discuss their theories on fractions, decimal, and percentages.

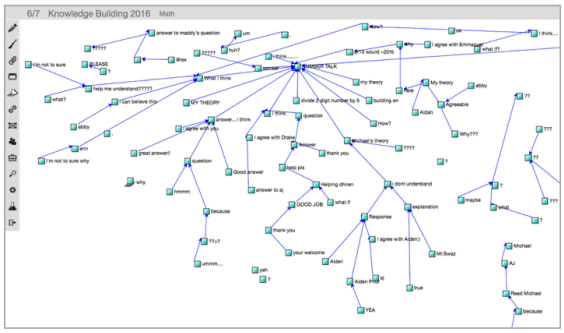
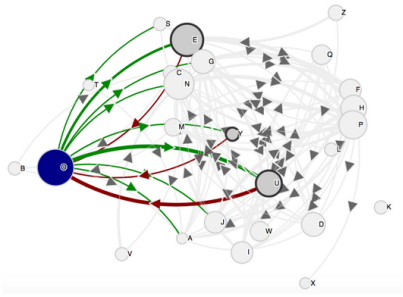
a)  b) 

Figure 2. a) Grade 6/7 Knowledge Forum view and b) Knowledge Forum social network tool.

Figure 2a) shows the discussion surrounding the big question, "How can we figure out 20% of a number?". Students generated many theories and prompted one another to test and refine their theories. Some examples of their decimal theories include: "20% of a number is 20/100 which can be simplified to 2/10 which can be simplified into 1/5"; "100 divided by 20 = 5, so number divided by 5 = 20%"; and "multiply the number by .20. since .20 is the equivalent of 20%, multiplying by .2 will give you 20% of that number". Figure 2 b) shows the social network of the class working in the respective view. Student A, who had a tendency to speak less often at T.O.G.A. than her peers, is represented as the large blue node in the social network. She wrote a total of 13 notes, making her one of the top contributors on Knowledge Forum. The green arrows show that Student A built onto others' notes 11 times, and the red arrows show that others built onto Student A's notes 5 times. It was surprising to see how the conversation dynamics unfolded online for a shy, introverted student like Student A.

Student Reflection

At the end of the intervention, students were interviewed about their Knowledge Building experiences and whether or not they felt Knowledge Forum had supported their learning. Questions included: "What do you like about Knowledge Forum?". "Do you like building onto each other's ideas?", and "Do you feel heard on Knowledge Forum?". The interviews revealed not only shifts in students' attitudes and mindsets, but also shifts in their intellectual engagement toward greater levels of epistemic agency. Below is an excerpt from Student A:

> I like using Knowledge Forum because it gives everyone a chance – like, to feel safe, and it's, like, just explain what they're thinking about the, like, idea… [It's helpful to] see everyone's different theory and strategy of what they actually did… I feel comfortable even if my theory's wrong, putting it up, because it's not an answer that's right or wrong. It's just a theory… Like, I'm thinking in my head, "Can anybody build onto this?" So I post it. And it's like, I want people to build on so I can understand more about it.

Teacher reflection

At the end of the intervention, Suzana was interviewed about her Knowledge Building experiences, particularly what surprised her the most. Below is an excerpt of her reflection:

> [For a while,] students would still try to look to me for confirmation or to make the connection to another student. But as soon as I stepped out… they were happy to take on the leadership. And they were happy to start the discourse without me entirely. So it was at that point I feel as though that was something that I had an "Aha!" moment. From the beginning, I'd say some students were reluctant to share. Their perception of who the expert is in mathematics really came into play. And they were reluctant to share at that point. And soon they started to determine that this -- their perception of a person who was an expert, may not be so. So they began to now pose questions and refine their thinking by asking for advocating and asking for clarification from each other. And really started to understand that they were involved in this learning process, and they were a valuable contributing member to the ideas of this group. And the group can advance with their contribution. And that's the beauty of this model. It is a

reverse-type of model where the students gather, collectively, and start to really think about strategies and what these strategies are. And start to share ideas and generate a few theories. And from that point, then the students refine these theories and decide that they're going to explore these theories in an inquiry-type fashion model. And break out and continue to really start testing the theories. And then they will… reconvene and start to make connections between all of these strategies and the theories they had thought about at the beginning of the lesson. Which is pretty amazing because these students are all actively thinking. Their minds are on… And I feel that this has been a huge advancement for the group's knowledge.

