Taking on the Challenges of Learning in the Digital Age: Grade 5 Students' Mindsets and Strategies in Knowledge Building Communities

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Abstract: The goal of this study is to advance the understanding on the mindsets and strategies that students employ as they deal with the challenges, obstacles, and setbacks inherent in knowledge building communities. In the first iteration of a three-year design based research study, students in four grade 5 classroom knowledge building communities studied human body systems. We collected data on 93 students from peer-interviews dealing with the challenges and approaches that they employed during their inquiry process. Using an inductive approach that examined students' reactions, we identified 247 relevant utterances which we organized and coded. Our first key finding indicates the inter-relation between students' attitudes, beliefs, understandings, and feelings related to their mindsets. Our second key finding shows that students rely on different strategies of an inquiry cycle when they face challenges and setbacks. These results set the stage for further inquiry and design modifications.

Reorganizing education in the digital age

Education in the digital age needs to be reorganized to enculturate creative knowledge practices, which are the new norm in most social sectors (Adams Becker, Freeman, Giesinger, Cummins, & Yuhnke, 2016). As a key challenge, the new model of education needs to provide a way into the knowledge-creating culture for every child, not only the highly engaged learners. Collaborative, inquiry-based programs have been developed to bring authentic knowledge-generating processes and practices, like questioning, into the classroom (Hod & Sagy, 2017). Research has identified productive patterns of inquiry and discourse, with a strong correlation showing that the more students engage in such processes, the deeper understanding they achieve (Zhang, Hong, Scardamalia, Teo, & Morley, 2011). However, the learning sciences still faces a serious gap of knowledge about how to support students who are not actively engaged in such processes. Addressing this challenge requires us to understand the whole child in inquiry-based learning. In addition to investigating the sociocognitive processes of idea development, we need to understand students' socioemotional experiences that may support or hinder their productive engagement. This research attempts to expand the idea-centered foci of knowledge building by examining the different mindsets and strategies that students take when they participate in knowledge building practices. The goal is to understand students' approaches as they face the challenges, obstacles, and setbacks inherent in the knowledge building process and test designs to better motivate and engage all learners.

Challenges and approaches of knowledge building in the digital age

A set of core principles has been identified to characterize the complex dynamic practices that students in Knowledge Building Communities (KBCs) must develop to be productive (Zhang et al., 2011). Students need to take high levels of *epistemic agency* to choose what they want to learn, at what time, and with whom they want to engage in a sustained learning trajectory (Scardamalia & Bereiter, 2014). They must actively *improve ideas*, treating ideas as objects of never-ending refinement in their quality and coherence. Likewise, students must contribute to a culture where *collective responsibility* is a norm, requiring them to stay aware of the contributions of others and contribute in ways that complement those contributions even though they may be working on different inquiry questions (Zhang, Scardamalia, Reeve, & Messina, 2009). Enculturating these types of practices can be a challenging undertaking for any learner.

A great deal of research on KBCs has aimed to elucidate and foster these types of practices among the KBC participants. For example, in their study investigating the epistemic agency of students in four KBCs, Cacciamani (2010) reported on the strategic actions that students took when they engaged in self-organized learning. As part of their examination of the way students continually improved their ideas, van Aalst and Chan (2007) found that portfolios as part of the knowledge building process was effective in fostering inquiry and deeper levels of domain understanding. To foster collective cognitive responsibility, Zhang et al. (2009)

progressively adapted the social structures from fixed, to interacting, to opportunistic groups. While a significant body of knowledge has developed about how to develop the complex practices students need to foster their participation in knowledge building cultures, research has emphasized sociocognitive dimensions of learning. Investigations of learning in KBCs that also take into consideration the motivational and socioemotional aspects of the way students deal with the challenges of knowledge building are needed (Miyake & Kirschner, 2014).

New approaches to fostering students' growth

In recent years, new research directions have emerged which are relevant to the challenge of promoting knowledge building in the digital age, but which have not yet been applied to this line of research. In particular, the notion of fixed and growth mindsets has gained widespread popularity across a number of areas, including organizational psychology, athletics, parenting, and interpersonal relationships (Dweck, 2006). People's views of intelligence as being fixed or incremental and their ability to persist in the face of obstacles and challenges are associated with different learning engagements. People with fixed mindsets are likely to shy away from these challenges, as they threaten to disconfirm their positive views of their own intelligences and/or capabilities. Whereas, those with growth mindsets see challenges as opportunities to learn and grow and therefore are more likely to embrace challenges and persist despite setbacks. This line of research on mindsets is consistent with several other contemporary concepts, such as productive failure (Kapur, 2008), desirable difficulties (Schmidt & Bjork, 1992), impasse-driven learning (Van Lehn, Siler, Murray, Yamauchi, & Baggett, 2003) and research on grit (Duckworth, Peterson, Matthews, & Kelly, 2007), which suggest that persisting in the face of challenges and obstacles is a disposition of highly successful and creative people.

As a pedagogy well-suited for contemporary times that entails having students confront the complex challenges of learning and knowledge creation in the digital age, we contend that KBCs may favor students with growth mindsets, but those with fixed mindsets may face a more significant challenge, particularly in comparison with traditional modes of instruction. To begin our exploration of this contention, and with the aim of better understanding how students deal with the challenges, obstacles, and setbacks inherent in the knowledge building process, this study examines students' mindset-related experiences in four Grade 5 knoweldge building communities. Our research questions include: (a) What types of core attitudes, beliefs, understandings, and feelings do 5th grade knowledge builders demonstrate in line with a growth mindset? And (b) what are the different strategies that 5th grade knowledge builders take to deal with the challenges of knowledge building?

