Capacity Building Series

SPECIAL EDITION #27

The Third Teacher

Designing the Learning Environment for Mathematics and Literacy, K to 8

Thinking about the learning environment ...

"Look at your learning space with 21st century eyes: Does it work for what we know about learning today, or just for what we know about learning in the past?"

Sir Ken Robinson
The Third Teacher (2010)

Imagine the ideal learning environment for today's learner. What would it look like? Think about how much the world has changed in the last three decades and how rapidly it will continue to change in the years to come. How do we ensure that the instruction we provide is responsive to the shifting demands of the 21st century?

Researchers and practitioners in a wide range of disciplines – early childhood and developmental education, psychology and cognitive science, school architecture and design – maintain that the key to learning in today's world is not just the physical space we provide for students but the social space as well (Fraser, 2012; Helm et al., 2007; OWP/P Architects et al., 2010). The learning environment, they suggest, is "the third teacher" that can either enhance the kind of learning that optimizes our students' potential to respond creatively and meaningfully to future challenges or detract from it. Susan Fraser, for example, writes:

> "A classroom that is functioning successfully as a third teacher will be responsive to the children's interests, provide opportunities for children to make their thinking visible and then foster further learning and engagement." (2012, p. 67)

Many futurists highlight the importance of innovation, entrepreneurship and creativity in an age of globalization and rapid technological development; others emphasize the importance of communication skills and critical thinking. All concur that developing high levels of literacy and mathematical proficiency will be foundational for success – the focus for this monograph.

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A place for wonder, mystery and discovery ...

"We need to think about creating classroom environments that give children the opportunity for wonder, mystery and discovery; an environment that speaks to young children's inherent curiosity and innate yearning for exploration is a classroom where children are passionate about learning and love school."

(Heard & McDonough, 2009)

Getting Started with the Physical Environment

OVERALL ...

It is both an art and a science to design (as opposed to decorate) a learning environment that responds to our ultimate goal as educators – to develop independent and rigorous thought. Therefore, if we want to foster discovery and reflection, dialogue and the sharing of ideas, the overall physical environment should include:

- A large gathering space for whole-group work and discussions, located near whiteboards, easels and/or projector screens.
- A gathering space for small-group and whole-group discussions – where students can see clearly the representations of learning that are posted on boards or screens and hear classmates as they share ideas.
- Flexible and reconfigurable space for small-group collaborative work and inquiry – space must allow for groupings of various sizes, such as pairs, triads and groups of four or more.
- Desks and tables configured to facilitate discussion by allowing eye contact with peers and teacher, the unencumbered flow of traffic and enough space for students to write collaboratively.
- Active areas for inquiry, investigation and wonder and quiet areas for thinking and exploring technology – all areas need to be accessible to students for communicating and documenting their own learning (e.g., computers, computer software, tablets, digital cameras and video recorders, document cameras, interactive white boards).
- Instructional materials organized in such a way as to provide easy selection and access for all students – materials may include computer software, educational web sites and applications, found materials, graphic organizers, newspapers and other media, resource texts, etc.

FOR MATHEMATICS ...

Mathematically literate students demonstrate the capacity to "formulate, employ and interpret mathematics" (OECD, 2012, p. 4); they view themselves as mathematicians, knowing that mathematics can be used to understand important issues and to solve meaningful problems, not just in school but in life. By extension, the physical environment for mathematics learning should include:

- Spaces where students can use manipulatives to solve problems and record their solutions.
- Board and/or wall space to display student solutions for Math Congress and Bansho – student solutions should be easily visible from the group gathering space.
- Space to post co-created reference charts such as glossary terms and past and current summaries of learning that specifically support the development of the big ideas currently under study.
- Instructional materials organized in such a way as to provide easy selection and access for all students; may include mathematics manipulatives, calculators and other mathematical tools, mathematical texts, hand-held technology.

FOR LITERACY ...

Today's literate learners experience "a constant stream of ideas and information" – they need strategies for interpretation and making sense and lots of practice in identifying meaning, bias and perspective (Ontario Ministry of Education, 2009, 2006). By extension, the physical environment for literacy learning should include:

- Spaces where students can talk, listen, read and write.

- Board and/or wall space for co-constructed documentation, anchor charts, shared writing texts, student-generated inquiry questions, etc.
- A variety of learning materials that are "found" and often contributed by students and families themselves along with commercial materials that are relevant to the students' learning
- Central writing storage area with a variety of authors' writing and publishing supplies – along with reference materials like dictionaries, thesauruses, etc.
- Clipboards and other writing materials located in various areas where students work to allow for writing and recording of thinking
- A well-stocked, co-constructed classroom library with a variety of text forms, genres and text levels – organized and labelled; selections should be changed on a regular basis according to students' needs, interests and what they are thinking about at a given time.

