

Knowledge Building and Young Children: Learning Sciences and Early Childhood Pedagogy

Dr Teo Chew Lee
Senior Research Scientist & Programme Director
Learning Sciences & Innovation
National Institute of Education
Nanyang Technological University

Dr Manasi Pande
Research Fellow
National Institute of Education
Nanyang Technological University

It is widely accepted that children learn how to socialize during their preschool years: away from home, they learn how to interact with peers and adults, and they experience new materials in a novel environment. Those who subscribed to Piaget's (1972; 1980) developmental theory agree that preschool children do not have the conceptual structures to reason sophisticatedly. They would then assume that it is developmentally inappropriate to include learning beyond their cognitive level. This aspect of Piaget's theory on preschool thought was challenged by Lev Vygotsky (Vygotsky, 1978 in Wertsch & Tulviste, 1992). Vygotsky explained that a child's real developmental potential should rightfully be determined by the capacity to learn and solve problems under guidance or collaboration with others and their potential and capability should be understood through these social interactions' scaffoldings.

The first five years is a time of enormous cognitive, linguistic and even conceptual capability growth (Walsh et al., 2006). From birth, infants display immense abilities to explore their environments. This view that a child has ideas on how things work and learns from his young peers to construct knowledge stands in stark contrast to earlier views on Piagetian and neo-Piagetian theorists' development.

Though cognitive abilities can typically be understood in developmental stages, advances need not be limited by age. In the same vein, young children should not be seen as passive receivers of knowledge. Instead, our experience tells us that when we actively engage a child, we notice how quickly a child learns, picks up our cues and responds to stimuli. These observations and experiences present substantial implications for learning opportunities and early childhood pedagogy. Many a time, the child's learning is limited by the imagination of the adults. We have read of how

nurturing and trusting parents have supported the development of children with learning disabilities to achieve great things in life. Yet very often in other cases, even as we notice the child's immense potential, we quickly revert to our biases influenced by the developmental theory that the child cannot go beyond the developmental stage that defines him.

Research has challenged the common notion of what young children can do by suggesting that children as young as four years old can learn a great deal when they are in supportive environments (Pelletier et al., 2006). How children respond to opportunities and interactions for learning suggests the potentially important role that preschool programmes play in supporting independent learning and developing creativity.












Knowledge Building (KB) is an educational theory and approach that places greater emphasis on collaboration rather than the individual acquisition of knowledge (Scardamalia & Bereiter, 2010). KB seeks to engage learners in knowledge creation. Through such an approach, students own the learning, outcomes and processes; teachers become partners in learning.

What is Knowledge Building: Building Principles

KB pedagogy focuses on supporting children's natural curiosity. The pedagogy centres on bringing children's authentic ideas and questions into the work of the class so that the children establish more meaning in their learning. As a result, the class would go beyond the curriculum. At the heart of KB practice in the context of early childhood is the notion that authentic, collective creative work with ideas is possible with young children if provided with the right support and conducive environment. KB pedagogy is undergirded by twelve interacting principles on knowledge creating community.

Figure 1

Knowledge Building Principles (Scardamalia, 2002 in Resendes & Dobbie, 2015)

 Real Ideas, Authentic Problems Knowledge problems arise from efforts to understand the world. Ideas produced are as real as things touched and felt. Problems are the ones learners care about — usually very different from textbook problems and puzzles.	 Improvable Ideas All ideas are treated as improvable. Students work continuously to improve the quality, coherence and utility of ideas. This requires a culture of psychological safety so that people feel safe taking risks — revealing ignorance, voicing half-baked notions, giving and receiving criticism.	 Idea Diversity Just as biodiversity is crucial to the success of an ecosystem, so is idea diversity to knowledge advancement. To understand an idea is to understand the ideas that surround it — including those that stand in contrast to it.
 Epistemic Agency Students take responsibility for their ideas by determining the learning outcomes, processes, and the accompanying challenges. Students engage in negotiation and dialogue to fit personal ideas with others.	 Democratizing Knowledge The creation of knowledge is not confined to a few. Instead, all are empowered to create and are recognized as valid contributors to advance community knowledge.	 Pervasive Knowledge Building Knowledge Building is not confined to particular occasions or subjects but pervades mental life.
 Rise Above Creative Knowledge Building entails working towards higher-level forms of problems. It means learning to work with diversity, complexity, and messiness. By moving to higher planes of understanding, Knowledge Builders transcend oversimplifications.	 Symmetric Knowledge Advance Expertise is distributed within and between communities; community members understand that “to give knowledge is to get knowledge.”	 Knowledge Building Discourse The power is in the discourse — in collaborative interchanges that lead to better solutions, better explanations, and better ways forward.
 Embedded, Concurrent & Transformative Assessment Assessment is part of the effort to advance knowledge — it is used to identify problems as the work proceeds and is embedded in the daily workings of the organization. The community engages in its own internal assessment, which is more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expectation of external assessors.	 Constructive Use of Authoritative Sources To know a discipline is to be in touch with the present state and growing edge of knowledge in the field. This requires respect and understanding of authoritative sources, combined with a critical stance toward them.	 Community Knowledge, Collective Responsibility Contributions to shared, top-level goals of the organization are prized and rewarded as much as individual achievements. Team members produce ideas of value to others and share responsibility for the overall advancement of knowledge in the community.