Year 2: Making Cross-curricular Connections

Real ideas, authentic problems, Pervasive Knowledge Building, Knowledge Building discourse, Rise above

Design Challenge

In Year 2, Suzana was teaching a grade 5/6 class consisting 22 students, several newcomers and ESL learners. Suzana attempted to incorporate Knowledge Building across multiple subjects – math, science, and technology – in order to deepen the student engagement and learning in her class. However, robotics activities posed as a stereotype threat for some of her students. It is unfortunate that children enter schools holding clear stereotypes that boys are better than girls at robotics and coding (Master et. al., 2017). These beliefs have a negative impact on student interest and engagement. Suzana identified this as her problem of practice and began to explore how creating a Knowledge Building culture can not only shift attitudes and mindsets, but also gender stereotypes.

Knowledge Building Intervention

Building onto Year 1, Suzana gathered her students at the "Table of Great Achievement" (T.O.G.A.) to foster a sense of psychological safety and build community knowledge together. In addition to the existing set of KB scaffolds along the sides of the table, a new set of scaffolds co-designed by the students were placed at the center of the table along with a microphone to capture their face-to-face discourse (see Figure 3a). Examples of the new scaffolds include: "How do you know this?", "Let's take a moment to think about this…", "Should this be revised?" and "I've changed my thinking…". Since Suzana was also new to robotics and coding, she invited an expert into her classroom to speak at T.O.G.A and help her students with coding their VEX robots (see Figures 3b) and 3c). "Project Innovation" allowed students to gain a deeper understanding of math, robotics, and coding. While initially the boys in her class were more excited to play with the VEX robot than the girls, eventually, everyone became very comfortable with designing their own problems, and building and coding their robots. Students particularly enjoyed coding their VEX robots to draw different shapes and travel along certain obstacle courses. Toward the end of the year, students' ideas extended outside of the classroom, and they invited parents to help them tackle their wicked challenge: "How can VEX contribute to a "clean and green" city?" The students decided to re-design their VEX robots to pick up litter, which involved adding shovels at the front and baskets at the back. Suzana noticed that by allowing students to become the designers of the lessons, they felt empowered to take ownership of their learning at the highest levels. Since the students were the ones making the decisions for next steps on their KB journey, Suzana also learned a lot from following their lead.

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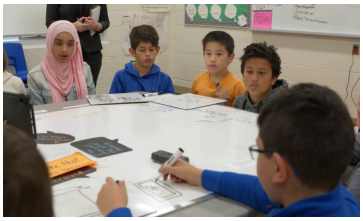
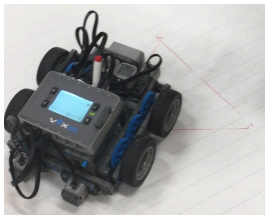
b) 
c) 

Figure 3. a) New scaffolds added to T.O.G.A, b) Students discussing ideas at T.O.G.A, and c) VEX robot.

Knowledge Forum Support

Knowledge Forum served as the online community space to sustain Knowledge Building discourse, as well as facilitate self-organization around *idea improvement* and *rise above*. Over the span of a few months, students wrote over 400 notes across 10 views to discuss their theories on robotics, math, and coding. Figure 4a) shows one of their discussions on robotics, and Figure 4b) shows the scaffolds used in that view. Emergent topics included comparing the relationship between variables, exploring the geometric properties of shapes, mapping coordinates along a Cartesian plane, and discussing strategies for data management and data visualization.

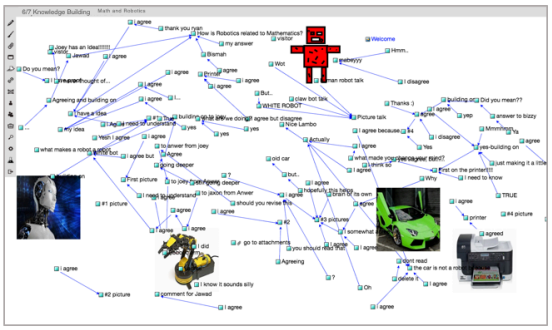
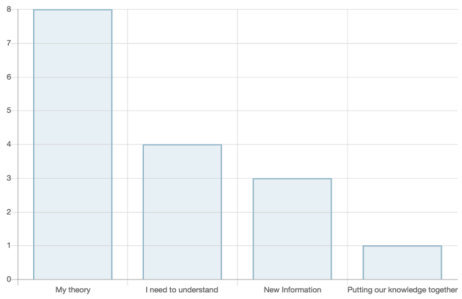
a)  b) 

Figure 4. a) Grade 5/6 Knowledge Forum view and b) Knowledge Forum scaffold growth tool.