Designing the Social Environment

KEY COMPONENTS FOR MATHEMATICS AND LITERACY LEARNING ...

Learning is both an internal process of assimilating new information and a social process of discussion and negotiation. Cross suggests that we need to integrate both in the design of learning environments that optimize learning (2009, p. 906). Other education researchers concur, emphasizing that knowledge is constructed through engagement both with ideas and with others. Crick et al. (2007) propose that in order to create a learning environment that builds learning power a teacher must create positive interpersonal relationships, honour student voice and encourage perspective taking.

Key components of a rich learning environment are identified below, with some suggestions for classroom practices that support today's learners.

1. Empower student learning through collaboration.

When students have a sense of belonging and safety within a community of learners, they are empowered to take risks and explore new ideas. This happens best within a collaboratively established structure. Students are invited to think about and co-create norms for how they interact with each other. These norms, stated in the students' own words, help students take responsibility for their learning and the learning of their classmates. They might include:

- We will listen carefully to what others are saying with the goal of understanding their thinking and reasoning.
- We will share our strategies and ideas to contribute to the understanding of others.
- We will take turns and make sure everyone else has a turn and participates.
- We will respond to the ideas of others with respect and with interest (for example, by asking a question about a solution or strategy, making a suggestion for a more efficient way to solve a problem or rephrasing to clarify).
- We will disagree with respect, by giving our reasons for not being in agreement. Our comments and questions will be focused on the mathematics or literacy learning, not the person.

Where all learners can make progress ...

"All students and teachers can learn significant mathematics within a nurturing environment, given sufficient time, developmentally appropriate goals, well-considered learning materials, and strategic program, instruction, and assessment."

(Literacy and Numeracy Secretariat, 2007)

A community for building understanding ...

"The community provides an environment in which individual mathematical ideas can be expressed and tested against others' ideas … This enables learners to become clearer and more confident about what they know and understand."

(Fosnot, 2005, p. 10)

2. Give weight to student voice through dialogue.

When engaging students in dialogue, we give their voice the weight required for them to develop critical thought as they clarify, articulate, justify and synthesize their ideas. Dialogue involves responding to others' ideas, sometimes in agreement, sometimes not. It is in this "bumping of ideas" that students' knowledge and understanding will grow. As teachers, we support this process by inviting different students to contribute and to rephrase what others have said. Sometimes the teacher will "revoice" students' contributions to help the progression of the dialogue.

Dialogue occurs among *all* members of the learning community; students talk back and forth with each other, not just in response to teacher prompts. They may question each other's ideas and clarify their own, thus deepening the conceptual understanding of the group. Lucy West, in a recent video, defines five types of math talk that are apt descriptors for language learning as well (*Leaders in Educational Thought*, 2012). She emphasizes the importance of dialogue in producing robust learning:

- *Rote* – The teacher drills facts, ideas and routines through constant repetition.
- *Recitation* – Students are asked to recall information provided by the teacher.
- *Instruction* – The teacher models or explains how to perform a procedure, use a strategy or solve a problem.
- *Discussion* – Students share information, exchange ideas and solve problems together; accountable talk is aimed at leading students toward an acceptable answer or solution.
- *Dialogue* – Students work toward a common understanding by listening to and reflecting upon each other's ideas.

3. Focus on student solutions and interpretations.

In dialogue, we shift our focus away from the answer as being the point of discussion to processes and strategies. Even when a student gives a correct answer or fully explained account, we ask, "How do you know that?" or "Tell us more about this!", to ensure the thinking is solid. When a student gives an incorrect answer or an incomplete account, asking questions and inviting other students to share their perpectives helps clarify the thinking.

Dialogue that is centred on student solutions and interpretations supports the idea that concepts and ideas are connected to one another and that there are multiple ways to view a problem or interpret a text. Students are expected to support their thinking with evidence and examples from their work and the work of others. As students become used to looking beyond the answer and/or the interpretation, they will begin to see the similarities and differences in the various solutions. When they learn to disagree respectfully with the ideas of others, their own conceptual understanding will deepen. Viewed from this perspective, diversity becomes a strength. For example:

- When students are considering options for school sports, peers from different cultures may describe different ways to play with the same equipment, such as soccer balls or hacky sacs, and prepare a chart to explain the options.
- When students are investigating options for dealing with bullies, victims and bystanders, they may take different perspectives to develop a realization of the responsibility for fairness and respect that they all share.

