Powerful Instructional Practices

A Resource for Teachers and Administrators

September 2011

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Overview

Powerful Instructional Practices

Instructional Approaches: A Framework for Professional Practice (1991) outlines four foundations of effective instruction that still resonate today: effective instruction can be defined and described, teaching is an art as well as a science, teachers are instructional decision makers, and students should be viewed as autonomous learners.

While the 1991 document indicates that much research regarding instructional strategies had been and was being conducted, significantly more research of this type has been undertaken, especially in the areas of cognitive psychology, learning theory, teaching strategies, and multicultural education.

Given the expanding research base in teaching and learning, it is appropriate that educators reflect on their use of instructional strategies within their teaching practice. Current research organizes instructional practice by the types of thinking it supports. In a complete cycle of instruction, student thinking should involve knowledge acquisition, engagement of cognitive processes, engagement of metacognitive processes, and attention to one's disposition when learning. Research-proven practices that support each of these types of thinking are presented in the following chart:

<table>
<tr><td colspan="4">The instructional cycle should engage all four of the types of thinking represented below.

Students may be engaged in more than one type of thinking at a time as teachers use instructional practices in sequence or in tandem. Inquiry overarches all practices.</td></tr>
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For teachers, this document provides a definition and explanation of each practice, what context might best support each practice, examples of the practice in action, planning and reflection questions, and indicators of effective implementation.

For administrators, the basic information that is provided for teachers has been repeated. Also, guidance for coaching is provided to enable administrators to better support their teachers as they work to incorporate these practices into their instructional repertoire.

The reference list offers professional resources that are valuable for further study of instructional practices. These resources may be available from school/school division libraries or from Stewart Resources Centre (www.stf.sk.ca, or phone 1-800-667-7762 or 306-374-1122).

A series of videos has been produced to accompany this resource. This series entitled *Powerful Instructional Practices* is available on Recommended Online Video Education Resources (ROVER) at http://rover.edonline.sk.ca/index.htm. ROVER offers video programs that have been purchased by the Ministry of Education for use in Prek-12 schools in Saskatchewan.

Moving from Tacit to Explicit

Think of something that you can do automatically without thinking. In the space below, write a description of that process for someone who has never done what you can do.

How difficult was it to write out the entire process? What did this reveal to you?

All of us have a portion of our practice that contains tacit knowledge (i.e., effective things we do that have workings we are unable to explain because they are second nature to us). Many of us entered the teaching profession for this reason. Bennett & Rolheiser (2001) argue that teachers must have a working knowledge of instructional strategies and be able to apply them in an informed manner to meet the needs of their students. Teachers are to be informed practitioners who have the ability to explain why the instructional strategy they are using is the best one for a particular purpose, at that moment, and in that specific context.

Attending to Context through Equitable Instruction

A teacher is preparing to teach a unit on justice and fairness in English Language Arts B10. Traditionally, the teacher chose selections that portrayed the horror and injustice of war to the class. This year, the teacher has a student in class who witnessed and fled the genocide in Rwanda. ***Why might the teacher be thinking that the traditional way of teaching this unit is now inappropriate?***

The predominant modes of instruction in a classroom are reading, note-making, and writing. ***Which students might be advantaged in this setting? Which students might be disadvantaged?***

Western scientific knowledge has traditionally been presented as factual, and we assume that this is the way things are. Some cultures and faiths accept scientific knowledge on different criteria. Facts for some cultures and faiths come from other sources we might tend to discount. ***In what ways can we honour various ways of knowing?***

The instructional strategies that teachers choose must be framed by a consciousness of the many social contexts and realities represented by the students in their care. This consciousness changes the ways in which teachers deliver curriculum and compels us to examine our definitions of excellence. Kohl (1994) suggests that "the notion of excellence will not be based on the premises of any one culture but tied to the quality of work within a multiplicity of traditions" (p. 167). Students must see their life experience both reflected and honoured in the work they are asked to do at school. Planning for instruction is not an either-or proposition; rather, all students benefit from learning through a variety of approaches, strategies, and resources that allow students to authentically interact with the multiplicity of realities present within each classroom.

Five Lenses on Instructional Practice

Sociocultural Constructivism
Learners construct their understanding within a cultural context mediated by language and symbol systems.

First Nations and Métis Ways of Knowing
Creating a learning environment that is infused with traditional ways of knowing and that honours cultural learning processes will benefit all students.

Gender-Specific Teaching
While males and females may demonstrate preferences for some differing instructional strategies, both sexes benefit from exposure to all teaching strategies. Attention to differences regarding class and race within sexes, and thinking of ways to respond to the ways that boys and girls perceive their identities as scholars are more pressing than using differentiated strategies by gender.

The Adaptive Dimension
The Adaptive Dimension refers to the concept of making adjustments in approved educational programs to accommodate diversity in student learning needs in order to help students achieve curricular outcomes. It includes those practices that the teacher undertakes to make curriculum, instruction, and the learning environment meaningful and appropriate for each student. Many of the practices within differentiated instruction support teachers' use of the adaptive dimension.

Universal Design
Initially conceptualized for students with profound disabilities, universal design is being applied to the design of instruction for all students to better meet their individual needs. Within universal design, attention is paid to multiple means of representation, expression, and engagement to encourage student success.

In what ways are the five lenses presented evident in your teaching practice?

Which of these lenses most informs the way in which you approach planning for instruction? Why do you think this is?

Looking ahead, which of these lenses will become more important for your work in the future?

A Conceptualization of Pedagogical Decisions or Moves

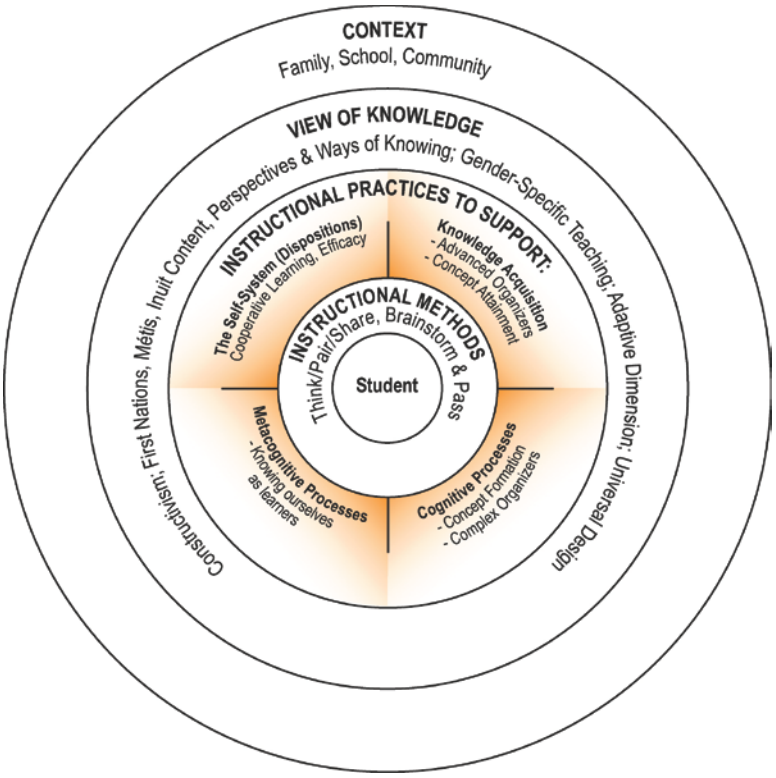
Context refers to being aware of the social context where instruction takes place.

View of Knowledge refers to the theories of cognition or learning, such as constructivism that guide the design of our instruction.

Instructional Practices are general descriptors for a range of instructional approaches that support thinking in each of the four domains of cognition:

- Knowledge Acquisition
- Cognitive Processes
- Metacognitive Processes
- The Self-System (Dispositions).

Instructional Methods are practices that target specific areas of cognition. Instructional methods have a teacher and student component so that the work is equally shared.



It is important to note that all instructional practices must be chosen and utilized within the context of the community, learning environment, and learning needs of the students. Educators must first understand the context of the broader community where they work. This informs how curricular material will be presented in order to match the community's traditional ways of knowing. Within the context of community, the educator will be viewing his or her instruction through the lens of one or more theories of knowledge such as constructivism or multiple intelligences. Understanding the context and choosing an instructional organizer helps the teacher make informed decisions regarding instructional practices to facilitate learning in the domains of knowledge acquisition, cognitive processes, metacognitive processes, and the self-system. The student is at the centre of all of these pedagogical decisions, and it is important that the teacher monitor the effectiveness of teaching and learning strategies to ensure that students are obtaining the maximum benefit from the instruction they are receiving.

Think of a lesson or unit that is highly successful. In what ways have you attended to each area in the previous diagram? How many of those areas were explicitly attended to through your design? How many of those areas were attended to tacitly?

Section I: Inquiry

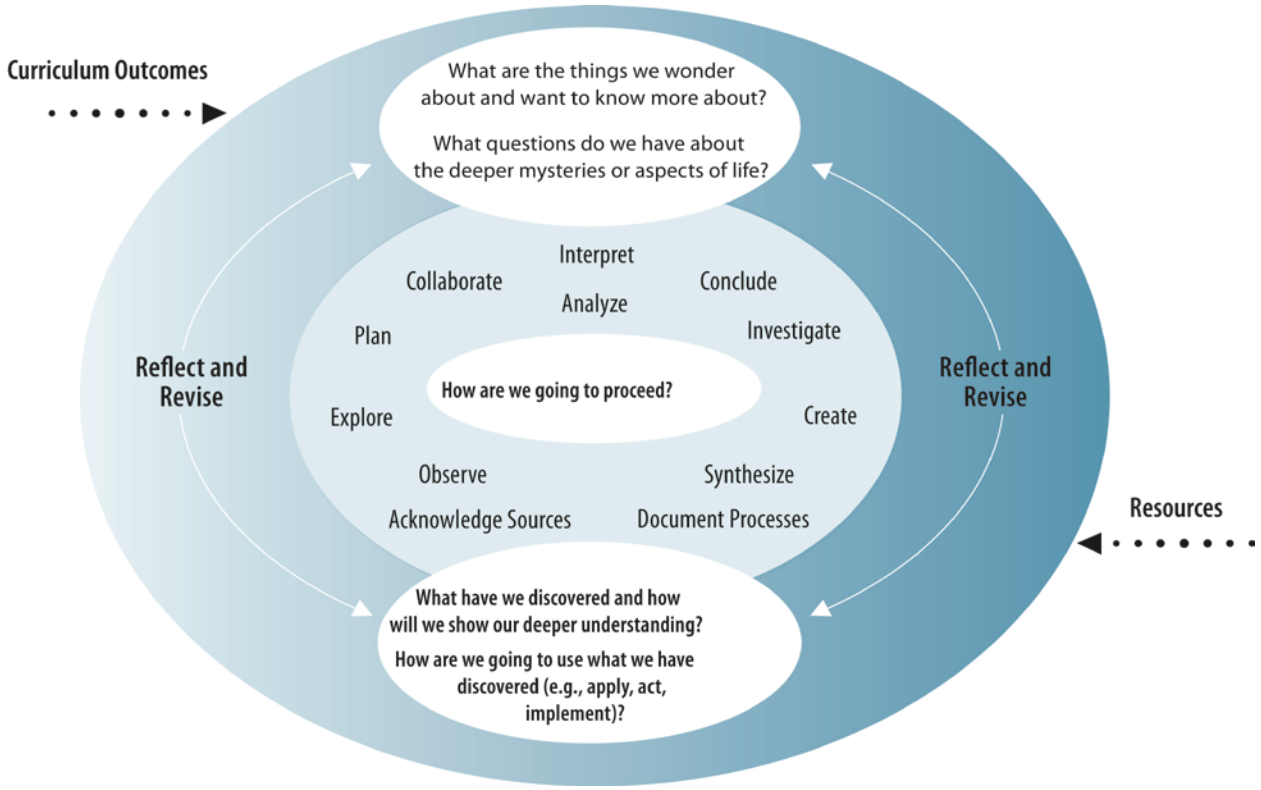
Inquiry: A Philosophical Stance

Information for Teachers
What Is Inquiry?

Inquiry overarches all instructional practices, and offers multiple opportunities for increasing student engagement, insight, and depth of understanding. Hammerman (2006) defines *inquiry* as "the careful, ongoing questioning of our understandings about the world around us; it is a dynamic, creative endeavour filled with wonder and surprise" (p. xxii). Mills and Donnelly (2001) suggest, "Inquiry is a philosophical stance rather than a set of strategies, activities, or a particular teaching method. As such, inquiry promotes intentional and thoughtful learning for teachers and children" (p. xviii).

Inquiry is a philosophical approach to teaching and learning, grounded in constructivist research and methods, which engages students in investigations that lead to disciplinary and transdisciplinary understanding. Inquiry learning is not a step-by-step process, but rather a cyclical process, with various phases of the process being revisited and rethought as a result of students' discoveries, insights, and co-construction of new knowledge. The Saskatchewan Ministry of Education has developed the following model to represent this cyclical inquiry process.

Constructing Understanding through Inquiry



Inquiry learning provides students with opportunities to build knowledge, abilities, and inquiring habits of mind that lead to deeper understanding of their world and human experience. The inquiry process focuses on the development of compelling questions, formulated by teachers and students, to motivate and to guide inquiries into topics, problems, and issues related to curriculum content and outcomes.

Teaching for Understanding

Inquiry is a dynamic process of being open to wonder and puzzlement and coming to know and understand the world. As such, it is a stance that pervades all aspects of life and is essential to the way in which knowledge is created. Inquiry is based on the belief that understanding is constructed in the process of people working and conversing together as they pose and solve the problems, make discoveries, and rigorously test the discoveries that arise in the course of shared activity.

Retrieved June 3, 2008, from http://www.galileo.org/inquiry-what.html#1

Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests, and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding. Students who are engaged in inquiry:

- construct deep knowledge and deep understanding rather than passively receiving information
- are directly involved and engaged in the discovery of new knowledge
- encounter alternative perspectives and differing ideas that transform prior knowledge and experience into deep understandings
- transfer new knowledge and skills to new circumstances
- take ownership and responsibility for their ongoing learning and mastery of curriculum content and skills.

(Adapted from Kuhlthau & Todd, 2007)

Inquiry in Practice

Inquiry is an opportunity to engage students with curriculum in meaningful ways. To achieve the learning outcomes of the provincial curriculum, teachers support students in identifying topics of interest for their inquiry. Initially, inquiry may be teacher-directed with students assuming more responsibility over time. As students learn the habits of inquiry, they become more responsible for their own learning and use the inquiry process to reflect upon and monitor their own learning as they explore ideas, interpret experiences, and set goals for future actions.

Inquiry prompts and motivates students to investigate topics within meaningful contexts. The inquiry process is not linear or lock-step, but is flexible and recursive. Experienced inquirers will move back and forth among various phases as new questions arise and as they become more comfortable with the process.

Classroom Example

A Grade 2 science teacher plans to engage his students in an inquiry into pond habitats as part of the "Earth and Space Science: Air and Water in the Environment" unit and "Physical Science: Liquids and Solids" unit. He studies the learning outcomes and indicators for the units and develops a plan that will engage his students in a collaborative inquiry process.

Experience

The teacher sets the context for students by taking them on a walk to a local pond. He asks them to identify all the places where they can see or find water. The students excitedly come up with the following insights and questions:

- How did the pond get there?
- How does the water keep filling the pond? (Some students think that the pond continually fills from underground.)
- What is water, anyway?
- I think the clouds hold water. What makes clouds? If they are full of water, why don't they fall down?
- Can there be water in the dirt? How come the ground around the pond is dry?
- Why doesn't the pond soak into the ground?
- In winter, we skate on the pond. What happens to the water when it freezes?