Images from Knowledge Building Community. Introduction to Knowledge Building. Retrieved from: www.kbsingapore.org/12-principles-of-kb/

Instead of dictating step-by-step procedures for teachers and students to follow, the principles translate into guiding questions and reflection tools to help teachers rationalise their moves and plans. The pedagogy looks towards a collective effort to explore and to learn more about the topic. In KB, students are responsible for improving their ideas and advancing the community's ideas and knowledge. It is the children, supported by teachers and adults, who are expected to increasingly take on the responsibilities of questioning, exploring and seeking information (Bereiter & Scardamalia, 2014). The focus is on collective effort. This essence of KB marks the distinction between KB and other educational approaches.

KB Principles and Play Pedagogy in Early Childhood

KB differs significantly from the knowledge-telling approach in traditional classrooms, which typically occurs in the following sequence: teacher initiates questions - students answer - teacher evaluates and elaborates on students' answers. Instead, KB engages students in collaborative improvement of ideas. KB pedagogy premises on authentic, creative work with ideas and it starts with the youngest students.

According to the Ministry of Education's (MOE) most recent curriculum framework for early childhood education, Nurturing Early Learners (2012), the role of preschool education is to nurture children as “co-constructors of knowledge”, provide “authentic learning through quality interactions” and to facilitate a child's development into a confident person, self-directed learner and active contributor (MOE, 2012).

The four most relevant principles that define KB pedagogy are aligned with the MOE's kindergarten curriculum framework, vis-à-vis the learning areas and the learning dispositions as shown in Figure 2 below.

Figure 2

Alignment of the KB principles with the Curriculum Framework for Kindergartens in Singapore

	KB Principle	What the KB principle means to the teacher	Kindergarten Curriculum Framework
1	Real Ideas, Authentic Problems	Students explore problems about the world around them; these are problems initiated by themselves and those they really care about.	<u>Learning area:</u> Discovery of the world <u>Learning disposition:</u> Engagement; Sense of wonder and curiosity

	KB Principle	What the KB principle means to the teacher	Kindergarten Curriculum Framework
2	Idea Diversity	Students explore different ideas. They feel safe sharing half-baked ideas.	<u>Learning area:</u> Aesthetics and creative expression; Language and literacy; Social and emotional development <u>Learning disposition:</u> Inventiveness; Appreciation
3	Improvable Ideas	All ideas are treated as improvable, and students work to improve the quality of their ideas.	<u>Learning area:</u> Language and literacy; Social and emotional development <u>Learning disposition:</u> Perseverance
4	Rise-above	Students work with different ideas and viewpoints and attempt to move towards new and better ideas. They aim to learn more.	<u>Learning area:</u> Language and literacy; Social and emotional development <u>Learning disposition:</u> Reflectiveness

Another common pedagogical approach used in early childhood education which is also adopted by Singapore Kindergartens' curriculum framework is "engaging children in learning through purposeful play" (also known as "learning through play"). According to Dietze and Kashin (2019), play is a self-initiated, intrinsically motivated activity. It involves spending time building new knowledge from prior experiences, and is a process, not a prearranged outcome. This principle of learning through play is also much aligned with the principles of KB pedagogy and here we teased out ways in which KB might value-add to the current practice of learning through play:

- KB pedagogy encourages exploration of ideas that drive young children's KB efforts. For example, children are encouraged to explore ideas related to real-world problems by exploring "why do we need to recycle?" and not just "what are the recycling activities?" Other example of questions that came from students are "is cloud a system?" "Do trees have lungs?"
- KB pedagogy focuses on the joy of working together, discovering that the more you know, the more you do not know; giving everyone an equal chance to contribute and learn.