4. Encourage real-world problem solving.

When students are given opportunities to solve real-world problems that are important and relevant to them, they see the significance of the real world in their school learning environment. Students are naturally curious, and when they are intellectually engaged,

they are developing the higher-order thinking skills and habits of mind that lead to deep learning. Asking questions and engaging in dialogue to make sense of information also helps students to stay on task and persist in their efforts to understand and solve a problem. Instructional strategies to support the creation of learning environments conducive to real-world problem-solving might include:

- Selecting interesting problems that connect to students' experience and life outside of school and will engage their imagination.
- Centring learning goals on big ideas or key concepts across curriculum areas – this will provide opportunities for robust dialogue and expand the relevant use of non-fiction texts and learning materials.
- Encouraging collaborative learning and creating intellectual spaces for students to engage in rich talk about their thinking and learning.
- Providing wait time during discussions to give students time to put their thoughts into words – this will lead to greater quantity and quality of student responses, foster respect for the thinking of others and encourage risk-taking.

5. Build self-efficacy.

Self-efficacy is the belief that one has the capacity or power to learn; it is predicated on having a positive view both of the subject itself and of one's own abilities to master it. Here are some ideas teachers might consider in creating a learning environment that builds self-efficacy:

- Model excitement and curiosity by posing questions that students are interested in thinking about.
- Validate thinking at all points on the continuum of learning.
- Expect and support all students, no matter their abilities, to participate in the experience of sense-making within the classroom learning community.
- Invite all students to defend their thinking about their solutions or interpretations and ensure they have opportunities to discuss with a partner why they chose a particular strategy.
- Acknowledge your errors, too, so that students see that errors are normal and not something that should be hidden – show them that errors are an opportunity for knowledge to expand and understanding to deepen.

Building self-efficacy is not just a matter of instilling positive attitudes toward learning; it is also a matter of developing confidence based on the acquisition of applicable skills. Explicit instruction – an example of what John Hattie calls "activating" learning – is just as important as dialogue and the sharing of ideas in helping students develop the "cognitive schemas" that enable them to acquire the skills they need to acquire knowledge themselves. Therefore:

- Think aloud so that students can hear your wonderings and see that your own knowledge is growing as you listen to their ideas, ask questions and come to have new ideas about a topic of interest.
- Model precise language so that students can better express their own thinking and be equipped to share ideas and engage in dialogue.
- Demonstrate how math makes sense and how words work by highlighting and focusing on connections within and across concepts and strands.
- Provide timely and specific feedback so that students have opportunities to revise their work and make it more precise.

Where students have time to learn ...

"Providing students with time to learn also includes providing enough time for them to process information. … The implication is that learning cannot be rushed; the complex cognitive activity of information integration requires time."

(Bransford, Brown, & Cocking, 2000, p. 58)

"To become proficient, they need to spend sustained periods of time doing mathematics – solving problems, reasoning, developing understanding, practicing skills – and building connections between their previous knowledge and new knowledge."

(Kilpatrick, Swafford, & Findell, 2001, p. 135)

VOICES FROM THE FIELD

Educators in a range of teaching and administrative roles participating in ministry and board inquiry projects have told us that …

"We knew that if we expected deep learning to occur, our students needed to be provided with rich and engaging learning environments."

"We removed materials that we felt would impede the inquiry process and replaced them with open-ended materials that fostered creativity and problem-solving. We decided to be very intentional in planning and preparing student materials … We noticed the way students responded to the environment."

"We have learned that perhaps the highest impact we can have on our students is taking the time to talk with them and connect with them."

A Learning Environment for Today's Mathematics Learner

The mathematics learning environment should reflect the beauty and creativity that is at the heart of mathematics (Clements & Sarama, 2009, p.7); it should also support what the National Research Council describes as "a productive disposition" to the subject. The classroom learning environment, if properly structured, can be a third teacher that over time instills "the habitual inclination to see mathematics as sensible, useful and worthwhile, coupled with a belief in diligence and one's own efficacy" (Kilpatrick, Swafford, & Findell, 2001).

SEVEN MATHEMATICAL PROCESSES

The Ontario curriculum identifies seven interconnected processes for today's mathematics learner. *How do these processes encourage students to become active participants in the creation of their learning environment? How might these processes evolve in the development of the mathematics learning environment?*

Problem Solving: Develop, select, apply and compare a variety of problem-solving strategies as you pose and solve problems and conduct investigations, to help deepen understanding.

Reasoning and Proving: Develop and apply reasoning skills to make conjectures, assess conjectures, and justify conclusions, and plan and construct organized arguments.

Reflecting: Demonstrate that you are reflecting on and monitoring your thinking to help clarify your understanding as you complete an investigation or solve a problem.

Selecting Tools and Computational Strategies: Select and use a variety of concrete, visual and electronic learning tools and appropriate computational strategies to investigate ideas and to solve problems.