The students have many animated discussions about their insights and questions. Misconceptions abound. During the discussion, the teacher listens to the students' questions and considers possibilities for building on their observations back in the classroom.

Information

When they return to the classroom, the teacher asks the students how they might explore water. The students suggest that they would like to find out what happens to water when it gets cold and hot. The students also want to explore why the pond does not disappear. The teacher and students begin to develop some theories about what happens to water when it gets colder and hotter. They also develop some theories about what things might hold water better than others.

Knowledge Building

The teacher locates some picture books about water and reads them aloud to the class. Students are encouraged to raise their hands if they think one of their questions or theories is answered in the book. If so, the teacher writes this down on their exploration wall. The teacher also sets up displays of books and photos, and shows DVDs about water habitats to the students. He asks students to think of some experiments they might conduct to learn more about how water behaves. The students decide on the following:

1. Put water into a pail and freeze it. What happens?

The students mark the water level on the side of the pail before they put it in the freezer. After it is frozen, the students notice that the ice is higher than the original line. They now have more questions. They also notice that there appear to be things like snowflakes in the frozen water. Where did those come from?

2. Put water into a pot with a lid and boil it. What escapes when the lid is lifted?

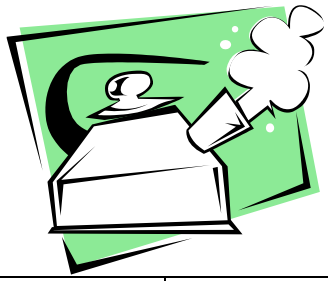
The teacher takes a mirror and holds it above the pot of boiling water. The students notice that the mirror fogs up and then water begins to drip off the mirror. When the teacher removes the mirror, it instantly clears. Where did the water go? The students begin to make some suggestions about what they think is happening. One student remarks that his bathroom gets all foggy when he is showering. Now he understands why!

3. Immerse a number of items in water. Which hold water? Which do not?

The students notice that rocks do not absorb water. Sponges absorb lots of water, but cannot hold it. Students build "ponds" out of sand and dirt at the sand table. They notice that the sand ponds do not hold water while the dirt ponds do. Again, the students are beginning to create some ideas about the absorbency of materials.

Understanding

To capture students' understanding, the teacher redirects the students to the inquiry wall. On the wall, he has created the following chart:

					
We learned:	We wonder:	We learned:	We wonder:	We learned:	We wonder:

The teacher asks students to tell him what they have learned and what they still wonder about in each area of inquiry. He transcribes their answers onto the chart as they make plans to move their inquiry even further in the coming weeks.

Planning for Inquiry-Based Learning

Experience

Teachers should use the curriculum, learning resources, and students' interests as a starting point. Considering the outcomes and content of the curriculum, about what topics might students wish to inquire? It is often helpful to develop criteria for deciding which topics to include in the inquiry. These criteria should include identifying big ideas and selecting topics that provide a meaningful context to address curriculum learning outcomes that define what students should know and be able to do at each grade level.

Teachers and students can begin their inquiry at one or more curriculum entry points; however, the process may evolve into transdisciplinary integrated learning opportunities, as reflective of the holistic nature of their lives and interdependent global environment.

Questions for deeper understanding are used to initiate and to guide the inquiry and give students direction for developing deep understandings about a topic or issue under study. It is essential to develop questions that are evoked by students' interests and have potential for rich and deep learning.

The process of constructing compelling questions can help students to grasp the important disciplinary or transdisciplinary ideas that are situated at the core of a particular curricular focus or context. These broad questions will lead to more specific questions that can provide a framework, purpose, and direction for the learning activities in a lesson, or series of lessons, and help students connect what they are learning to their experiences and life beyond school.

Using a concept map is one way for students to brainstorm all possible elements of the topic. This provides many possibilities to connect with students' interests.

Another way to engage students in the inquiry process is to find or to identify a complex, problematic situation that reflects the major concepts and ideas within the unit. For example, "What would happen if . . .?" or "You have been contracted to design and build . . ." are ways to involve students in an authentic way. This problem-based approach to inquiry can be described as follows:

> An alternative to simply progressing through a series of exercises that derive from a scope and sequence chart is to expose students to the major features of a subject domain as they arise naturally in problem situations. Activities can be structured so that students are able to explore, explain, extend and evaluate their progress. (Bransford, Brown, & Cocking, 2000, p. 139)

Information

Challenges and opportunities for students to explore ideas, to gather information, to analyze information, to achieve understanding, and to use what they have learned in new situations are some of the main activities that students will be involved in as they explore the curriculum outcomes.

Formative assessment is to be embedded (and should naturally occur) in the inquiry process as teachers and students begin their inquiry. Students should formulate questions that they would like answered as they begin documenting their learning.

Knowledge Building

Bateman (1990) suggests that "one must go through the stages of setting a problem and collecting data. A conclusion given to you is not yours; it does not convince. This great truth we all learn many times" (p. 77).

As students are working their way through the knowledge-building phase, teachers should have them consider what problems they might pose and how to develop ways to solve those problems. What experiences or experiments might they need to carry out? What banks of knowledge might they need to tap?

Formative assessment also plays a role at this stage. An important part of any inquiry process is student reflection on their learning and the documentation needed to assess the learning and make it visible to students. Students, in conjunction with their teacher, should begin to articulate the assessment criteria that would demonstrate their learning in light of the curriculum outcomes. In what ways will students demonstrate what they know and are able to do at the end of their inquiry? By what methods will students document their learning and reflect upon their progress? Documentation and reflection methods might include journals or blogs, to encourage ongoing discussion throughout the inquiry. It is often useful to create stems for reflection such as "I have learned . . ." or "I am still wondering . . .." Student documentation of the inquiry process may take the form of reflective journals, essays, notes, drafts, three-dimensional models, works of art, photographs, sound compositions, presentation software, video footage, and other methods of documentation specific to an area of study.

Understanding

Students should be encouraged to demonstrate their understanding in a variety of ways. It is preferred that such demonstrations be authentic practices within the discipline. For example, the demonstrations of an inquiry in music might include the development of program notes or a recital of a composer's works, rather than an essay about the composer and his works.

At this point, students should review the variety of formal and informal formative assessments that have been carried out throughout the inquiry. As students consider and reflect upon this information, how might it inform the ways in which they demonstrate their current understanding of the topics or outcomes under consideration?

Students should consider how their demonstrations of understanding fulfill the criteria they set out at the beginning of their inquiry. Students should assess their work based on the criteria, as well as assessment by the teacher.

A component of their final presentations or submissions should include a reflection on what they have learned about themselves and their changing understandings throughout the process.

Teachers should encourage students to consider how they might transfer/apply what they have learned to other subjects or to their lives outside of school.

The Teacher's Changing Role

In an inquiry classroom, the teacher's role is dramatically different from the traditional roles teachers have occupied in the past. The teacher is no longer the fount of all knowledge at the front of the class, but a facilitator of learning and a co-learner with the students.

Rather than view curricula as a series of isolated outcomes to be met, a teacher using inquiry must begin with a global perspective on the curriculum and be able to identify the big ideas expressed through the outcomes and the many possible ways that students might come to learn those big ideas. Creating multiple entry points for students to navigate through curriculum outcomes ensures that learning occurs in an authentic context and strengthens students' understanding of the concepts and skills being studied.

Reflection

1. How was my planning affected?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .

Inquiry

Information for Administrators
What Is Inquiry?

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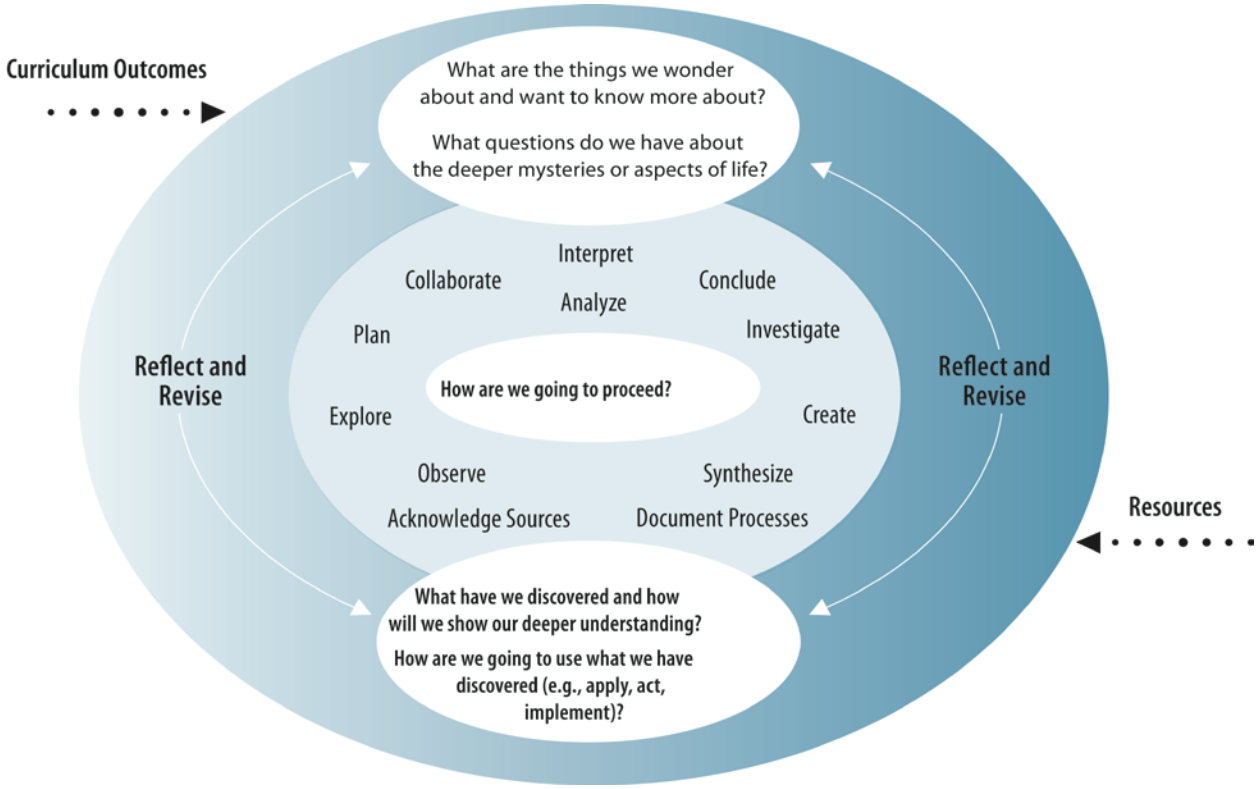

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(Adapted from Kuhlthau & Todd, 2007)

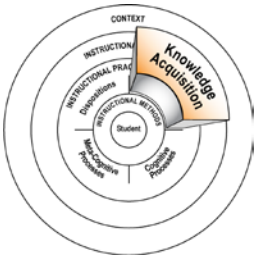
Guidance for Coaching

As administrators support teachers in implementing curricula using inquiry learning, they may meet with teachers prior to or after they have used inquiry. Carefully planning the questions that administrators will ask the teachers is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in effective classroom inquiry experiences follow.

Examples of Questions	
Pre-Instruction • On which curriculum outcomes will you be focusing? • In what ways are you planning to have students identify topics of interest within the framework of the curriculum outcomes to be achieved? • How will you support students in developing compelling questions related to the topic and documenting their inquiry process? • What other supports do you have in place to assist students as they engage in inquiry (e.g., collaborating with community resource people)? • What types of work and documentation will you accept as evidence of student understanding?	**Post-Instruction** • As you consider your use of inquiry, what stands out for you regarding your use of this approach and students' engagement? • What factors contributed to what you have described in your use of this inquiry approach? • What things will you keep the same the next time you use this approach? What things would you like to change? • Which of your ideas do you plan to implement the next time you use this approach?

Examples of Observations	
Teachers may be: • designing inquiry plans with students • encouraging students to think about 'big ideas' and compelling questions • encouraging students to question common understandings or ways of doing things • occupying the role of facilitator • accepting a variety of inquiry topics and projects as evidence of student learning • encouraging divergent responses to questions • meeting curriculum outcomes in a non-linear fashion • not teaching material the same way each year.	**Students may be:** • creating questions relating to topics of interest within the lesson or unit outcomes • negotiating learning plans with teachers • working in a variety of groupings in various locations inside and outside school • designing projects, collecting and analyzing data, and reporting findings in ways that are appropriate to the area of study • creating a diverse range of products that demonstrate understanding.

A classroom engaged in inquiry will at times appear messy and noisy but will have students who are engaged in learning in an active, energetic way!



Section II: Knowledge Acquisition

Questioning

Information for Teachers

What Is Questioning?

Nancy Lee Cecil (1995) states that "the question is a pivotal – if not the pivotal – component in critical thinking" (p. 37). Students are faced with hundreds of questions from their teachers every day. Many of these questions are simple recall questions or are leading to an answer the teacher has in mind. Productive questions should stimulate and expand thinking that leads to the production of new knowledge or deeper understanding. Wiggins and McTighe (2005) suggest that "it is through the process of actively 'interrogating' the content through provocative questions that students deepen their understanding" (p. 106).

Research into the use of questioning has indicated that attention to the design and use of questions can improve student understanding and can provide quality formative assessment data to teachers.

Increasing the effectiveness of questioning can be achieved by paying attention to three areas of practice: creating norms that support questioning, using thoughtful design, and providing thinking time for students.

Questioning is:

- a planned component of instruction
- a strategy that must engage and involve all students
- a way of eliciting thinking
- a gateway to generating more questions.

Teaching for Understanding

Effective questioning is a key element in teaching for understanding. Effective questions encourage divergent thinking, open up possibilities, and create opportunities for students to make their thinking visible in a variety of ways. Questioning that engages more advanced cognitive processes deepens inquiry and understanding.

Questioning in Practice

Classroom Example

As part of a Grade 6 social studies unit, the teacher uses the following cue to engage students:

"People who move to new countries are usually called *immigrants* or *refugees*. How do these terms make you feel?"

The students think for a while, and one student mentions that her great-grandparents were immigrants to Canada. She suggests that she would not mind being called an *immigrant*. Another student says that his church is sponsoring some refugees from Afghanistan. He shares with his classmates that he does not believe being a refugee is a bad thing – these people had to flee their country to be safe. He thinks that he would not mind being called a *refugee*. The students begin an animated discussion about the immigrants and refugees they know and their feelings about the terms *immigrant* and *refugee*.

The teacher moves the lesson to extend the students' thinking by asking, "Are immigrants and refugees the same? I would like your table group to work together to answer this question. You may want to create a Venn Diagram, a T-Chart, or any other visual to support your thinking. Please have one person in your group raise his/her hand when you are ready to answer. When I see that all groups are ready to answer, I will call on each group for its answer."

The students work very hard to answer the question, but in the process raise many new questions for themselves. Soon, all groups have signalled that they have an answer.

Following the first group's response of, "Immigrants chose to move while refugees did not," the teacher waits before commenting. While the teacher is waiting, a student from another group suggests, "We thought that both groups chose to move. Immigrants choose to move for different reasons than refugees." Before the teacher can comment, another group adds, "We agree. Refugees move because their homes are destroyed or they are fleeing for their lives." The first group responds, "That is what we meant. We just did not put it down clearly enough!"

The teacher turns the students' attention to the questions they raised while working on their initial answers to the question. She has each group read their questions, and she charts them on the board. After all of the questions have been charted, the teacher asks students to suggest ways that they might be grouped into larger topics. Each group then selects a topic and the accompanying questions for further inquiry.