- KB practice understands that learning is not so much a matter of getting the right answer as putting the pieces together to make sense and valuing the class learning as much as an individual's own learning.
- KB pedagogy centers on representing students' ideas and knowledge in words, in drawings and making ideas visible to the class. Such visual representation of ideas motivates the whole class to further develop the ideas, leading to idea growth.

The Teacher's Role in KB Pedagogy

In a KB classroom, duties that were traditionally reserved only for the teacher, such as creating and setting knowledge goals, assessing progress and the next steps forward, revisiting questions and revising strategies and so on, are handed over to the students as much as possible (Bereiter & Scardamalia, 2014).

Nevertheless, it is critical to highlight at this juncture that KB teachers are not simply "letting go" or letting the students struggle on their own. On the contrary, teachers work hard to scaffold the learning process. Some common strategies adopted by KB teachers to assist them in the scaffolding include listening to ideas and questions, supporting, modeling, designing, and planning for knowledge building to happen. Experienced KB teachers shared their common strategies: (a) they devised ways to stop themselves from giving the answers and talking more than the students; (b) they valued the children's ideas regardless of how silly the ideas sounded, so long as they felt that the children were genuine about the ideas; and (c) they found all ways to scribe and archive ideas and questions. All these strategies take time and tenacity to implement in class. They require constant practice. Hence, instead of labeling KB as a teaching and learning strategy, it may be more appropriately regarded as a culture: a habit or practice that thrives over time with cultivation.

A KB Classroom in Action: The Food Wastage Project

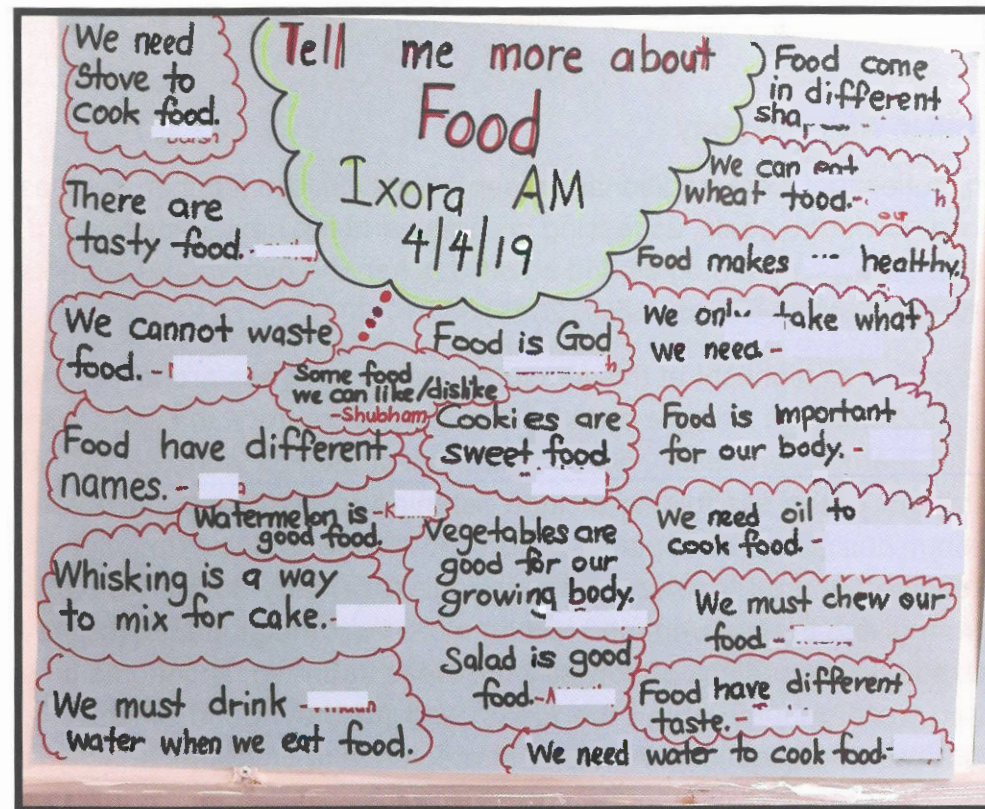
The case study of Teacher Sandy working with a group of K2 students on food wastage which is framed under the bigger theme of "environment" demonstrates the value of KB pedagogy. More importantly, this case study allows us to appreciate the possibilities and potential of how young children grow and develop their ideas.