Connecting: Make connections among concepts and procedures, and relate ideas to situations or phenomena drawn from other contexts.

Representing: Create a variety of representations of ideas, connect and compare them, and select and apply the appropriate representations to solve problems.

Communicating: Communicate thinking orally, visually and in writing, using vocabulary and a variety of appropriate representations, and observing conventions.

A Learning Environment for Today's Literacy Learner

The challenge for today's students, according to Allan Luke, is that they are being asked to read not just the text, "but the world." Students need to be taught a "repertoire of strategies" – "to enable them to move beyond basic comprehension skills to understanding and using texts on several levels for a range of purposes in a range of technologies." In Ontario (and elsewhere), many teachers are using the Freebody-Luke Four Roles Model as a touchstone for learning environment design.

FOUR ROLES FOR THE LITERATE LEARNER

All students acquiring literacy skills need experience and practice in each of the Four Roles of the Literate Learner. Readers may wish to reflect on the integration of the Four Roles in their classroom using some guiding questions as a reflective tool. *Where are all the places that literate behaviours are supported and evident in the learning environment? How does the learning environment support students taking an inquiry stance in order to shape and master the repertoire of capabilities called into play when managing texts in ways appropriate to various contexts?*

Meaning Maker

Uses prior knowledge and personal and/or world experiences to construct and communicate meaning when reading, writing, speaking, listening, viewing and representing. The literate learner is a "text participant," forming and communicating his/her own interpretation in light of his/her own knowledge and point of view.

Code User

Recognizes and uses the features and structures of written, visual and multi-modal texts, including the alphabet, sounds in words, phonemic awareness, phonics, spelling, conventions, sentence structure, text organization and graphics, as well as other visual and non-visual cues to break the "code" of texts.

The Literate Learner

Text User

Understands that purpose and audience help to determine the way text is constructed: form, format, medium, structure, tone, the degree of formality, and sequence of components. The literate learner uses this knowledge and a variety of thinking processes to read, listen and view, as well as to write, speak and represent ideas.

Text Analyzer

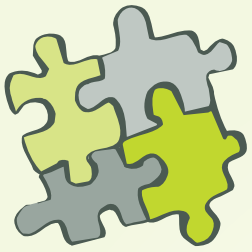
Understands that texts are not neutral; that they represent particular views, beliefs, values and perspectives to serve different interests; that other views and perspectives may be missing; that the design and messages of texts can be interpreted, critiqued, challenged and alternatives considered. The literate learner decides what to think now, considers possibilities and when to take action.

Adapted from *Literacy for Learning: The Report of the Expert Panel on Literacy in Grades 4 to 6 in Ontario* (2004).

VOICES FROM THE FIELD cont.

"[Questioning] is important to all subject areas and not just literacy. It values everyone's voice and builds a respectful community of shared understanding. We need to study what does discourse look like, specifically, and how do we build it into the learning environment in an intentional way."

"Engagement is HUGE! Connections to the real world motivated students, and their interests, in turn, shaped instruction. Teachers, impressed by the level of classroom discussion, concluded that integrated curriculum lends itself to higher order thinking skills."



In Brief

Planning the learning environment should be intentional and involve all those working in that classroom – teachers, administrators, parents and students.

Begin by examining your beliefs and philosophy about students' social/physical/cognitive development and their learning needs.

How well does the learning environment reflect the values identified by the team as important?

How will the physical space be used to encourage students to push their learning and deepen their understanding?

How will the environment mirror an image of the student that conveys potential and the capacity to learn?

Co-plan the environment with students before learning happens.

Are students engaged, included and respected, and can they see themselves reflected in the learning environment?

Are students free to interact with the environment in a safe and personally meaningful way?

Facilitate the adaptation of the environment based on student input and teacher observations.

How do the space, materials and organization of time help facilitate optimal mathematics and literacy learning?

How does the teacher provide materials, documentation, provocation and time to enable students to go deeper in their thinking?

Does the environment promote deep thinking in mathematics and literacy across time and space?

Does the environment allow for the flexible use of space, materials and learning opportunities?

Think about what happens when students enter into the environment and interact with it.

Does the environment convey a sense of wonder and encourage inquiry?

Does the environment allow for students to have big ideas, share those ideas and then take action on the basis of those ideas?

Are students able to take responsibility for their learning?

How might students communicate their ideas about their learning environment, including what changes they would like to see made?

Ensure that the learning environment conveys respect for students, families and communities.

How will the learning environment reflect the diversity of the students, families and communities represented in the school?

Is the learning environment welcoming, inclusive, safe and accepting?

Stand back and reflect on the learning environment you have created.

Does the environment offer experiences that heighten multi-sensory awareness?

Does the environment allow for choice, risk-taking and the open sharing of ideas?

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