In this class, quality questioning provides the students with a challenging question requiring complex thinking. The teacher is specific in her directions and expects all students to work at developing an answer. She has provided means for students to make their thinking visible. She deliberately pauses (see the "Providing Time for Thinking" section of this document) to ensure that students have time to think and to build upon one another's answers as they construct new knowledge.

Planning for Questioning

When creating questions to develop deeper understanding, it is important to keep the following characteristics of questions in mind (Wiggins & McTighe, 2005):

1. Questions should cause genuine and relevant inquiry into the big ideas and core content.

2. Questions should provoke deep thought, lively discussion, sustained inquiry, and new understanding, as well as more questions.

3. Questions should require students to consider alternatives, weigh evidence, support their ideas, and justify their answers.

4. Questions should spark meaningful connections with prior learning and personal experiences.

5. Questions should naturally recur, creating opportunities for transfer to other situations and subjects.

There are generally three phases to attend to when planning for questioning: creating norms, designing questions, and providing time for thinking.

Creating Norms That Support Questioning

Creating an environment for questioning requires that both teacher and students agree upon a set of norms for interaction in an environment where thinking is public. Walsh and Sattes (2005) recommend the following:

1. We all need time to reflect upon past experiences if we are to gain new understandings.

2. We all need time to think before speaking.

3. We all need to think out loud and to complete our thoughts.

4. We learn best when we formulate and answer our own questions.

5. We learn from one another when we listen with attention and respect.

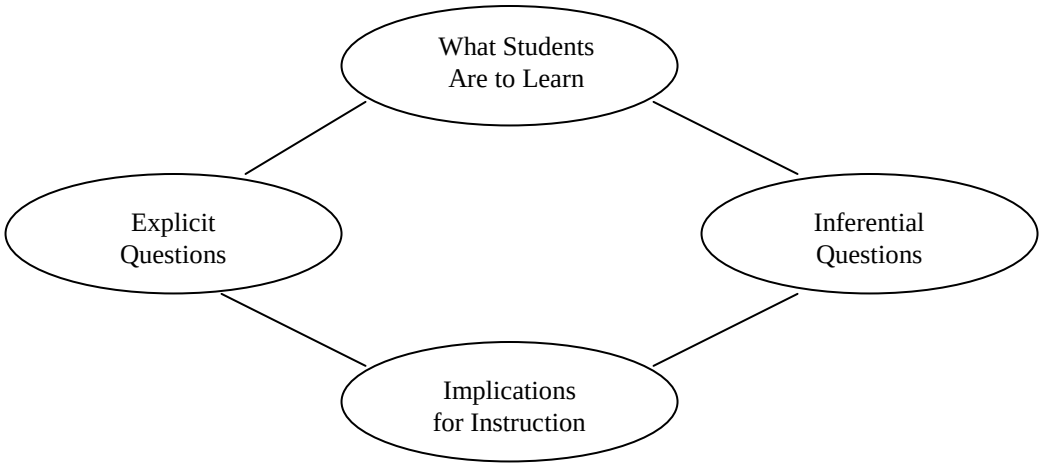
6. When we share talk time, we demonstrate respect, and we learn from one another.

Teachers should take some time with their classes to develop norms that will support an environment for questioning.

Using Cueing Questions to Activate Prior Knowledge

Marzano (2001) defines cues as "explicit reminders or hints about what students are about to experience" (p. 267). The use of cues is much like a motivational set, but cues are more specific in their design, using questioning to activate students' prior knowledge and to reveal misconceptions regarding the specific concepts or processes within the unit of study.

When planning to use cues, teachers should identify the curriculum outcomes addressed in the unit or lesson. Once curriculum outcomes have been identified, teachers should identify the explicit and inferential questions that they might ask students as they move toward studying the content of the lesson.



Five Design Considerations for Quality Questions

1. Quality questions are framed around authentic problems that are directly linked to one or more curriculum outcomes. These questions should engage students and require higher level thinking.

Consider the big ideas within a unit or lesson with which you are familiar. What types of questions might you ask that link directly to those big ideas?

In what ways might you present the big ideas to students and have them create their own questions?

How might you frame your and the students' questions within authentic problems?

What types of thinking are reflected in the questions that you and the students have created?

2. Quality questions are scaffolded through increasingly complex levels using a taxonomy such as Bloom's.

Locate an assignment, lesson, or unit plan, and highlight all of the questions within it. If students have generated a list of questions based on big ideas, have them complete this activity as well.

Number the questions that you and the students have highlighted.

On the continuum below, place the question numbers from less powerful to more powerful, based on the thinking required in the question. For students, ask them to consider if their questions require simple or complex thinking. The numbers may not be listed in sequential order on the continuum below.

Less Powerful *More Powerful*

What are the qualities of the questions that seem most robust?

What are the locations of questions along the continuum? Is there a balance?

Based on the results above, what is the predominant type of thinking that students are being asked to exercise?

3. Quality questions clearly communicate what is being asked. Teachers should take time to assess the assumptions within questions. Specificity of language and attention to assumptions create space for divergent thinking, help students understand what is being asked of them, and enable them to respond productively. Teachers should encourage students to work through this process on questions they have designed.

In what ways is increased globalization destroying the preservation of culture?

What are the assumptions in the question?

How easy would it be to answer this question?

How might this question be made more specific?

Write a revised version of the above question that contains more specific language and is free of assumptions:

_____

4. Quality questions invite students to answer by specifying the reasons or evidence for the answer (e.g., from your experience, in chapter three, from the data you have gathered).

In what ways do you require students to explain the reasons or to provide the evidence for answers? At what points in instruction are explanations or the provisions of evidence more important than others?

5. Quality questions require that ***all*** students be engaged in making their thinking visible through the use of language, symbols, or visual representations.

Those experienced in the use of questioning often wait until all students have signaled that they have formulated an answer before asking for a volunteer to share. In Elementary Level grades, the use of cards or signs that students hold up can help teachers get a visual reading of student readiness. In the Middle and Secondary Level, students should be provided with the opportunity to think visually through the use of white boards, graphic organizers, symbols, discussion, or debate, prior to answering. The following link contains a variety of visible thinking strategies for students: http://www.pz.harvard.edu/vt/index.html. The section on "Thinking Routines" provides a wealth of ideas for teachers.

Find a unit or lesson that involves extensive questioning. In what ways might you provide opportunities for ***all*** *students to make their thinking visible?*

What strategies might you employ to ensure that all students have equal expectation and opportunity to answer?

Providing Time for Thinking

Providing time for thinking is essential to effective questioning. Research has shown that teachers who do not practise wait time answer their own questions the majority of the time. This practice excludes students from learning.

When using questioning in class, we must be aware of Wait Time 1 and Wait Time 2 (Walsh & Sattes, 2005):

Wait Time 1 – after asking a question, before designating a student to answer.

Wait Time 2 – after a student responds, before the teacher reacts or comments. The student may expand upon his/her answer, or another student may extend the answer or ask a new question.

The effective use of wait time gives students time to formulate answers, encourages students to give longer responses, results in more students answering questions, and raises the cognitive level of subsequent questions.

In an upcoming lesson, introduce and use the concepts of Wait Time 1 and 2 with your students. Following the lesson, ask the students to reflect upon their participation. For yourself, reflect upon the types of questions that were raised, the quality of answers, and the participation level of the class.

Reflection

1. How was my planning affected?

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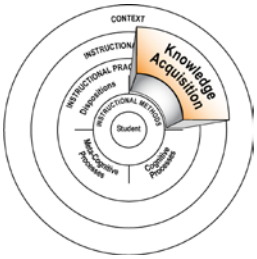
3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



Questioning

Information for Administrators
What Is Questioning?

Nancy Lee Cecil (1995) states that "the question is a pivotal – if not the pivotal – component in critical thinking" (p. 37). Students are faced with hundreds of questions from their teachers every day. Many of these questions are simple recall questions or are leading to an answer the teacher has in mind. Productive questions should stimulate and expand thinking that leads to the production of new knowledge or deeper understanding. Wiggins and McTighe (2005) suggest that "it is through the process of actively 'interrogating' the content through provocative questions that students deepen their understanding" (p. 106).

Research into the use of questioning has indicated that attention to the design and use of questions can improve student understanding and can provide quality formative assessment data to teachers.

Increasing the effectiveness of questioning can be achieved by paying attention to three areas of practice: creating norms that support questioning, using thoughtful design, and providing thinking time for students.

Questioning is:

- a planned component of instruction
- a strategy that must engage and involve all students
- a way of eliciting thinking
- a gateway to asking more questions.

Teaching for Understanding

Effective questioning is a key element in teaching for understanding. Effective questions encourage divergent thinking, open up possibilities, and create opportunities for students to make their thinking visible in a variety of ways. Questioning that engages more advanced cognitive processes deepens inquiry and understanding.

Guidance for Coaching

As administrators support teachers in developing their questioning skills, they may meet with them prior to or after they have used a questioning technique. Carefully planning the questions that administrators will ask teachers is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are using questioning effectively follow.

Examples of Questions

Pre-Instruction

- Which curriculum outcomes will you be addressing?
- In what ways are you planning to direct students' attention to the purposes of the learning? How might you engage them using:
  a) explicit questions?
  b) inferential questions?
- In what ways do these questions make direct connections to the curriculum outcomes to be achieved?
- On which area of your questioning practice would you like to focus?
- On which big ideas will your questions be focused?
- In what ways will you give students opportunities to create their own questions?
- What types of thinking would you like your students to do?

Post-Instruction

- What were the big ideas that you wanted the students to examine in this discussion?
- Why did you consider these big ideas important?
- Based on your post-discussion reflections, how useful were your questioning skills in the students' examination of the big ideas?
- Which questions did you see as particularly helpful in getting students to examine the big ideas?
- To what extent were you able to be respectful and non-threatening in your responses, using students' ideas to formulate questions that would help them examine issues more critically?
- What new insights did you gain about the art of questioning from your reflections on this discussion?

Adapted from Wassermann (1992).

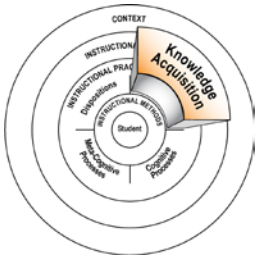
Examples of Observations

Teachers may be:

- asking questions that link to the prior knowledge of students
- addressing misconceptions or misunderstandings prior to instruction
- encouraging students to make their thinking visible
- encouraging all students to engage in formulating and sharing answers
- encouraging students to generate their own questions
- asking questions that engage students in thinking deeply about ideas
- asking less complex questions at the beginning of a lesson and more complex questions at the end.

Students may be:

- asking questions about the big ideas and the upcoming methods of instruction
- working alone or in small groups to formulate answers to questions
- creating visual representations, discussing possibilities, and generating more questions
- extending on other students' answers
- engaging in discussion around the questions they have generated.



Advance Organizers

Information for Teachers
What Are Advance Organizers?

Advance organizers are used to introduce new material to students prior to engaging them in learning activities. Advance organizers provide students with organizational frameworks or general principles upon which they can build new knowledge. Joyce and Weil (2004) state that "advance organizers are generally based on major concepts, propositions, generalizations, principles and laws of a discipline" (p. 194). Another key feature of advance organizers is the opportunity to connect new information with previously learned material.

Advance Organizers are:

- created to build a foundation for new learning
- designed to activate what has been previously learned
- varied in their design and application
- designed to focus on the most important ideas in previous and new learning.

Teaching for Understanding

Advance organizers provide organizational frameworks upon which students can build new knowledge. As we teach for understanding, it is important to help students situate new learning in what they already know. Making connections within and across disciplines is an important process in teaching for understanding.

Advance Organizers in Practice

Classroom Example 1

Prior to the study of probability in a Math B30 class, the teacher reminds the students of the concept of fundamental counting principles when determining the number of possibilities that exist in a given situation as an advance organizer to better enable students to engage with the instruction on probability.

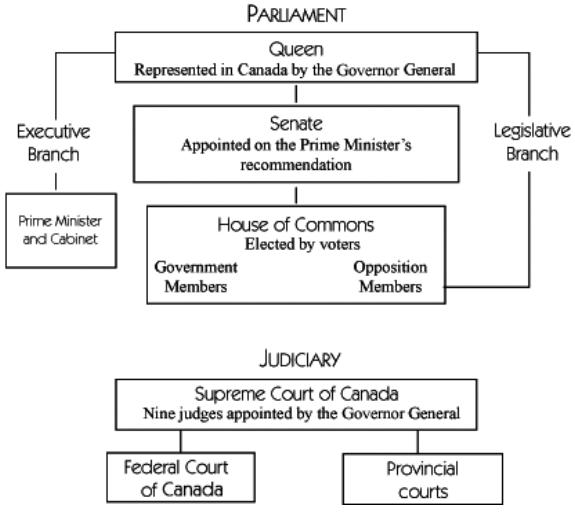
The teacher gives the students a handout and displays the following information:

The fundamental counting principles are those that deal with the combining of the numbers of outcomes in given situations.	
Fundamental Counting Principle 1 (The Multiplication Principle) If the first part of a procedure can be performed in m ways, and the second part of the procedure can be performed in n ways, then the procedure can be carried out in mn ways.	Fundamental Counting Principle 2 (The Addition Principle) If one task can be performed in m ways, and a second, mutually exclusive task can be performed in n ways, then the number of ways of performing either task is given by $m+n$ ways.

The teacher asks students to form groups of three and to brainstorm examples of each principle in practice.

Classroom Example 2

Prior to the study of Canada's Parliamentary system, the teacher provides the students with the following graphic organizer so that students have a map to which they can refer as they explore the workings of Canada's government.



Reprinted with permission from © Her Majesty the Queen in Right of Canada, (2005). Retrieved July 25, 2011 from http://ecommunity.pwsd76.ab.ca/file.php/863/Federal_/branches_of_govt.pdf

Planning for Advance Organizers

There are five instructional tactics within advance organizers. Each of the following tactics should be selected based on the context of the upcoming lesson and the type of material to be learned.

Expository

An expository advance organizer is a description of new content in verbal or written form. It is essential only to emphasize important content. Expository advance organizers may be presented as a written or verbal overview or background with visuals, diagrams, rules, frameworks, and the like.

Narrative

A narrative advance organizer is the use of stories to bring abstract or unfamiliar concepts closer to students' experiences. For example, prior to a unit on farm animals, a teacher might relate some stories of growing up on a farm.

Skimming

Teaching students how to skim text prior to introducing new text helps them to create a framework for what they are about to read. Students could skim text for headings, bold text, pictures, block quotations, and other clues.

Comparative

The comparative advance organizer is used with material that is familiar to students and is designed to discriminate between old and new concepts that contain similarities. For example, when introducing a dialectic argument, the teacher may make comparisons to a debating structure previously studied by students to point out similarities and differences.

Graphic Organizers

Graphic organizers are especially helpful with information that is complex or unfamiliar to students. Providing a completed visual organizer gives students a map to follow for complex systems of information. Alternatively, the teacher could provide the upcoming elements of study and ask students to use a blank organizer to predict the associations in the upcoming unit of study.

Advance Organizers Planning Guide

What knowledge will students be learning?

What specific important information will I provide to students in the advance organizer?

What tactic will I use?

- ☐ Expository advance organizer
- ☐ Narrative advance organizer
- ☐ Skimming
- ☐ Comparative advance organizer
- ☐ Graphic organizer
- ☐ Other _____

How will I monitor how successful the advance organizers are in helping to prepare students for new learning?

How will I respond if the advance organizers are not helping some students to learn new content?