Student reflection

On the last day of school, one of Suzana's students – who came from a culture with strict gender roles – wrote her a thank-you card. She reflected on how Knowledge Building has shaped her confidence and well-being:

> I am writing this letter to say thank you. You might be wondering, thank you for what? Well thank you for being the best teacher ever!! You builded my confidence and no other teacher has done that. You've gave me a better understanding of math and other subjects. T.O.G.A. really helped me because in any other class I've been in, the teacher just gives the work and you do it, but T.O.G.A. let everybody share their theory… [The KB scaffolds] help us speak politely and make the conversation more comfortable. So Mrs. Milinovich, Thank You. P.S. Can you PLEASE grade 7 next year?

Teacher reflection

At the end of the intervention, Suzana was interviewed about her Knowledge Building experiences, particularly what surprised her the most. It is interesting to note that when Suzana took a risk with her teaching, it yielded one of her greatest learning experiences. Below is an excerpt of her reflection:

> At first I was very uncomfortable with robotics. I know nothing about robotics. So to take that risk for me was huge. And you know, I believed in these kids. And they brought me along the ride. And I would constantly be referring back the manual, thinking okay, does this make sense? Are they going to get this part? And I so wanted for them to rise above, several times. And they did. And they had different creative ideas on how to build a plow at the front, and then they had a catcher at the back, or how they would take the residual garbage and how it would catch at the back – they amazed me. And I feel like if I hadn't taken that risk, I wouldn't know as much as I do about Knowledge Building and knowledge creation.

Year 3: Designing Cross-community Collaborations

Community knowledge, Democratizing knowledge, Idea Diversity, Symmetric knowledge advancement

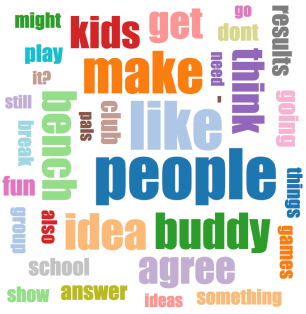
a)  b) 

Figure 5. a) Grade 6 Knowledge Forum view and b) Knowledge Forum word cloud tool.

Design Challenge and Next Steps

In year 3, Suzana is teaching a class of grade 6 students, consisting 23 students – a few students were in her class during Year 2 and a few students are new to the school. Due to a school-wide initiative to promote school inclusiveness, students started the year with designing surveys to collect data from each of the classes to study the school culture and climate. As a result, Suzana extended her Year 2 cross-curricular design by using safety, inclusiveness and well-being as learning goals to weave into various curriculum areas, such as health, social studies, science, and math. Figure 5a) shows the community's welcome view, and Figure 5b) shows the word cloud from their first brainstorming session. Over the next few months, Suzana's students will be exploring the relationships between technology, health, and well-being before connecting with two other classrooms in Ontario to explore the larger question "What role do robots play in society?". Students will be working toward building *community knowledge* while making *symmetric knowledge advancements* on Knowledge Forum.

Discussion

As a longstanding research stream in the Learning Sciences, Knowledge Building has a consistent record of fostering key 21st century skills, as well as knowledge-creating competencies essential for participation in the Knowledge Society (Scardamalia & Bereiter, 2014). The current study emphasizes how Knowledge Building simultaneously develops students' intellectual engagement and sense of well-being. Over the span of three years, Suzana has designed and re-designed classroom practices to shift students' attitudes, mindsets, and epistemic agency. Not only did they take ownership of their learning, they also took risks with ideas. Students collectively identified their knowledge goals and pushed each other to advance their community knowledge. According to Suzana, creating a Knowledge Building culture actually starts with nurturing student well-being:

> Students in a Knowledge Building community really get a sense of understanding and learning… and feel very inclusive as a collective. When I think back to preparing my students for a year of learning at the beginning of the year… you're getting to know each and every one of your students... And you start to imagine the possibilities for them. And so I think that when we look at students in this way and we provide and set the conditions for our learning community, students will truly thrive, and really exceed our expectations as educators. You know, a knowledge-building community will allow students to act as resources to each other. Students will call upon each other, and eventually the teacher role shifts a bit. And really, I see that it's very powerful as an educator in the future, in the upcoming years.

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Acknowledgments

We are grateful to Knowledge Building researchers and consultants, Dr. Monica Resendes, Ahmad Khanlari, Karen Dobbie, Elaine Hine and Denis Maika for their time and support. Their creative ideas and insight have been invaluable to our Knowledge Building.