Taking Time to Decide on the Direction of the Inquiry

At the initial stage, Teacher Sandy encouraged the students to share ideas about "food". She scribed all the ideas and questions and embraced all possible directions the inquiry questioned at this point in time (Figure 3). Her focus at this stage was for the children to understand that they were in control of their learning and their own experiences. Sandy reflected that ideas about food were relatively intuitive and naive

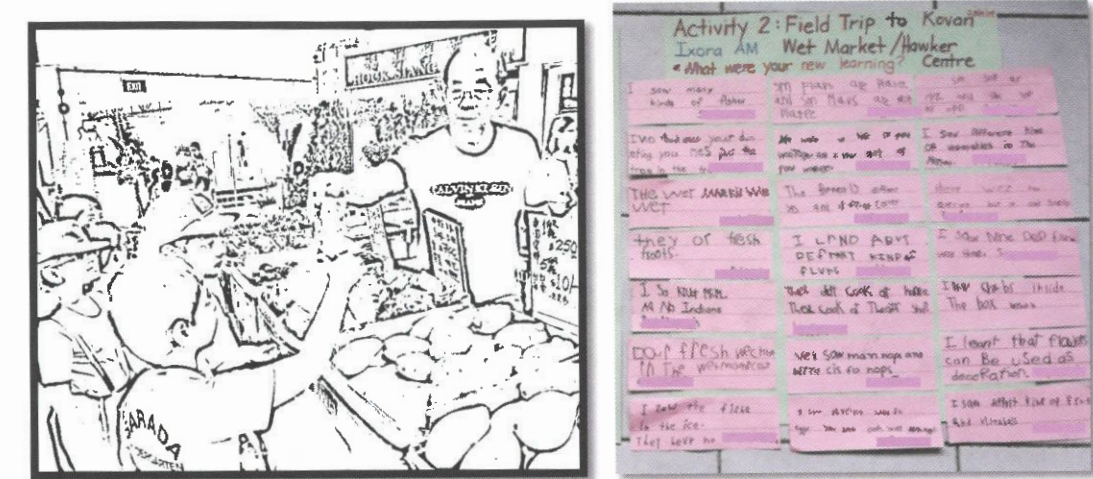
Figure 3
Scribing Children's Thoughts on their Knowledge about Food

Figure 3
Scribing Children's Thoughts on their Knowledge about Food



After the teacher piqued the children's curiosity and interest in the topic at hand, it was time for students to start generating ideas about the theme. Children went on a field trip to the Kovan wet market and hawker center. Later, they scribed their learnings from the trip and shared those with another class. At that point, the teacher paid special attention to questions, suggestions, or observations that arose. She continued to scribe those ideas on chart paper, and the class walls were filled up with the students' unadulterated questions and ideas.

Figure 4
Children go on a Field Trip to a Hawker Center (left) and a Wet Market and later share their learnings with Another Class (right)



At this point in time, the students had already come up with a pool of questions, ideas, and information which was displayed all over the classroom. They sat down for a KB talk. In this KB talk, students were given wooden blocks and they were told that each block represented an idea and that they had to share two precious ideas. This strategy aimed to help students understand the notion of sharing and building in two ways: first, to heighten students' grasp of an "idea" and second, to help them appreciate the need to "share an idea" using wooden blocks to represent their ideas.

Whenever the child listened carefully and gave related ideas, not just any idea they fancied, they got to place the block close to their friend's block. In that way, the blocks (ideas) came together as something bigger than individual blocks. Through the KB talk, the children began to understand the act of building ideas towards something bigger than the sum of individual ideas. The teacher supported consolidation and elaboration of facts by distilling a few common ideas and questions. Finally, the children agreed on the two questions: (a) what happens to the food waste? And (b) how to have zero food wastage? The students decided that they needed to answer both the questions as both were inter-connected.