Adapted from Marzano, R. J., Norford, J. S., Paynter, D. E., Pickering, D. J., & Gaddy, B. B. (2001). *A handbook for classroom instruction that works*. Alexandria, VA: Association for Supervision and Curriculum Development.

Reflection

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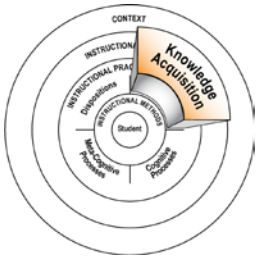

Advance Organizers

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Teaching for Understanding

Advance organizers provide organizational frameworks upon which students can build new knowledge. As we teach for understanding, it is important to help students situate new learning in what they already know. Making connections within and across disciplines is an important process in teaching for understanding.

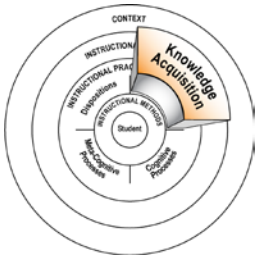
Guidance for Coaching

As administrators support teachers in implementing curricula using advance organizers, they may meet with teachers prior to or after they have used the method. Carefully planning the questions that administrators will ask teachers is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in a classroom where a teacher is using advance organizers effectively follow:

Examples of Questions	
Pre-Instruction • What knowledge will students be learning? • What specific important information will you provide to students in the advance organizer? • What tactic will you use? ☐ Expository advance organizer ☐ Narrative advance organizer ☐ Skimming ☐ Comparative advance organizer ☐ Graphic organizer ☐ Other _____ • How will you monitor how successful the advance organizers are in helping to prepare students for new learning? • How will you respond if the advance organizers are not helping some students to learn new content?	**Post-Instruction** • As you consider your use of advance organizers, what stands out for you regarding your use of this technique and students' engagement? • What factors contributed to what you have described in your use of this technique? • What things will you keep the same the next time you use this technique? What things would you like to change? • In what ways did the advance organizer that you used help to prepare students for new learning? • In what ways did you respond if the advance organizer was not helping some students to learn new content? • Which of your ideas do you plan to implement the next time you use this technique?

Adapted from Marzano, R. J., Norford, J. S., Paynter, D. E., Pickering, D. J., & Gaddy, B. B. (2001). *A handbook for classroom instruction that works*. Alexandria, VA: Association for Supervision and Curriculum Development.

Examples of Observations	
Teachers may be: • teaching the skill of skimming, and building graphic organizers to students • telling personal stories that relate to the upcoming learning • providing frameworks for new knowledge.	**Students may be:** • skimming text prior to reading • designing or completing graphic organizers • comparing the elements and processes of previous learning strategies with new ones • referring to a graphic organizer during instruction.



Note-Making

Information for Teachers

What Is Note-Making?

Many of us assume that all students possess note-making (also referred to as notetaking) skills, but research has shown that this is not the case. Most students capture less than half of the critical ideas froma text or lecture in their notes. Note-making skills must be taught in order to be effective.

Dodge (1994) reports "research suggests that the very act of note-making, in any form, promotes retention of information. Note-making increases concentration. It helps the individual to organize, process and encode information and it provides material for the student to study later on" (p. 39). The key activities within note-making are determining what is important and having a way to capture it in a concise format. Note-making also increases active listening.

All students need to be provided strategies for capturing the information being taught. A variety of note-making strategies should be taught to students so that they have a repertoire of skills to apply to different learning situations. A growing body of research suggests that while teaching note-making skills is beneficial to all students, those with learning and behaviour problems benefit most.

Teaching note-making skills early is essential as these skills are increasingly required in high school, post-secondary education, and many work settings.

Note-making is:

- a technique that requires students be active in processing the content being taught
- a way to capture the important parts of written or spoken information
- a place where students can interact with content through questions, summaries, and the creation of visual symbols.

Teaching for Understanding

Although we sometimes refer to summarizing and note-making as mere "study skills," they are two of the most powerful skills students can cultivate. They provide students with tools for identifying and understanding the most important aspects of what they are learning. (Marzano, Pickering, & Pollock, 2001, p. 48)

Note-Making in Practice

Classroom Example 1

After teaching students about bias and stereotypes regarding First Nations, Métis, and Inuit (FNMI) people in resources, a Native Studies 10 teacher organizes a variety of resources in centres for small groups of students. The teacher asks each group to examine and discuss the resources before reporting back to the class regarding the group's observations. The teacher provides each group with the following note-taking matrix.

Title of Resource	Format (e.g., picture book, poster, journal)	Example of Bias/Stereotype	Example of Positive Portrayal of FNMI people

Classroom Example 2

As students prepare to watch a safety video in their Electrical and Electronics 20 course, the teacher decides to use the Cornell Note-Taking System with her students. While the students watch the video, she asks them to take general notes in the right-hand column. Following the video, she asks students to look over their notes and place key words, symbols, and questions in the left-hand column. She then directs students to partner and to quiz one another using the guide words, symbols, and questions from their left-hand columns. By doing this, she has seen an increase in attentiveness when showing a video and greater retention of the material that was presented.

Key Words, Symbols, and Questions	Make General Notes Here

Planning for Note-Making

Explicit instruction is essential when using any note-making method. Teachers should begin with a discussion of the method, highlighting the reasons for its use and its benefits during instruction. Second, teachers should model the method so that students can see it in action. Third, teachers should give the students an opportunity for guided practice. Students will engage in independent practice as they apply the method and teachers should monitor usage of the method throughout instruction.

Note-making methods should be supported by the skills of effective listening. If students are making notes from a lecture or instructional video, they should be taught to listen for verbal clues such as “first of all,” “most importantly,” “therefore,” “as a result,” “to summarize,” “on the other hand,” and “on the contrary.”

There are a variety of note-making methods. It is important to match a method to the appropriate context and to teach a variety of note-making methods to students.

The most common note-making method is the Outlining Format (Fry, 1994):

Title
Author

I. First important topic in the text
  A. First subtopic
    1. First subtopic of A
      a. First subtopic of 1
      b. Second subtopic of 1
    2. Second subtopic of A

II. Second important topic in the text

Other note-making formats include the following:

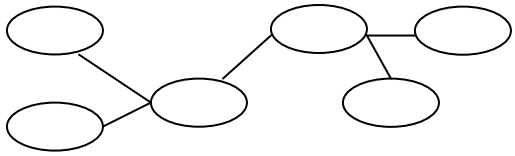
- Timeline: This can be used for both lecture notes and making notes from written texts.
- Concept Tree: This is a basic hierarchical graphic organizer where the main idea is at the top and supporting ideas are below.
- Vocabulary List: This is a list of unfamiliar words that students create while they read.
- Guided Notes: This is a skeleton outline of the material that leaves space for students to complete the notes during instruction. Notes can be provided as a skeleton, where only the framework is provided; or partial notes, where approximately half of the information is provided. Partial notes tend to be more effective than skeleton notes because students benefit from having to encode the provided text as they add to what is already there.

- Matrix Notes: This is comparative information organized into a matrix. Matrix notes result in greater learning than assembling the same information in an outline because it is easier for students to quickly compare the information that has been collected. Matrices can be provided to the students prior to reading text or class instruction.

- KWL (Know, Want to Know, and Learned) Chart: This note-making method activates prior knowledge, makes learning relevant, and allows students to consolidate their learning following instruction. Prior to instruction, students complete the "Know" column with everything they already know about the topic at hand. Next, students brainstorm things they would like to learn or things they wonder about. During instruction, students add more questions to the "Want to Know" column. After questions have been addressed and the instruction is complete, students complete the "Learned" column, which serves as answers to the items in the Want to Know column and as a review for studying.

Know	Want to Know	Learned

- Basic Mapping: This is a strategy that students can use to link concepts as they take notes from learning resources or during inquiry activities.



- Cornell Note-Taking System: This system was designed by Walter Pauk for use by his university students and has since become one of the most common and powerful note-making and study aids available. Divide note-making sheets into two columns – the left 2.5 inches (6.25 cm wide) and the right 6 inches (15 cm wide). Leave a 2 inch (5 cm long) space at the bottom of each page to summarize the notes on that page. The accompanying strategy for Cornell notes can be summed up in the The Five Rs (Schumm, 2001):

1. **Record:** Take notes in the right-hand column during reading or instruction.

2. **Reduce:** Following the reading or instruction, use the left-hand column to summarize the notes by writing in key words, symbols, images, or relevant questions.

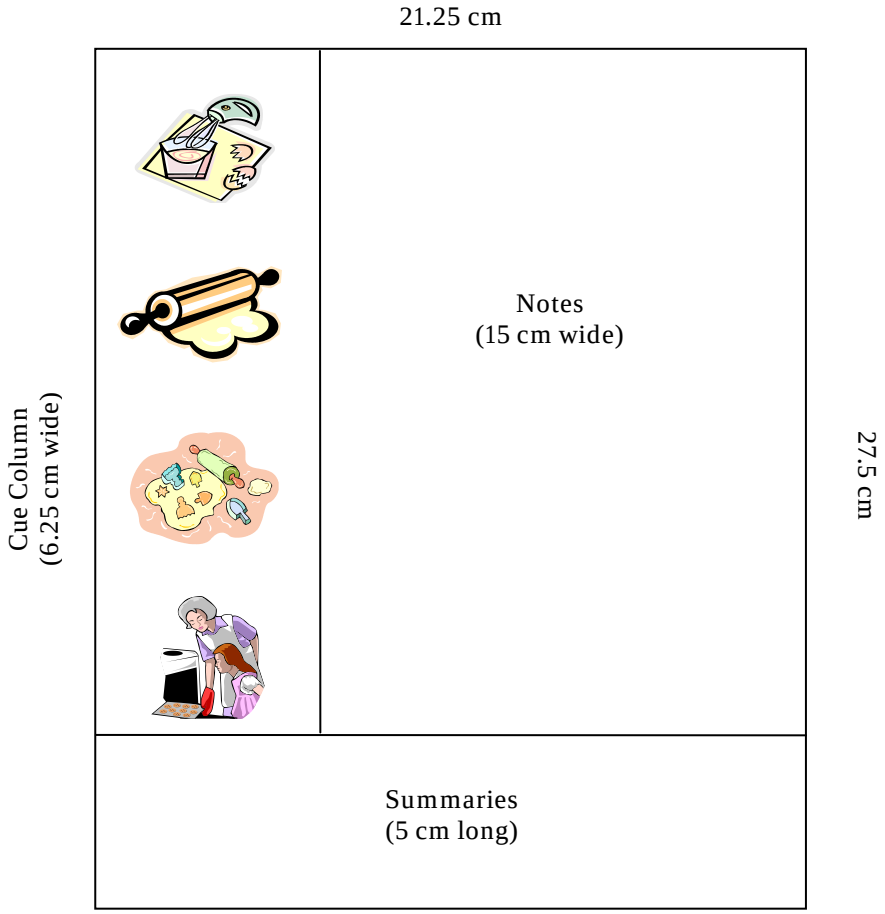
3. **Recite:** Cover the note-making column, and try to recite the information you cannot see based on the notes you have made. To study or review, cover the right-hand column, and use the abbreviated notes as a guide for questions.

4. **Reflect:** After a space of time, reflect on your notes and jot down any key ideas or questions at the bottom of each page.

5. **Review:** Review your notes on a regular basis so that the content can be easily accessed when needed.

Cornell Note-Taking System Variations

The cue column can contain main ideas, key words, questions, and/or drawings and symbols (Dodge, 1994). Students could also create a visual chronology of a multi-step process or detail sequential events in the cue column to create a visual representation of the material studied. (See the example below.)



Reflection

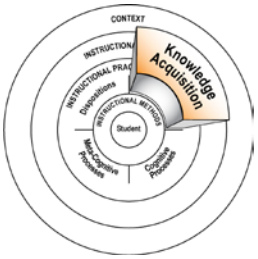
1. In what ways did adding note-making techniques support my planning for instruction?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



Note-Making

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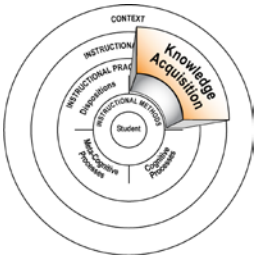
Guidance for Coaching

As administrators support teachers in teaching note-making techniques, they may meet with teachers prior to or after they have used these techniques. Carefully planning the questions that administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in a classroom where teachers are teaching note-making techniques effectively follow:

Examples of Questions	
Pre-Instruction • Which note-making technique do you plan to introduce to the students? • In what ways do you think this technique will support student learning? • In what ways will you monitor students' use of the technique? • In what ways will you collect evidence regarding the effectiveness of the technique?	**Post-Instruction** • How easy was it to teach this technique to your students? • What elements of the note-making technique did the students find beneficial? Not useful? • What evidence did you collect regarding the effectiveness of the technique? What did that evidence tell you? Did certain groups of students benefit more than others? • In what ways might you apply this technique in the future? • What elements of this technique might you adapt next time you use it? • What other note-making techniques are you planning to introduce to your students in the future?

Examples of Observations	
Teachers may be: • explicitly teaching note-making techniques • modelling note-making techniques • providing skeleton or partially completed notes to students • incorporating the activities of the Cornell Note-Taking System into ongoing instruction • teaching active listening skills.	**Students may be:** • completing pre-formatted note-making templates or skeleton notes • identifying key ideas, symbols, or creating questions from the notes they have taken • reciting, reflecting, and reviewing their notes • practising the skills of active listening • creating their own note-making systems.



Concept Attainment

Information for Teachers

What Is Concept Attainment?

Joyce and Weil (2004) define *concept attainment* as a method that "requires a student to figure out the attributes of a category that is already formed in another person's mind by comparing and contrasting exemplars that contain the attributes of the concept with exemplars that do not contain those attributes" (p. 62). They point out that this is not a name-guessing game, but a strategy to clarify the attributes of a category.

Our brains constantly seek to create patterns in new information. The concept attainment method invites the brain to look for patterns that lead to better memory retention and deeper understanding. Concept attainment requires students to engage in critical analysis of the attributes of concepts, rather than simply take the attributes from a description. Using analysis to identify patterns requires students to actively construct the meaning of concepts, rather than passively receive the information.

When using the concept attainment method, one must be very clear about the category one has in mind and the defining attributes of the concept, and take into account the range of values. When students have identified the concept, they must be provided opportunities to come to understand the attributes of the concept and then apply the attributes of the concept in a creative manner.

The concept attainment method can be used with students of all ages in all subject areas.

Concept Attainment is:

- a critical thinking skill
- a metacognitive activity
- a strategy that helps students identify patterns.

Teaching for Understanding

One role the teacher plays is to engage students in thinking related to concepts; to help them meaningfully grasp the design of a concept; to own it; to think and be creative with it. The reason for this is that our understanding of concepts is how we represent what we know; it brings meaning to facts, principles, systems, theorems, etc. You could argue that for every concept the students do not understand, the less likely they are to understand the meaning of the fact, or principle, or whatever. (Bennett & Rolheiser, 2001, p. 210)

Concept Attainment in Practice

Classroom Example

A Grade 1 social studies teacher uses roleplay to help students understand the concept of *cooperation*. Along with volunteer students, he presents alternating "yes" and "no" scenarios that illustrate cooperating and not cooperating. After each scenario, he asks the students to vote on whether the scenario illustrated cooperating or not cooperating. Below are examples of the types of scenarios that could be presented.