Methodology

The study was conducted in the midst of an ongoing design-based research (DBR) study with the dual aim of advancing theories of learning while contributing to practice-based principles (Anderson & Shattuck, 2012). The general structure of our research program is to implement three progressively refined iterations of a KBC in the context of 5th grade science classes taking place in one elementary school in upstate New York. We are currently analyzing data from four classrooms after the first iteration of the study and here report on our findings thus far. Based on the findings related to our research questions, we will be implementing a refined iteration in four classes during the 2017-2018 academic year, followed by a third iteration in 2018-2019.

We audio recorded, transcribed, and analyzed data from 53 student pair-interviews who signed consent forms for interview analysis (for a total of 93 students), where they were asked to reflect upon their knowledge building processes throughout the year and discuss their answers with each other. During these interviews, students interviewed each other about their 'journey of thinking,' where they faced challenges and obstacles and how they dealt with them, and what advice they would give future students engaged in knowledge building. Based on students' responses to these interview questions, we were interested in examining how the students described the way they dealt with the challenges of knowledge building.

Our data corpus included 247 utterances—defined as meaningful units information about an idea—that related to their experiences and mindsets as knowledge builders. We used an inductive data analysis approach (Hatch, 2002; Strauss & Corbin, 1998), which involved reviewing the data repeatedly in stages of progressive refinement, until their meanings became clear to us and we could organize these utterances into categories. Three researchers coded the data, with an acceptable inter-rater reliability (Cohen's kappa = .87).

Preliminary findings

Our preliminary findings capture a set of core attitudes, beliefs, and feelings assocaite with students' knoweldge building experiences as well as the range of strategic responses that the students took to deal with the various challengse and barriers of knowledge building (see Table 1).

Table 1. Students' reported core and secondary mindsets when faced with the challenges of knowledge building

Growth Mindsets Categories	Examples of Sub Categories	Student Utterances
Core growth mindset (attitude, belief, understanding, feeling)		
Have a positive outlook and be serious about the learning	Work hard Try your best	"Try your hardest, and if it gets hard…"
Understand their will be setbacks in the process	Don't give up Work it out	"Never stop working hard"
Trust or believe that your persistence will pay off	Believe that you will find the answer	"But you just got to keep going and eventually you'll find it"
Enjoy the process despite setbacks	Follow what interests you Find it interesting	"I find it is interesting to me. Do something that you are into."
Strategies to deal with challenges		
Come up with good questions	Pick generative research topics	"Pick an umbrella question - that main question and branch off of that"
Check what authoritative sources have to say	Ask an expert Check resources	"I asked the person studying the same topic as me and they gave me the answer for it"
Gather relevant information	Build up information Make connections	"Start out with stuff that you understand and then excel from that point"
Examine or analyze the knowledge that you find	Do experiments Make a model	"Bring in experiments"
Collaborate with others	Share with others Work together	"We all worked together to solve it"

We refer to the growth-oriented attitudes, beliefs, understandings, and feelings that the students had in regards to the challenges of knowledge building as 'core' growth mindset issues. Each one of these four mindset issues were further broken down in sub-categories (n=17), which were further sub-divided into a number of related utterances (n=96). The actions that students described or suggested to others as part of their mindset strategies were indicative, but secondary expressions of students' mindsets. Like with the core mindset, each strategy was broken down in sub-categories (n=24), further sub-divided into related utterances (n=152).

Discussion

Our goal in this ongoing research is to understand students' approaches as they face the challenges, obstacles, and setbacks inherent in knowledge building communities and test designs to better motivate and engage all learners. Our preliminary results are promising. Overall, we have identified four categories of core knowledge building mindsets and five related strategies after a careful examination of 93 5th grade students.

The core knowledge building mindsets span the attitudes, beliefs, understandings, and feelings that we discovered using an inductive approach to analyze the data. At this point, we cannot correlate students' performance as knowledge builders with the type of mindsets that we have found. However, the existing data indicate that students' reactions to the challenges and obstacles must be examined through a holistic perspective to get a full account of their experience. Students expressed feelings together with their attitudes, understandings, and beliefs, suggesting that these are interrelated. Such findings that are indicative of holistic perspectives are consistent with a wide range of contemporary sociocultural research (e.g., Heyd-Metzuyanim & Sfard, 2012; Herrenkohl & Mertl, 2010).

The strategies, unlike the prior category, appeared to indicate different aspects of research that the students were collectively engaged in. Specifically, their responses corresponded to a model of inquiry along the lines of (1) question; (2) check authoritative sources; (3) gather information; (4) analyze; and (5) collaborate.

Next steps and conclusion

This first stage of research will be followed up with additional analysis steps that will build on our knowledge about the relation between mindsets and KBCs. Specifically, we plan to: (1) Conduct a content analysis to examine the quality of students' knowledge building and how this relates to their core beliefs and strategies that we found during the peer interviews; (2) Take a careful look at students' experiences together with their with fixed or growth mindsets to better understand their knowledge building practices at a fine level of detail; and (3) Repeat this study in iteration two and three, each time with refinements. In iteration two, during metacognitive meetings the teachers will facilitate student-led discussions about the different beliefs and strategies related to facing obstacles that the students employed, as we have discovered thus far at this stage of the research.

To sum, KBCs have reconceptualized classroom practice for over two decades, yet further research is needed to better understand how to continue to support students in the complex transition to participate in knowledge building cultures. Developing growth mindsets and strategies with regards to the challenges, obstacles, and setbacks entailed in authentic knowledge building are one of the most important goals of education in the digital age, particularly as they address the whole student. This study contributes to the endeavor to advance this vital area of research and practice on learning in the digital age.

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