Figure 5

A KB Talk in Progress that Helped Children Connect Different Ideas



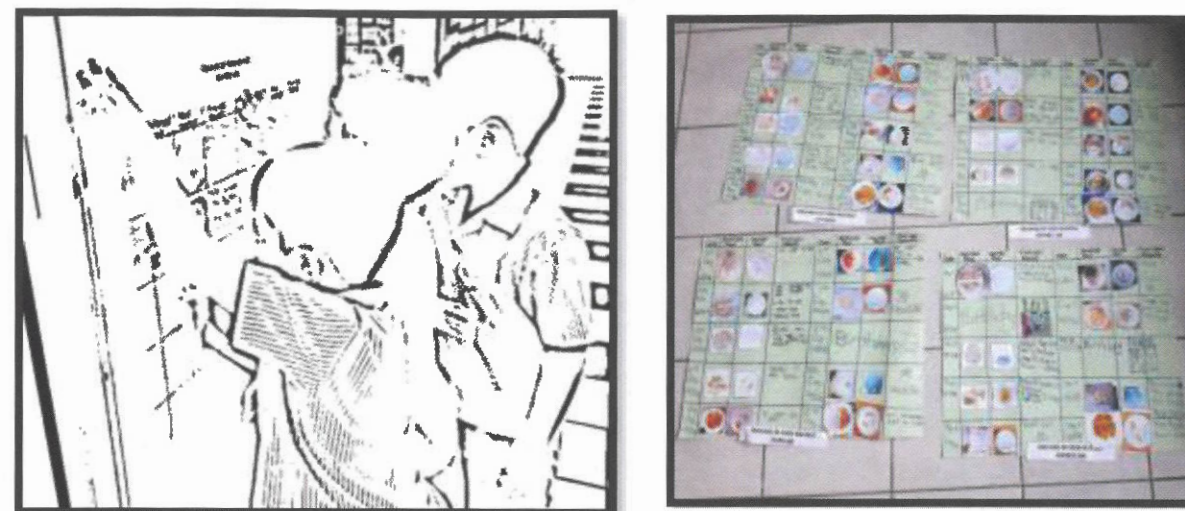
New Information, New and Conflicting Ideas

With the renewed conviction of the collective inquiry, the children started to wonder how they could get the information that they needed in order to find out more about food wastage in school. The teacher brainstormed with the children on what was the best way forward, and the children came up with the following three things to do:

1. They decided to interview Uncle Jon who brought them lunch every day because they supposed that Uncle Jon could help them solve their problem.
2. They decided to track food wastage for two weeks in the K2 classes, including their own class. They also figured that their tracking should exclude classes with birthday celebrations because that would not reflect the class' real food waste.
3. Finally, they would also like to find out what happened to food waste in Singapore and other countries by consulting books, YouTube videos, Google search, and parents. The teacher supported the children to come up with a tracking chart to track the food waste and the leftover food in the K2 classes. To achieve that, they realized that they needed to seek permission from the other K2 teachers. So, they explained their project and asked for permission from the respective teachers. Through this activity, the children also understood that it was necessary to value and respect other people's decisions.

Figures 6a and 6b

Children Conducting Tracking Activity (left) and their Tracking Chart (right).



In the interview with Uncle Jon, the children realised that in addition to wasted food, leftover food that was not served also contributed to food waste. The children then re-planned their tracking chart as they only had a column for wasted food initially but later on, they needed to track the leftover food too. The children planned their tracking chart and took pictures of the wasted and leftover food to track food waste for five days (Figure 6b). The children later requested to interview their vice principal, as they wanted to see if they could convince the vice principal to order less food for the classes.

Effort to Save Food Beyond our Class.

As the children grappled with their own food waste problem, they became interested in food wastage in other countries. They suggested using the Google search engine to find answers to those questions. The children also brought many books from the library on food wastage and they had a sharing session in class. A field trip to a food pantry was also planned. The children asked the person-in-charge of the food pantry many questions such as: "Why can't vegetables be donated?" "What is the difference between expiry and best before date?" "What is the importance of having different coloured tags for the bread? Can anyone come to ask for food in the food pantry and the foodbank?" The teacher later heard from one of the parents that her child questioned why she needed to buy two cans of food when the family only needed one. The parent was pushed to admit that she bought it because the items were on sale. The parent was surprised at how the child reasoned with her on her purchasing habit.

Pulling the Knowledge Together and Making a Change.

The children understood their contribution to food wastage. The class decided to reduce their wastage by getting everyone to share their food before they started eating so that the food would not be wasted. They successfully did this for weeks.

Figure 7

"We have to change too!" Children figuring out how to reduce food wastage in their class. They decided to share the food before they eat them so that all could finish up the food.



Spreading the Message

The children also created posters for K2 classes as a constant reminder to not waste food. To wrap up their learning, the children took a pledge to reduce food wastage. They came up with their own words and ideas for the pledge.

Figure 8

Children Making their own Pledge through Posters:



Challenges in the KB Process

One of the biggest challenges in this project was sustaining the KB talk to get the "big idea". During the first KB talk, children had various questions that they wanted to explore. Discussing each question and identifying the most important one became challenging and long-drawn (the process took more than an hour). As a result, the teacher decided to vote and selected two most popular questions out of the 21 questions.