Examples of a "Yes"	Examples of a "No"
Call upon a student volunteer to roleplay drying dishes. Instruct the student to ask for some help when you walk up to him/her. When the student asks for help, pick up another tea towel and answer, "Okay, I'll help you."	Call upon a student to volunteer to roleplay drying dishes and to ask for help. Reply by saying, "No, I am too busy," and walk away.
Call upon a student volunteer to act as if she/he is having trouble closing the zipper of her/his jacket. When you walk towards the student, say, "May I help you do up your zipper?"	Call upon a student volunteer to act as if he/she is having difficulty doing up a zipper. This time just ignore the student and walk by.
Call upon a student volunteer to roleplay building a tower with blocks. She/he is to ask for help when you approach. You join the student and help build the tower.	Call upon a student volunteer to roleplay building a tower out of blocks. When she/he asks you for help say, "Sure, I'll help," and then kick the tower over.

After the teacher guides the students in presenting a few scenarios, he asks small groups of students to create and present their own "yes" and "no" scenarios to the rest of the class. The class then tries to determine whether each scenario is a "yes" or a "no."

Following the roleplays, the teacher discusses the “yes” idea. He asks the students, “What is the same in all of the “yes” examples?” “What is the “yes” idea?” He accepts their suggestions. Through discussion, he brings out the understanding that the “yes” idea is *cooperation*. He then asks the students to identify the attributes of cooperation. They discuss what cooperation looks and sounds like in the classroom. He guides the students to reflect on their thinking.

Following the discussion, the teacher asks the students to create a class story illustrating how cooperation wins the day, or make a book displaying examples and non-examples of the concept *cooperation*, using pictures from magazines.

Planning for Concept Attainment

Key Elements within the Method

Bennett and Rolheiser (2001) suggest that all concepts have four components:

Component	Example
1. Concept name: All concepts have a name (e.g., motorcycle, peace, cooperation, dendrite).	Motorcycle
2. Examples/Exemplars: Model cases must share one or more attributes.	All motorcycles have two wheels and an engine.
3. Attributes: All concepts have essential and non-essential attributes.	Essential: two wheels, engine Non-essential: chrome, size of engine
4. Value range: Some attributes have a range of values (e.g., colour, size, shape).	There are a range of wheel types and engine sizes on motorcycles.

When choosing exemplars, the first positive exemplar should be the best possible example of the attribute(s). Negative exemplars help students identify the boundary of the concept, especially if attribute values are in play. When possible, use physical examples.

Learners will examine the data set either holistically or by focusing on discrete elements. The way the data sets are introduced will determine the way in which some approach the analysis. There are advantages and disadvantages to each approach. Those approaching the data set holistically might be challenged if a number of essential attributes are present in both data sets. Those approaching the set by examining discrete elements will have to locate a new focus each time one of their theories is proven wrong.

An enjoyable introductory activity would be to play the game where students have sticky notes with the names of various famous characters on their backs. Students have to guess who they are by asking questions, and good questions lead to the essential attributes of the person they are trying to identify. Following the activity, the teacher asks students if they approached the problem by asking holistic or discrete (specific) questions.

It is important to wait until the end of the process to provide definitions, attribute lists, and classification of the concept. It can be tempting to reveal these details during the process, but it is important to allow students to think through the entire process before formalizing attributes and definitions.

Phases of the Concept Attainment Method

Prior to instruction:

1. Define the concept:

Component	Concept
1. Concept name	
2. Examples/Exemplars	
3. Attributes	**Essential:** **Non-Essential:**
4. Value range	

Adapted from Bennett, B., & Rolheiser, C. (2001). *Beyond Monet: The artful science of instructional integration*. Toronto, ON: Bookation Inc. Reprinted with permission.

2. Assemble 15-20 exemplars and non-exemplars that will be marked as parts of the data set. Assemble another 3-5 exemplars and non-exemplars that will be presented unmarked to test the attainment of the concept.

Phase One: Introducing the process and presenting the data set

- Introduce the process and explain its function. Ensure that students understand the terms *exemplar* and *attribute* or introduce more age-appropriate terms.
- Present the labelled exemplars and non-exemplars in alternating fashion to the students.
- At varying intervals, pause to have students individually write down their initial hypotheses and the reasons supporting each.
- Reveal about half of the data sets.

Phase Two: Sharing thinking and refining hypotheses

- Have students form small groups and share their initial thinking and hypotheses.
- Continue to present more data sets, and ask groups of students to work together to identify the concept.
- After the last data set is presented, ask students to name the concept and share their thinking regarding the essential attributes of the concept.

Phase Three: Testing attainment of the concept and extension

- After students have named the concept and its essential attributes, present unlabelled exemplars and non-exemplars to test the accuracy of their answer. If necessary, invite students to revise or to refine the essential attributes and/or the name of the concept.
- When the concept is accurately named and the essential attributes have been identified, have students name other examples of the concept.
- Create a formal definition and essential attribute list of the concept.

Phase Four: Reflecting on thinking strategies

- At the conclusion of the process, students should be engaged in a discussion regarding how their thinking changed during the concept attainment process.
    - Did students approach the attributes in the data sets as discrete elements or combine them in a holistic way?
    - What information did students use to create each of their hypotheses?
    - In what ways did students work to discriminate between attributes?
    - How might students approach this process differently in the future?
    - In what ways has this process strengthened students' understanding of the concept being taught?

Reflection

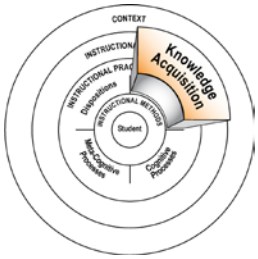
1. How was my planning affected?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



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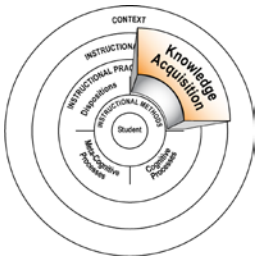
One role the teacher plays is to engage students in thinking related to concepts; to help them meaningfully grasp the design of a concept; to own it; to think and be creative with it. The reason for this is that our understanding of concepts is how we represent what we know; it brings meaning to facts, principles, systems, theorems, etc. You could argue that for every concept the students do not understand, the less likely they are to understand the meaning of the fact, or principle, or whatever. (Bennett & Rolheiser, 2001, p. 210)

Guidance for Coaching

As administrators, support teachers in the concept attainment process, they may meet with teachers prior to or after they have used the process. Carefully planning the questions administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are using the concept attainment practice effectively follow:

Examples of Questions	
Pre-Instruction • What concept are you planning to teach using the concept attainment process? • In what format are you planning to present the exemplars and non-exemplars (e.g., objects, demonstrations, pictures, written text)? • What challenges do you anticipate students will encounter as they work to attain the concept? • What significant understandings regarding the essential attributes of the concept are you hoping students will take from this lesson? • In what ways are you planning for students to work with this concept following the concept attainment process?	**Post-Instruction** • How effective were the data sets in allowing students to identify the essential attributes of the concept? What might you change for next time? • How accurate were students' initial hypotheses? What misconceptions did students' initial hypotheses reveal? • What seemed to be the key attribute that enabled students to identify the concept? • In what ways did you notice student understanding was increased? • How easily could students provide their own examples of the concept? • What will you adapt the next time you use this process?

Examples of Observations	
Teachers may be: • presenting exemplars and non-exemplars to students • asking students to explain the thinking behind hypotheses • asking students to provide examples of the concept being demonstrated • using language that includes "This is a yes," and "This is a no."	**Students may be:** • creating and testing hypotheses, individually and in small groups • defending the thinking behind an individual or group hypothesis • identifying exemplars and non-exemplars of the concept • using and applying the concept in creative ways.



Activating Prior Knowledge

Information for Teachers
What Is Activating Prior Knowledge?

Activating prior knowledge is an instructional practice that is foundational for ensuring that students are prepared to learn new information. While there is not one discrete method for activating prior knowledge, there are many ways one may attend to this need through a variety of instructional methods. Research has proven that attending to this instructional practice increases students' ability to connect with new material and to construct new knowledge and understandings in congruence with what they already know. The methods presented in this document are examples of instructional methods tailored to activate the prior knowledge of students.

Activating prior knowledge is based on Anderson's (1977) Schema Theory. Schemas are the rules or scripts we hold in our minds to interpret the world. When encountering new information, we compare what is already in our schema to what we are learning. Schemas are used to interpret information we are receiving and to predict what might happen next based on our existing schema. Schema theory suggests that knowledge is based on the meanings we apply to things. We represent this knowledge through propositions (e.g., the earth is round) or theories. Schemas are actively constructed and revised throughout the learning process. Schemas can include our understanding of a discipline or context as well as our cultural and experiential background. Activating prior knowledge is a critical activity in comprehension because our prior knowledge is the base upon which new knowledge is built.

Kujawa and Huske (1995) suggest the following:

> Prior knowledge is a composite of who we are and what we know about content and about strategies we have learned from both our academic and everyday experiences. The information we have may be complete or incomplete, correct or incorrect, or filled with misconceptions. . . . Our collective experiences are the fundamental strengths we bring to learning; they are the conceptual and experiential base upon which new concepts are built. (p. 3)

Lipton and Wellman (1998) assert that students who are unsuccessful bring no prior knowledge to their work because they have no strategies for linking their previous knowledge to new information. Activating prior knowledge allows these students to access what they already know and to build frameworks within which they can make sense of new information.

Activating Prior Knowledge is:

- a critical factor in comprehension
- a strategy that ensures new knowledge is integrated with prior knowledge
- a psychologically safe way to surface and address misconceptions.

Teaching for Understanding

Through this process [of activating prior knowledge], we move students from memorizing information to meaningful learning, and begin the journey of connecting learning events rather than remembering bits and pieces. Prior knowledge is an essential element in the quest for meaning making, changing the isolated learning of unconnected skills into a comprehensive accumulation of new knowledge. (Kujawa & Huske, 1995, p. 3)

Activating Prior Knowledge in Practice

Classroom Example 1

A Christian Ethics 20 teacher decides to use a brainstorm-and-categorize tactic to engage the prior knowledge of the students at the beginning of a unit on sacrament traditions. He invites students to brainstorm all of the sacrament traditions that they have encountered or know about. Following their brainstorm, the students group the sacraments using categories such as liturgical seasons, denominations, or doctrine. The teacher uses this information as an informal assessment of students' prior knowledge and frames of reference regarding the sacrament traditions.

Classroom Example 2

In the Grade 2 health education outcome on illness and disease, the students wonder and question their prior knowledge of how health is affected by illness and disease. The teacher creates a wall-sized anticipation/reaction guide as follows:

When We Are Sick

Our First Ideas:		True or False?	Our New Ideas:	
True	False		True	False
		I have a cold and sneeze on my hand, then touch the library books. Other students could catch my cold.		
		Illnesses can be serious or not serious.		
		You can tell a person is sick by looking at him/her.		
		People can see germs.		
		Drinking lots of fluids is important when you are sick.		

The teacher reads each proposition out loud to the class. Each student has a Popsicle stick with a happy face on one side and a sad face on the other. After the teacher reads each proposition, students display a happy face if they think the proposition is true and a sad face if they think the proposition is false. After each, the teacher asks students to explain why they think this. The teacher records their votes on the wall chart. Each student has a copy of the wall chart where he/she records his/her individual responses.

Following their voting, students proceed in small groups through five stations that address each of the propositions. As students acquire the information, compare ideas, make connections, and shape new thoughts regarding each of the propositions, they mark either true or false on the right side of their sheets and prepare to support that position.

When students complete their investigation at the stations, the teacher reconvenes the large group, and they begin to discuss what they have learned following their first votes.

Planning to Activate Prior Knowledge

Lipton and Wellman (1998) identify three key activities when introducing new material:

1. Engage prior knowledge and understandings.
2. Expand the mutual knowledge base by using individual and group work to organize an exchange of information.
3. Surface and articulate frames of reference that students are bringing to the learning situation.

A variety of tactics, such as associating, brainstorming, anticipating, reacting, enumerating, estimating, forecasting, hypothesizing, identifying, predicting, problem posing, recalling, speculating, and visualizing can be employed to activate students' prior knowledge. The following are examples of three methods for activating prior knowledge.

1. Anticipation/Reaction Guide

Anticipation/reaction guides help students respond to a series of propositions taken from a text about to be read or from a lesson about to be taught. Prior to the lesson, students read each proposition and indicate whether they think it is true or false. The teachers should assure students that it is acceptable to be wrong. Students may also give reasons to defend their decisions. During the reading or discussion, students should be instructed to watch for each proposition to see if it is true or false. As each proposition is located, students indicate on the right side of the sheet the actual answer, make notes, and document the source of the information.

This strategy engages students throughout the reading or lesson as they discover whether their initial responses are correct or incorrect. Student misconceptions are revealed, and new knowledge is added to their initial thinking.

Prior Knowledge Topic Survey

Anticipation/Reaction Guide

Instructions: Respond to each statement twice: once before the lesson and again after reading it.

_____ Write A if you agree with the statement.
_____ Write B if you disagree with the statement.

Response before Lesson	Topic:	Response after Lesson

Kujawa, S., & Huske, L. (1995). *Strategic teaching and reading project guidebook*. Oak Brook, IL: North Central Regional Educational Laboratory. Reprinted with permission from Learning Point Associates, an affiliate of American Institutes for Research.

2. Graphic Organizers

Graphic organizers are another method for students to activate prior knowledge. A simple bubble map can be used for students to indicate all they know about a topic prior to instruction. This process makes thinking visible and allows for informal assessment of content knowledge, connections between ideas, and the cultural/experiential frames students bring to the topic at hand.

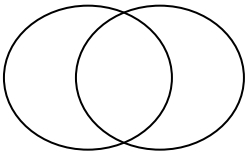
There are a variety of associating techniques that allow students to make associations to new content. Techniques involving the creation of analogies or the use of Venn diagrams can allow students to build associations from their past knowledge and to experience new ideas.

Example 1:

A _____ is like reducing fractions because _____ .

Example 2:

As we continue in our study of Saskatchewan's First Nations people, use the following Venn diagram to list all of the similarities and differences between the Cree and Dene.

Cree  Dene

3. Brainstorming

There are many excellent brainstorming tactics that allow students to generate all they know about a topic prior to instruction. Lipton and Wellman (1998) present a variety of brainstorming tactics in their book *Pathways to Understanding: Patterns and Practices in the Learning-Focused Classroom*:

Brainstorm and Pass	Students in groups take turns offering one idea on the topic at hand. If someone does not have an idea at her/his turn, she/he can pass.
Brainstorm and Categorize	Students brainstorm ideas related to the topic, then categorize their ideas and provide titles for each category.
Modality Brainstorming	Students brainstorm ideas related to the topic. The students code their ideas as visual, kinesthetic, auditory, and olfactory/gustatory, based on how the idea occurred in their brain.
Brainstorm with Side Trips	Students brainstorm on an imaginary journey with the following side trips: places, things/objects, personas, and time periods. Other side trips can be created as students' imaginations allow!
Carousel Brainstorming	The teacher writes a set of questions or topics on chart paper and places them around the room. Small groups of students rotate from station to station, brainstorming as much as they can until they have visited all of the stations.

Reflection

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3. I noticed . . .

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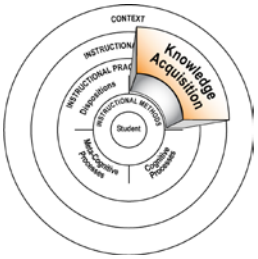

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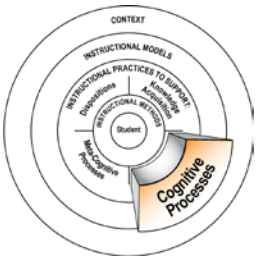
Guidance for Coaching

As administrators support teachers in activating students' prior knowledge, they may meet with teachers prior to or after they have used the practice. Carefully planning the questions that administrators ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are activating students' prior knowledge follow:

Examples of Questions	
Pre-Instruction • As you consider your upcoming lesson, in what ways would you like to activate students' prior knowledge? Brainstorm? Analogy? Concept Web? Anticipation/reaction? • In what ways do you think this technique will support student learning? • In what ways will you monitor students' learning and use of the technique? • In what ways will you use the information provided by the students to adapt your instruction? • In what ways do you plan to address student misconceptions?	**Post-Instruction** • How easy was it to teach the technique you chose to your students? • In what ways did students approach their learning following the use of a technique to activate prior knowledge? • What student ideas surfaced as you used this strategy? Were any ideas surprising? concerning? • In what ways might you apply this strategy in the future? • What elements of this technique might you adapt the next time you use it?

Examples of Observations	
Teachers may be: • having students complete analogies • administering what appears to be a true/false test • asking students to defend their position on a proposition • adapting instruction in response to the prior knowledge of students • critically examining the bias in instructional materials and processes • working to ensure instruction honours the culture and past experiences of students.	**Students may be:** • answering what appear to be true/false tests • working in small groups to brainstorm or to read a text • defending their positions on a proposition • creating visual representations of their prior knowledge • reading intently to discover if propositions are true or false • sharing personal stories prior to instruction.



Section III: Cognitive Processes

Synectics

Information for Teachers

What Is Synectics?

Synectics was designed in 1961 by William J. J. Gordon as a process for stimulating and sustaining creative thinking. In his study of how people solve problems, Gordon discovered that those who practised divergent, metaphorical thinking came up with the most creative solutions. He went on to outline the thinking process that we now know as *synectics*.

Synectics is derived from the Greek *syn* – bring together, and *ektos* – diverse elements. *Synectics* has also been defined as making the familiar strange, and the strange familiar. The foundation of synectics is metaphorical thinking where a likeness or analogy between objects or ideas is created to stimulate divergent, creative thinking.

Synectics activities can be used in a variety of contexts with two main purposes: 1) creating new thinking or ideas, or 2) making the strange familiar. Synectics helps create new thinking when brainstorming, pre-writing, examining divergent sides of an issue, or discussing a controversial topic. When introducing new (strange) material to students, synectics allows students to apply their prior knowledge in a familiar area to the new information about to be taught.

Synectics is most powerful when used as a collaborative activity. This allows a variety of viewpoints and creative ideas to be shared. Seligmann (2007) suggests that "one of synectics' unique strengths lies in its ability to individualize instruction by empowering the student to construct knowledge based on his own strengths and interests" (p. 15). Synectics is a powerful tool in a constructivist classroom.

The metaphorical thinking encouraged when using synectics is very powerful for students of all abilities. The sequence of thinking activities gives students a scaffold for thinking in a more divergent manner.

Synectics is:

- a structured process for stimulating and sustaining creative thinking
- a way to link prior knowledge to new concepts
- a powerful thinking scaffold for struggling students.

Teaching for Understanding

The active construction of concepts and original ideas is a constructivist approach to the development of understanding. As students think metaphorically using analogies to explore concepts and using compressed conflict to articulate their understanding of concepts, students develop a deeper understanding of the concepts being studied.

Synectics in Planning and Practice

Planning

Three metaphorical processes are used: direct analogy, personal analogy, and compressed conflict.

1. Direct Analogy: Students are asked to suggest similarities between two ideas or objects (e.g., In what ways is freedom like a highway?).

2. Personal Analogy: In the synectics process, students are asked to assume the viewpoint of one of the objects used in the analogy (e.g., You are the highway. What experiences and thoughts are you having?).

3. Compressed Conflict: Near the end of the process, students are asked to pair words or concepts that are seemingly opposite (e.g., defined freedom).

Two Synectics Strategies: Creating Something New and Making the Strange Familiar

(Joyce & Weil, 2004)

Classroom Example 1: Creating Something New

A Grade 10 English Language Arts B10 class has completed reading and viewing *Macbeth*. The teacher asks the students what character or idea they would like to explore further and what questions they are inquiring about as they explore and consider Macbeth's character. The students are fascinated by Macbeth's actions and would like to spend time exploring his character in the context of the "Equity and Ethics" unit (Who and What Is Right? Empowerment, Degrees of Responsibility, Rights and Responsibilities, Justice and Fairness).

Phase One: Description of Present Situation

- Teacher has students describe the situation (Macbeth) as they see it.
  - The students indicate that they want to explore the character of Macbeth.
  - The teacher asks students to write a short paragraph describing Macbeth.
  - The students share their paragraphs and decide that they do not capture the interesting aspects of Macbeth.

Phase Two: Direct Analogy

- Students suggest direct analogies, select one, and explore or describe it further.
  - In order to extend their thinking and spark some creativity, the teacher asks the students to supply some direct analogies by giving them the following stem, "Macbeth is like a _____."
  - The students supply analogies such as "Macbeth is like a virus" and "Macbeth is like a grass fire."
  - The teacher asks students to develop their analogies further by adding details from the play.

Phase Three: Personal Analogy

- Students personalize the analogy they selected in Phase Two.
    - The teacher encourages the students to personalize the analogy by viewing the play through the lens of the analogy. For example, students become the grass fire. How does a grass fire perceive the events of the play? How does a grass fire think throughout the play? Who started the grass fire? Why couldn't the grass fire be controlled?
    - Students' ideas are written down as they are shared, either by the teacher or by a partner. Vivid images and phrases are highlighted.

Phases One through Three initiated creative, divergent thinking for students in order to open up their analysis and interpretation of Macbeth's character. The previous processes enabled students to generate creative analogies and viewpoints regarding Macbeth. In Phases Four and Five, students will be asked to create *compressed conflicts* by combining unlikely pairs of analogies. Students then create new direct analogies using the compressed conflict as a springboard. This is done to stimulate even more divergent and creative thinking.

Phase Four: Compressed Conflict

- Students take their descriptions from Phases Two and Three, suggest several compressed conflicts, and choose one.
    - Students suggest ideas such as *hesitant tyrant* and *insane sovereign*.
    - After the students have created a list of compressed conflicts, the teacher asks students to choose one.

Phase Five: Direct Analogy

- Students generate and select another direct analogy, based on the compressed conflict.
    - The students choose *hesitant tyrant* to build a new analogy. Thinking of hesitant tyrant as a guide for the new analogy, students suggest ideas such as Macbeth is like a bear, rattlesnake, terminal illness, and so on.

Phase Six: Re-examination of the Original Task

- The teacher has students move back to the original task or problem and to use the last analogy and/or the entire synectics experience.
    - The teacher reminds the class that their original intent was to explore the character of Macbeth. Through the synectics process, students have had an opportunity to explore a variety of creative descriptions of his character.
    - When asked to choose their favourite final analogy, students choose terminal illness.
    - The teacher asks students to write or to represent how Macbeth is a terminal illness in Scotland.

Classroom Example 2: Making the Strange Familiar

A Grade 6 science class is studying classification systems used to organize human understanding of living things as part of the "Life Science: Diversity of Living Things" unit.

Phase One: Substantive Input

- The teacher provides information on the new topic.
    - The teacher informs students that they are going to begin studying the system scientists use to organize or to classify living things. The teacher writes the terms *kingdom, phylum, class, order, family, genus,* and *species* on the board. The teacher assigns pairs of students to each word and uses the Show, Don't Tell instructional tactic to have students define the words. Using reference material and dictionaries, the students are instructed to create a definition of the term in their own words, draw a visual of the word, and create a motion to show the word. When they have completed their research, each pair of students shows the class its picture and motion, and the other students try to guess the word. Once the word has been guessed, the pair shares its definition with the class. The whole class then reviews the term, the definition, the picture, and the motion.

Phase Two: Direct Analogy

- The teacher suggests a direct analogy between the classification system and vehicles, and asks students to describe the analogy.
    - After briefly explaining the terms within the classification system, the teacher asks students to think about the connections students see between these terms and vehicle manufacturers. The students create the following chart:

Kingdom	All vehicle manufacturers
Phylum	General Motors
Class	Domestic Vehicles
Order	Passenger Vehicles
Family	Cars
Genus	Hybrids
Species	Malibu

Phase Three: Personal Analogy

- The teacher tells students to personalize the analogy by "becoming" the direct analogy.
    - The teacher asks students to become a Malibu searching for its origins, and asks students to create a descriptive paragraph detailing the Malibu's thoughts on its journey to its maker.
    - The students brainstorm. One of the paragraphs begins, "I am driving around the parking lot looking for more of my kind. All I can see are trucks, cars, and SUVs. Finally, I see another hybrid – one of my own! I then realize that I'm just a more fuel-efficient version of the many cars in the lot and that we're all designed to carry passengers. . . ."

Phase Four: Comparing Analogies

- Students identify and explain the points of similarity between the new material and the direct analogy.

Phase Five: Explaining Differences

- Students explain where the analogy does not fit.

For Phases Four and Five, the teacher asks the students to complete a T-Chart where students identify similarities and areas where the analogy does not fit.

Similarities	Areas Where the Analogy Does Not Fit
• Each object shares a similar quality at each level of the system. • Objects are differentiated based on their design, function, and appearance. • One can start at any point in the system and move to more general or more specific characteristics.	• Cars are not living things. • Cars cannot breed between species, resulting in a different species of car. • The designs of cars are not adapted to their surroundings. • There are usually no anomalies in cars.

Phase Six: Exploration

- Students re-examine the original topic in its usual context.
    - The students choose a favourite animal or pet and use reference material to complete the classification system.
    - Students create a visual representation of how the elements of the classification system work together and how they classified their favourite animal or pet.
    - Students reflect on their insights, challenges, and questions following the process.

Phase Seven: Generating Analogy

- Students provide their own direct analogy and explore the similarities and differences.
    - Students brainstorm and attempt to create analogies using structures such as professional sports leagues, styles of music, and genres of movies.
    - Each student group is required to present its analogy to the other students and to discuss its strengths and weaknesses.
    - After students share their analogies, the teacher asks students to write a brief explanation of the classification system in their own words. The majority of students write explanations that are thoughtful and insightful.

Synectics for Younger Students

Lipton and Wellman's (1998) book *Pathways to Understanding* details the processes for Four Box Synectics and Visual Synectics. Both processes incorporate the use of visuals and are less rigorous in their design than the examples presented above.

Reflection

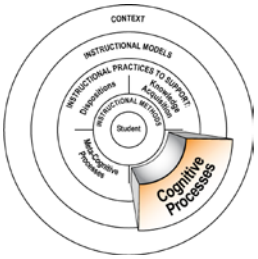
1. How was my planning affected?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



Synectics

Information for Administrators

What Is Synectics?

In 1961, William J.J. Gordon designed synectics as a process for stimulating and sustaining creative thinking. In his study of how people solve problems, he discovered that those who practised divergent, metaphorical thinking came up with the most creative solutions. He went on to outline the thinking process that we now know as *synectics*.

Synectics is derived from the Greek *syn* – bring together, and *ektos* – diverse elements. *Synectics* has also been defined as making the familiar strange, and the strange familiar. The foundation of synectics is metaphorical thinking, where a likeness or analogy between objects or ideas is created to stimulate divergent, creative thinking.

Synectics activities can be used in a variety of contexts with two main purposes: 1) creating new thinking or ideas, or 2) making the strange familiar. Synectics helps create new thinking when brainstorming, pre-writing, examining divergent sides of an issue, or discussing a controversial topic. When introducing new (strange) material to students, synectics allows students to apply their prior knowledge in a familiar area to the new information about to be taught.

Synectics is most powerful when used as a collaborative activity. This allows a variety of viewpoints and creative ideas to be shared. Seligmann (2007) suggests that "one of synectics' unique strengths lies in its ability to individualize instruction by empowering the student to construct knowledge based on his own strengths and interests" (p. 15). Synectics is a powerful tool in a constructivist classroom.

The metaphorical thinking encouraged when using synectics is very powerful for students of all abilities. The sequence of thinking activities gives these students a scaffold for thinking in a more divergent manner.

Synectics is:

- a structured process for stimulating and sustaining creative thinking
- a way to link prior knowledge to new concepts
- a powerful thinking scaffold for struggling students.

Teaching for Understanding

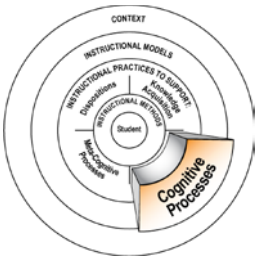
The active construction of concepts and original ideas is a constructivist approach to the development of understanding. As students think metaphorically, using analogies to explore concepts and using compressed conflict to articulate their understanding of concepts, students develop a deeper understanding of the concepts being studied.

Guidance for Coaching

As administrators support teachers in using synectics, you may meet with teachers prior to or after they have used this process. Carefully planning the questions that administrators will ask teachers essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are using synectics effectively follow:

Examples of Questions	
Pre-Instruction • In what ways might you include synectics in some upcoming instruction? • Are you planning to use synectics to create something new or to make the strange familiar? • What challenges do you anticipate students will encounter as they work through the synectics process? • Have you created examples of the type of thinking you would like students to do at each step in the process? • In what ways are you planning to have students use or apply their understandings?	**Post-Instruction** • Which parts of the process did students engage with the most? The least? • What student responses or thinking surprised you as you worked through the process? • Which students seemed to benefit the most from this process? • In what ways did you notice student understanding was increased? • How easily could students create their own analogies? • What will you adapt the next time you use this method?

Examples of Observations	
Teachers may be: • guiding students through a series of steps • asking students to create and to discuss "strange bedfellows" regarding the concepts at hand • asking questions about analogies created by students • encouraging divergent thinking and collaboration among students.	**Students may be:** • working collaboratively to examine or to create analogies • "becoming" analogies and explaining concepts, characters, or events from what seems to be a strange viewpoint • creating interesting and sophisticated pairs of words to describe concepts, characters, or events • creating definitions or explaining concepts in their own words.



Graphic Organizers

Information for Teachers
What Are Graphic Organizers?

Clarke (1990) defines *graphic organizers* as "words on paper, arranged to represent an individual's understanding of the relationship between the words" (p. 30). As students work with words that represent concepts and ideas, graphic organizers are a means of ordering and structuring the relationships among them. Graphic organizers provide students a "field organized to help them find meaning in the content [they are studying]" (Clarke, 1990, p. 45).

Perhaps the greatest benefit of using graphic organizers is that they provide a window into the thinking of students as complex thinking skills are represented in discernible ways. Graphic organizers help to make thinking visible for both students and teachers so that thinking can be reflected upon, discussed, and refined. This opportunity to see students' thinking makes graphic organizers an excellent medium for formative assessment while students are constructing new knowledge and understandings.

As students become more adept in the design and application of graphic organizers, they will begin to bring to their work the ability to see problems in terms of organizing patterns – something that experts in a discipline do. Graphic organizers help to develop sophisticated thinking skills in students that increase their understanding.

Graphic organizers are:

- a medium for building understanding
- ways to teach thinking patterns that apply to all areas of study
- a medium that is open-ended, and the design is dictated by the student's thinking
- a strategy that is effectively used in conjunction with other graphic organizers.