KB discourse is not something that comes naturally or easily to most people, let alone children. Not all children were willing to ask questions initially. It took time and practice before the children could engage in discourse. There were many instances when the teacher had to take time to invest in each question. That was challenging as the teacher did not want to give them the answers directly and could only prompt them to elicit the responses or solutions from them. The teacher's efforts were worthwhile as that created a safe environment for the eager children to understand that all questions were valid and would be honored.

Significance of KB in Current Times

The COVID-19 pandemic has resulted in educators across the world creating a new context for education. Teachers are faced with little choice but to seek new ways to do things differently and flexibly to meet students' emerging needs. This kind of emerging situation is exactly what KB pedagogy sets out to prepare us to do on a day-to-day basis. In such a situation, an educator's notion as the knowledge-holder who imparts wisdom to his pupils is no longer fit for a 21st century education. With students being able to gain access to knowledge and even learn a technical skill through a few clicks on their electronic devices, we will need to redefine the educator's role in the classroom. This may mean that educators' role will need to facilitate young people's development as contributing members of society – a role like theirs in KB pedagogy.

Moreover, children may need to continue to develop skills for learning outside of the regular learning environment for quite some time. For younger age groups, parents will probably have to step up and help support the teaching role. Providing parents with some KB resources such as how to support learning through play or using real-life opportunities to stimulate their curiosity is now important. By connecting learning opportunities to places in the community or home in tangible ways, children can learn beyond the confines of the classroom. Teachers and educators are also beginning to co-design KB resources for parents to engage with their children at home.

Conclusion

The knowledge economy needs creative, communicative, collaborative people who are committed towards public good. These are skills that children may acquire through knowledge building practices since KB emphasizes the concept of community and

around them. As educators, we must continue to cultivate a classroom environment where curiosity and wonderment are valued and where to give our children the opportunities to work with problems and issues that are meaningful to them. This crisis offered us a unique opportunity to rethink education and focus on what is most beneficial for our children in the long run.

References

- Bereiter, C. & Scardamalia, M. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In S.C. Tan, J. Yeo (Eds.), *Knowledge Creation in Education* (pp. 35–52). Springer.
- Ministry of Education Preschool Curriculum (2012). *Nurturing Early Learners – A Curriculum Framework for Kindergartens in Singapore: A Guide for Parents*. Singapore Ministry of Education. Retrieved May 24, 2021, from <https://www.moe.gov.sg/education/preschool/>
- Pelletier, J., Reeve, R., & Halewood, C. (2006). Young children's knowledge building and literacy development through Knowledge Forum®. *Early education and development*, 17(3), 323-346.
- Piaget, J. (1972). Intellectual evolution from adolescence to adulthood. *Human development*, 15(1), 1-12.
- Piaget, J. (1980). The psychogenesis of knowledge and its epistemological significance. In Massimo Piattelli-Palmarini (ed.), *Language and Learning: The Debate Between Jean Piaget and Noam Chomsky*. Harvard University Press. pp. 23–34.
- Resendes, M., & Dobbie, K. (2015). *Knowledge Building Gallery*. Retrieved from <http://thelearningexchange.ca/pdf/knowledge-building-gallery>, 1 Oct 2020.
- Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in a knowledge society: Chicago: Open Court* (pp. 67–98). Retrieved from: <http://iikit.org/fulltext/2002CollectiveCog.pdf>
- Scardamalia, M., & Bereiter, C. (2010). A brief history of knowledge building. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie*, 36(1), <https://doi.org/10.21432/T2859M>

- Vygotsky, L. (1978). Internalization of Higher Psychological Functions. In Cole M., Jolm-Steiner V., Scribner S., & Souberman E. (Eds.), *Mind in Society: Development of Higher Psychological Processes* (pp. 52-57). Cambridge, Massachusetts; London, England: Harvard University Press. doi:10.2307/j.ctvjf9vz4.9
- Walsh, G., Sproule, L., McGuinness, C., Trew, K., Rafferty, H., & Sheehy, N. (2006). An appropriate curriculum for 4–5-year-old children in Northern Ireland: comparing play-based and formal approaches. *Early Years*, 26(2), 201-221.
- Wertsch, J. V., & Tulviste, P. (1992). LS Vygotsky and contemporary developmental psychology. *Developmental Psychology*, 28(4), 548-557.