Teaching for Understanding

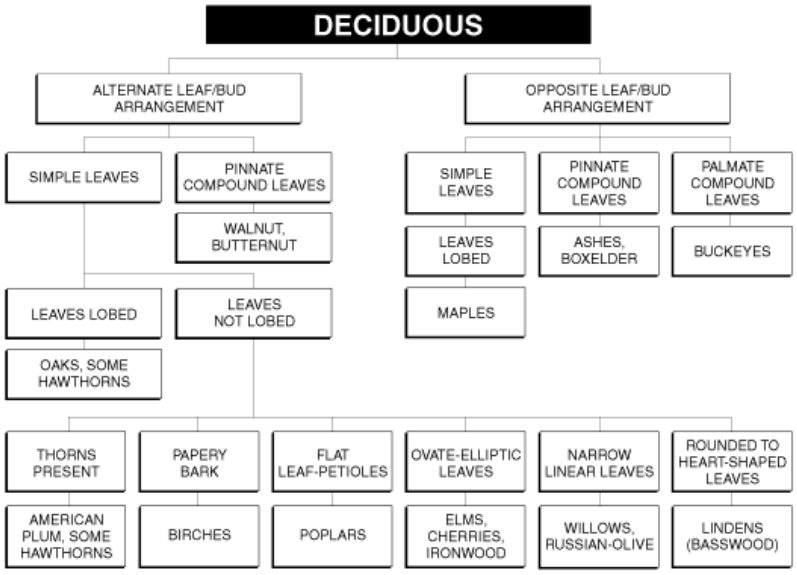
Graphic organizers support teaching for understanding by making thinking visible. As students explore the relationships between concepts and ideas, and look for ways to build and to refine classification systems and arguments, they are actively involved in thinking with the concepts they are studying, rather than memorizing discrete facts.

Graphic Organizers in Practice

Classroom Example 1

A Grade 11 science teacher wants to teach his students about dichotomous keys and their usage for classifying natural things. To introduce the concept, the teacher asks the students to create a dichotomous key for their class based on hair. The students begin by dividing the class by straight and curly hair. They further divide each of the new groups by long and short hair. Next, they divide each of the four groups by hair colour and continue on until their dichotomous key identifies every student in class. For homework, the teacher asks the students to bring as many different leaves as they can from home.

The next day, the teacher provides the students with the following dichotomous key and asks students to identify their leaf samples.



Retrieved April 2, 2008, from http://www.ag.ndsu.edu/pubs/plantsci/trees/eb38-01.gif
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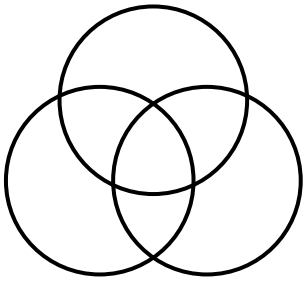
Classroom Example 2

A Food Studies 20 teacher asks students to use a Venn diagram to compare three types of cakes: (1) butter or shortened, (2) foam or sponge, and (3) chiffon. This teacher would use a triple Venn diagram (see example) so students could locate unique features of each, similarities shared between pairs of two cakes, and similarities shared by all three cakes.

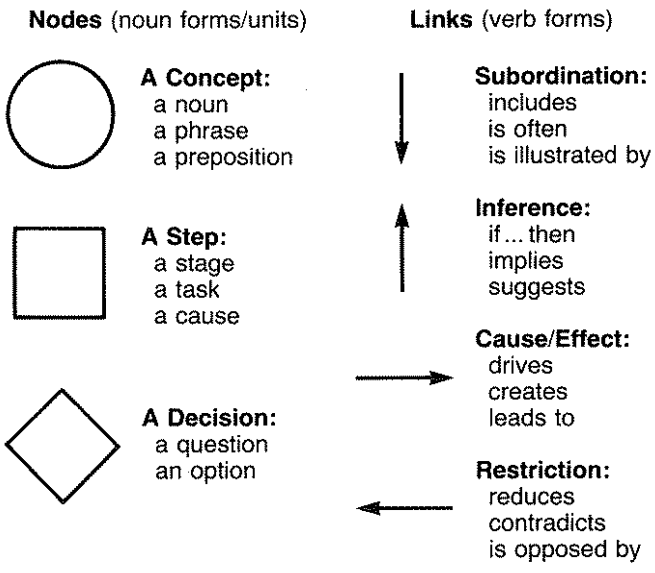


Planning for Graphic Organizers

Graphic organizers are more than templates that students complete. To make graphic organizers more powerful, students should be taught the rules for designing and using graphic organizers, as well as be given opportunities for creative adaptation of the organizers with which they are working.

Teachers should begin with simple diagrams and few rules when introducing graphic organizers to students, and work with one organizer until students are comfortable with it before introducing new ones.

Typically, there is no meaning associated with shapes within graphic organizers, but if distinction is important, the following rules from flow charting can apply:



Clarke, J. H. (1990). *Patterns of thinking: Integrating learning skills in context*. Needham Heights, MA: Allyn and Bacon. Reprinted with permission.

When teaching thinking skills such as graphic organizers, Beyer (1987) recommends the following steps:

1. Introduce
2. Gradual practice of the skill, with plenty of demonstration
3. Individual application in a familiar context
4. Transfer and elaboration, exportation to new contexts and more complex forms
5. Guided practice in new situations
6. Autonomous use

The goal is to help students build a repertoire of graphic organizers to apply in a variety of situations.

Type of Thinking	Organizers such as . . .
Generating and Identifying Ideas	Webs KWL Chart Concept Frame
Defining in Context	Circle Map
Describing	Bubble Map T-Chart Venn Diagram PMI
Classifying	Classification Wheel Classification Key/Tree Map Dichotomous Key Classification Table
Compare/Contrast	Double Bubble Map Venn Diagram
Whole – Parts	Concept Map Mind Map
Sequencing	Flowchart – linear or cyclic Timeline Date Line Fishbone
Cause-Effect	Multi-flow Maps Fishbone Interrelationship Diagram
Problem Solving	Decision-Making Tree or Chart Pros/Cons Advantages/Disadvantages Table Graphs Tables
Seeing Analogies	Bridge Map

Examples of the above can be found in:

Hyerle, D. (Ed.). (2004). *Student success with thinking maps: School-based research, results, and models for achievement using visual tools*. Thousand Oaks, CA: Corwin Press.

Hyerle, D. (n.d.). Designs for Thinking. Retrieved August 17, 2011 from http://www.mapthemind.com/index.html.

Walker, C., & Antaya-Moore, D. (1999). *Thinking tools for kids: Practical organizers*. Edmonton, AB: Edmonton Public Schools, Resource Development Services.

Reflection

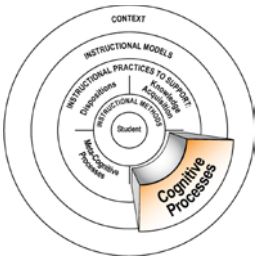
1. In what ways was my planning affected by incorporating graphic organizers?

2. In what ways did students interact with the graphic organizers? Who was advantaged? Who was disadvantaged?

3. In what ways was students' thinking made visible?

4. When I do this again . . .

5. Student learning seemed to be . . .



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Perhaps the greatest benefit of using graphic organizers is that they provide a window into the thinking of students as complex thinking skills are represented in discernible ways. Graphic organizers help to make thinking visible for both students and teachers so that thinking can be reflected upon, discussed, and refined. This opportunity to see students' thinking makes graphic organizers an excellent medium for formative assessment while students are constructing new knowledge and understandings.

As students become more adept in the design and application of graphic organizers, they will begin to bring to their work the ability to see problems in terms of organizing patterns – something that experts in a discipline do. Graphic organizers help to develop sophisticated thinking skills in students that increase their understanding.

Graphic Organizers are:

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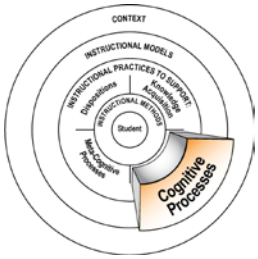
Graphic organizers support teaching for understanding by making thinking visible. As students explore the relationships between concepts and ideas, and look for ways to build and to refine classification systems and arguments, they are actively involved in thinking with the concepts they are studying, rather than memorizing discrete facts.

Guidance for Coaching

As administrators support teachers in using graphic organizers, they may meet with teachers prior to or after they have used this technique. Carefully planning the questions that administrators will ask teachers is essential as they support the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are using graphic organizers effectively follow:

Examples of Questions	
Pre-Instruction • What knowledge will students be learning? • What type(s) of thinking are you planning to support through the use of one or more graphic organizers? • What graphic organizers do you plan to use? • How will you introduce this graphic organizer to your students? • What types of formative assessment data will you be looking for as students make their thinking visible? • In what other contexts are you planning to have students use the graphic organizer they have been taught?	**Post-Instruction** • As you consider your use of graphic organizers, what stands out for you regarding your use of the organizer and students' engagement? • What factors contributed to what you have described in your use of the organizer? • What things will you keep the same the next time you use this organizer? What things would you like to change? • In what ways did the graphic organizer you used help make student thinking visible? • In what ways were you able to respond to the students' thinking? • Which of your ideas do you plan to implement the next time you use this organizer?

Examples of Observations	
Teachers may be: • teaching how graphic organizers are designed and having students construct them • expressing ideas and concepts visually and encouraging students to do so as well • asking students questions regarding the relationships identified within the graphic organizers being constructed or completed.	**Students may be:** • designing or completing graphic organizers • practising using graphic organizers for a variety of tasks • thinking deeply about and discussing the decisions made regarding the relationships within the content being studied • inquiring more deeply and broadly.



Manipulatives in Mathematics

Information for Teachers
What Are Manipulatives?

Manipulatives are included as one of a variety of representation strategies that students can employ as they study math. Moyer (2001) reports that "current research in mathematics education views students as active participants who construct knowledge by reorganizing their current ways of knowing and extracting coherence and meaning from their experiences" (p. 176). Fennell and Rowan (2001) suggest that using representations such as manipulatives "helps students organize their thinking and try various approaches that may lead to a clearer understanding and a solution" (p. 289). Reak, Stewart, and Walker (1995) state that "working with manipulatives gives students an opportunity to explore abstract concepts while manipulating concrete objects" (p. 20).

Manipulatives are best utilized when they are purposefully used to mediate students' conceptual thinking. Encouraging students to collaborate and to talk about their thinking while working with manipulatives is critical as students construct knowledge together.

There are many types of concrete manipulatives that a teacher may employ. Virtual manipulatives are also becoming increasingly popular as computers are more accessible in classrooms. Using a combination of concrete and virtual manipulatives has been shown to increase student understanding in mathematics. Each carries benefits but, when used together they are more powerful in improving student learning outcomes.

Using manipulatives to help mediate students' conceptual thinking has been proven to improve the learning of students of all ability levels. Steen, Brooks, and Lyon (2006) report statistically significant gains for all students who use manipulatives. Their findings also suggest that students who begin instruction with an ability level lower than their peers either catch up to, or surpass, their peers after using manipulatives. Miller, Butler, and Lee (1998) report that using manipulatives within a process of instruction, moving from concrete to semi-concrete to abstract, produced statistically significant gains for students with learning disabilities. Their research also suggests that skill and understanding developed using manipulatives transfers to abstract work. Incorporating manipulatives into math instruction leads to long-term retention of concepts and skills (Miller, Butler, & Lee, 1998).

Manipulatives are:

- valuable for mediating student thinking as they learn abstract concepts
- beneficial for all students, but especially for students who are having difficulty understanding particular concepts
- valuable for the development of abstract thinking and deeper understanding of mathematical concepts.

Teaching for Understanding

In today's world, mathematics is much broader than computation. Emphasis is on communication and complex problem solving. Rather than teaching specific rules for specific problems, teachers must help students develop thinking tools so that they are ready to meet the challenge of any new problem with confidence and enthusiasm. (Reak, Stewart, & Walker, 1995, p. 20)

Manipulatives in Practice

Classroom Example

As part of the Numbers Strand of the Grade 2 Mathematics Curriculum, students are exploring different representations of whole numbers to 100, strategies for counting, and strategies for estimating sums and differences. The teacher chooses the following extension activities:

A. Encourage students to use a variety of manipulatives (e.g., seeds of various kinds, units from base 10, buttons, bread tags) to estimate what 100 would be. After making an estimate, ask students to use some form of grouping to count the items. Have the students reflect in writing how near they were to the target of 100. Suggest that students repeat the activity and reflect upon whether they were able to make a closer estimate this time. It is important that students share and compare their strategies for estimating **before** counting. Also, students should be deciding on strategies for counting (and not being told to use grouping, for example).

B. Using a deck of cards, have students create a smaller deck containing 2 to 9 in each of the four suits; set the remainder of the cards aside. Instruct students to take turns turning over two cards and deciding what the number will be. For example, if a 2 and a 4 are turned over, they can choose to have 42 or 24. On the next student's turn, the two cards turned over should be used to make a number that, when added to the previous number, will make the sum as close as possible to 100. Encourage the students to use a variety of tools including calculators, proportional base 10 materials, and other manipulatives to determine the final sum. Students should decide whether being close to 100 can include being larger than 100. Ask the students to explain the strategies used to make their decisions.

C. Using grid paper, have the students cut out as many arrangements of five squares as possible (that do not fall apart). Have the students compare all of the arrangements and duplicate only those that may have been missed. Next, have the students use any or all of these arrangements to build/design a 2-D shape or picture and determine the number of squares in his/her creation. Ask the students to explain how his/her understanding of skip counting is related to the total number of squares in his/her creation.

Adapted from: Saskatchewan Learning (2005). *A companion resource for grade two mathematics*. Regina, SK: Author.

Planning for Manipulatives

The teacher's theoretical and practical knowledge in the use of manipulatives has a direct effect on student achievement (Moyer, 2001). Teachers must be skilled in their understanding and employment of manipulatives to ensure their effectiveness.

It is important not to take students step-by-step through problems. Students should explore on their own, with the teacher acting as a guide and providing a guiding structure or reason for the use of the manipulatives so that student work is focused on a specific problem.

It is important for students to work through a variety of representations as they work with manipulatives. For example, Suh and Moyer (2007) suggest that students be encouraged to represent their thinking in a variety of ways such as drawings, symbols, and written explanations.

As students work with abstract concepts, they move through three levels of reasoning and understanding: concrete, representational, and abstract.

Concrete:

> Given a problem to solve, students should have an opportunity to explore and to solve it using concrete manipulatives.

Representational:

> After students are able to solve the problem using concrete manipulatives, they should be encouraged to represent what they learned during their work with concrete manipulatives by drawing, using symbols, and writing an explanation. This moves students to a more abstract level of understanding.

Abstract:

> At this phase, students should be able to solve similar problems without using manipulatives or any type of representation. Scaffolding students' understanding through concrete and representational levels enables them to think and to work at the abstract level with a greater degree of understanding and confidence.

Integrating Manipulatives into Instruction

Plan

- Think about where the manipulatives will best support the development of student reasoning and the understanding of the learning outcomes.
- Consult the list of core learning resources accompanying the mathematics curriculum as it suggests manipulatives and potential applications for each grade level.

Prepare

- Always use the manipulatives yourself prior to using them with students. This will allow you to anticipate some of the challenges students may face, as well as the number of possible ways the problem might be solved.

Explain

- Always explain the purpose and function of the manipulatives students will be using.
- Highlight the ways in which the use of manipulatives will support students' thinking as they explore the concepts being studied.

Explore

- When introducing a new manipulative, allow students some free time to explore and to experiment before directing them to explore a concept or to solve a problem.

Setting Purpose

- Create authentic, provocative problems for students to explore using manipulatives.
- Ensure that students are aware of what mathematical concept they are exploring with manipulatives.

Model

- Model the ways in which manipulatives might be used to solve the problem at hand.
- Avoid the temptation to give students a step-by-step demonstration of how to solve the problem. This will limit student exploration and will stifle creative solutions to the problem.

Application, Sharing, and Discussion

- Allow students to construct meaning as they use manipulatives to solve the problem.
- Know that solving complex, authentic problems will take time and will be a somewhat noisy and messy procedure.
- Encourage students to talk about their thinking and to collaborate while they are working to solve problems.
- Expect to see multiple ways to solve problems.
- Allow students to use a variety of manipulatives to solve the problem. Which seemed to be most efficient?
- Instruct students to document or to represent their thinking continually as they work to solve the problem.
- Encourage students to ask their own questions while working to solve the problem.

Mediate Thinking

- Ask open-ended questions while students are working on their problems.
- When students ask questions, test their thinking by inviting other students into the discussion and by providing alternate viewpoints. Adopt a “show me” stance to encourage students to demonstrate their thinking.
- Provide time and space for thinking and learning to occur. Initial work solving problems with manipulatives will take more time as students begin exploring an abstract concept. This time is necessary as they work toward understanding.

Reflect and Write

- Following their work, ask students to reflect upon the process and to write about how they worked to solve the problem. What was their thinking at each stage of the problem and their attempts to solve it?
- Some students may find it helpful to have some stems provided:
    - We initially thought . . .
    - We now understand . . .
    - Approaches we tried . . .
    - Difficulties we encountered and solved . . .
    - We still wonder . . .
    - What might happen if . . .

Reflection

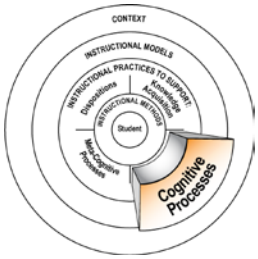
1. In what ways did using manipulatives support the development of student reasoning and understanding?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



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What Are Manipulatives?

Manipulatives are included as one of a variety of representation strategies that students can employ as they study math. Moyer (2001) reports that "current research in mathematics education views students as active participants who construct knowledge by reorganizing their current ways of knowing and extracting coherence and meaning from their experiences" (p. 176). Fennell and Rowan (2001) suggest that using representations such as manipulatives "helps students organize their thinking and try various approaches that may lead to a clearer understanding and a solution" (p. 289). Reak, Stewart, and Walker (1995) state that "working with manipulatives gives students an opportunity to explore abstract concepts while manipulating concrete objects" (p. 20).

Manipulatives are best utilized when they are purposefully used to mediate students' conceptual thinking. Encouraging students to collaborate and to talk about their thinking while working with manipulatives is critical as students construct knowledge together.

There are many types of concrete manipulatives that a teacher may employ. Virtual manipulatives are also becoming increasingly popular as computers are more accessible in classrooms. Using a combination of concrete and virtual manipulatives has been shown to increase student understanding in mathematics. Each carries benefits, but when used together they are more powerful in improving student learning outcomes.

Using manipulatives to help mediate students' conceptual thinking has been shown to improve the learning of students of all ability levels. Steen, Brooks, and Lyon (2006) report statistically significant gains for all students who use manipulatives. Their findings also suggest that students who begin instruction with an ability level lower than their peers either catch up to, or surpass, their peers after using manipulatives. Miller, Butler, and Lee (1998) report that using manipulatives within a process of instruction, moving from concrete to semi-concrete to abstract, produced statistically significant gains for students with learning disabilities. Their research also suggests that skill and understanding developed using manipulatives transfers to abstract work. Incorporating manipulatives into math instruction leads to long-term retention of concepts and skills (Miller, Butler, & Lee, 1998).

Manipulatives are:

- valuable for mediating student thinking as they learn abstract concepts
- beneficial for all students, but especially for students who are having difficulty understanding particular concepts
- valuable for the development of abstract thinking and deeper understanding of mathematical concepts.

Teaching for Understanding

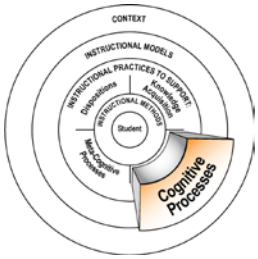
In today's world, mathematics is much broader than computation. Emphasis is on communication and complex problem solving. Rather than teaching specific rules for specific problems, teachers must help students develop thinking tools so that they are ready to meet the challenge of any new problem with confidence and enthusiasm. (Reak, Stewart, & Walker, 1995, p. 20)

Guidance for Coaching

As administrators support teachers in using manipulatives, they may meet with teachers prior to or after they have used this strategy. Carefully planning the questions that administrators will ask teachers is essential in support the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where manipulatives are being used effectively follow:

Examples of Questions	
Pre-Instruction • On which curriculum outcomes will you be focusing? What concepts will you be developing with the use of manipulatives? • In what ways do you anticipate the use of manipulatives will support student reasoning and understanding? • In what ways will your students represent the mathematical ideas of the lesson? • What models might be helpful in representing such mathematical ideas? • How might your students use representations to organize, record, and communicate mathematical ideas? • What will the representations being used by students tell you about their understanding of the mathematical concepts? • In what ways do you plan to ask students to document their learning? • What processes will you use for students to reflect upon and to write about their understanding?	**Post-Instruction** • As you consider your use of manipulatives, what stands out for you regarding your use of this approach and students' engagement? • In what ways did the use of manipulatives support the development of students' reasoning and understanding from concrete to representational to abstract? • Which of your students seemed to benefit the most from the use of manipulatives? • What things will you keep the same the next time you use manipulatives? What things would you like to change? • Which of your ideas do you plan to implement the next time you use manipulatives?

Examples of Observations	
Teachers may be: • encouraging students to "play" with manipulatives when they are introduced • presenting authentic problems to students and asking them to use manipulatives to create solutions • encouraging students to talk and to collaborate as they work to solve problems • asking open-ended questions of students' thinking and problem-solving approaches • accepting more than one solution to a problem • allowing students to access and to use manipulatives at any time to support their thinking.	**Students may be:** • working with a variety of manipulatives as they work to solve problems • "playing" with a variety of materials during math instruction • documenting their thinking, posing questions, and providing multiple solutions to problems • writing about their thinking and problem-solving approaches • talking, collaborating, working in groups, and having fun!



Mnemonic Devices

Information for Teachers

What Are Mnemonics?

Mastropieri and Scruggs (1998) define *mnemonics* as "systematic procedures for enhancing memory. Their particular use is in developing better ways to take in (encode) information so that it will be much easier to remember (retrieve)" (p. 202). Mnemonics are specialized tactics for improving recall for things that need to be memorized and can be used in every subject area and teaching context.

There are three common mnemonic tactics:

1. **Letter** tactics use acronyms and acrostics to make lists of information easier to remember.
2. **Keyword** tactics are used when students are required to remember new vocabulary, names, facts, or concepts.
3. **Pegword** tactics are used for remembering numbered or ordered information.

Each tactic associates meaningful phrases, words, or images to information that must be recalled. The associative process enables the brain to more easily store and recall information being learned. Scruggs and Mastropieri (2000) assert that "mnemonic strategies are effective because they form an effective acoustic-imaginal link between the stimulus and response" (p. 165).

Mnemonics are powerful tactics for use in the inclusive classroom. In studies of mnemonics, students of all ability levels reported that they were better able to learn content using mnemonics, compared to more traditional methods.

Mnemonics are:

- powerful for encoding information into memory and for facilitating its recall
- especially powerful for students with learning disabilities
- only for improving recall, not comprehension.

Teaching for Understanding

Mnemonics are powerful tactics that enable students to more efficiently remember and retrieve core knowledge in the discipline being studied. Students cannot engage in higher order thinking, such as problem solving and inquiry, without a base of knowledge from which to work.

♦ ♦ ♦

"A storehouse of factual knowledge in the long-term memory is a prerequisite for higher-order thinking and problem solving" (Goll, 2004, p. 310).

Mnemonics in Practice

1. Letter Mnemonics – Acronyms and Acrostics

Letter mnemonics employ the use of acronyms and acrostics as methods to retrieve related items from memory. For example, the **acronym** BEDMAS is typically used to help people remember the order of operations in mathematics – brackets, exponents, division, multiplication, addition, and subtraction. **Acrostics** are sentences where the first letter of each word in the sentence stands for a different item. Music students (and

their teachers) often learn the **acrostic** "I do play loud music at lunch" to remember the modal scales – Ionian, Dorian, Phrygian, Lydian, Mixolydian, Aeolian, and Locrian.

Common Acronyms	Item
ROY G. BIV	Colours in a rainbow - red, orange, yellow, green, blue, indigo, violet
SCUBA	Self-Contained Underwater Breathing Apparatus
LASER	Light Amplification by Stimulated Emission of Radiation
FACE	Names of the notes in the treble clef

Common Acrostics	Item
Kids Prefer Cheese Over Fried Green Spinach	Order of taxonomy - Kingdom, Phylum, Class, Order, Family, Genus, Species
Father Charles Goes Down And Ends Battle	Order of sharps in music – F, C, G, D, A, E, B
My Dear Aunt Sally	Multiply and Divide before you Add and Subtract

Encourage students to create their own mnemonic devices.

2. Keyword Mnemonics

Keyword mnemonics are best used whenever students need to remember new vocabulary or names for new facts and concepts (Scruggs & Mastropieri, 2000). When using keyword mnemonics, the new term to be learned is converted to a keyword – a familiar image that sounds similar to the term being memorized. The keyword is then combined with the definition to create a picture with the keyword and definition combined.

Classroom Example

A Physics 30 teacher is explaining the three types of vectors to her class. To help her students retain the definitions of each complex term, she explains how keyword mnemonics work and then provides students with the following template for constructing keyword mnemonics:

Target Term	Characteristics	Keyword (a familiar image that sounds similar to the target term)	Interactive Illustration
Equivalent vectors	have the same magnitude and direction		
Collinear vectors	can be added algebraically or graphically		
Non-collinear vectors	exist in more than one dimension		

Students work together and complete the chart as follows:

Target Term	Characteristics	Keyword (a familiar image that sounds similar to the target term)	Interactive Illustration
Equivalent vectors	have the same magnitude and direction	Equal sign (=)	a magnet attracting an equal sign
Collinear vectors	can be added algebraically or graphically	Coat	a plus sign wearing a coat
Non-collinear vectors	exist in more than one dimension	No collar	dogs running along the axes of a 3-D graph

3. Pegword Mnemonics

Pegword mnemonics are used when information that is sequentially ordered or numbered needs to be remembered. Pegwords use short rhyming words with the numbers (one is a bun, two is a shoe, etc.) to represent visual images for each. Pegwords are often joined with keywords by combining the pegword image and the list of concepts

(keywords). For example, if one needs to remember to buy hot dogs and cheese, one would combine the images into a hot dog in a bun (one) and shoes made of cheese (two).

The teacher explains to his students that pegwords are rhyming images for numbers. The most common pegwords are:

One – Run; Two – Shoe; Three – Bee; Four – Door; Five – Hive; Six – Sticks; Seven – Heaven; Eight – Gate; Nine – Vine; Ten - Hen

Classroom Example 1

A social studies teacher wants his students to remember that Canada has 10 provinces. Using pegword mnemonics, he asks students to suggest how they might use "ten-hen" to help them remember this fact. The students brainstorm and then create some sketches such as a hen sitting on all the provinces like eggs or a hen in a barnyard with 10 provinces like chicks running around her.

Classroom Example 2

Pegword mnemonics can also be combined with keywords to remember items that are classified by series or number.

A Chemistry 20 teacher wants students to memorize the first 10 elements in the periodic table. The teacher introduces the pegwords from 1 to 10 and then explains to students how the images will be combined with a keyword for each of the elements to help students remember them in order. The teacher supplies the following chart and completes the first two elements with students. The teacher then lets students work through the remainder of the chart in small groups.

Number	Pegword	Element	Keyword	Image (Pegword + Keyword)
One	Run	Hydrogen	Hydro (water)	Someone running through a puddle.
Two	Shoe	Helium	Balloons	A shoe being carried into the air by a helium balloon.
Three	Bee	Lithium		
Four	Door	Beryllium		
Five	Hive	Boron		
Six	Sticks	Carbon		
Seven	Heaven	Nitrogen		
Eight	Gate	Oxygen		
Nine	Vine	Fluorine		
Ten	Hen	Neon		

Planning for Mnemonics

The following steps for implementing mnemonic tactics are adapted from the implementation process suggested by Kleinheksel and Summy (2003):

1. Distinguish curriculum area(s) where mnemonics can be used to enhance memory.

   Mnemonics tactics can be used in a variety of subjects. Giving students a tactic they can use to enhance memory across subjects is a very powerful opportunity.

2. Discuss the mnemonic tactic with the students and model its use.

   When introducing mnemonics, explain their benefits to students and give a brief demonstration of a mnemonic. Be sure to think aloud as you are modelling the application of the mnemonic.

3. Explicitly teach the mnemonic tactic.

   Mnemonics design rules must be explicitly taught to students in order to be effective. When possible, reduce the strategy to manageable steps and allow students to practise each step. As seen in the examples, mnemonics are most useful when students are given the opportunity to create their own using the design rules for each.

4. Evaluate the tactic.

   The easiest way to evaluate the tactic is to administer a pre- and post-test on the material that needs to be memorized. For example, the teacher whose students were memorizing the first 10 elements of the periodic table could ask students to use whatever method they would like to memorize the elements and then administer a quiz. Following the teaching and use of the mnemonic tactic, the teacher could re-administer the quiz and examine if students have improved or not.

5. Conference with students, discuss, and promote generalization.

   It is important to gather feedback from students regarding their perceptions of the benefits of the tactic. Do they perceive it is helping? Do they enjoy the tactic? How might they apply this tactic in other subjects and settings? What further supports do they need?

6. Continuously monitor and evaluate the tactic.

   Steps Four and Five above should be repeated on a regular basis. It is important for students and teachers to continually monitor students' efficacy at using mnemonics and to ensure they are using them in the right way.

Reflection

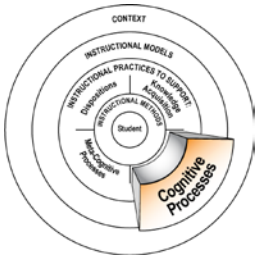
1. In what ways did using mnemonics enhance students' ability to recall information?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



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Teaching for Understanding

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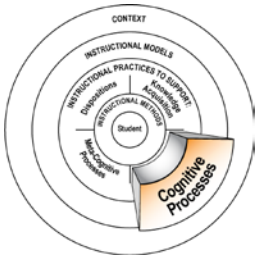
"A storehouse of factual knowledge in the long-term memory is a prerequisite for higher-order thinking and problem solving" (Goll, 2004, p. 310).

Guidance for Coaching

As administrators support teachers in using this approach, they may meet with them prior to or after teachers have used mnemonics. Carefully planning the questions that administrators will ask teachers is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are using mnemonics effectively follow:

Examples of Questions	
Pre-Instruction • For what concepts and terms will you be supporting students' memory with the use of mnemonics? • Will you be using letter, pegword, or keyword mnemonics? • What type of pre-assessment do you plan to administer in order to gather data on the effectiveness of this tactic? • In what ways will you help students learn and apply the mnemonic tactic you will be using? • After students have created mnemonics, will you allow them to use individual designs or will you have the class come to a consensus on one? • In what ways will you have students reflect upon and give feedback regarding their use of the mnemonic tactic used in class?	**Post-Instruction** • As you consider your use of mnemonics, what stands out for you regarding your use of this tactic and students' ability to recall information? • Which students seemed to benefit the most from using mnemonics to enhance memory? • What did the data from the pre- and post-assessment reveal? • What feedback did you receive from students? • As you consider applying mnemonics to other areas of instruction, what are you planning to do? • What are your perceptions regarding the effectiveness of using mnemonics?

Examples of Observations	
Teachers may be: • having students link seemingly unrelated concepts and images • having students recite acronyms or acrostics • having students talk through mnemonic devices as they store and retrieve information • encouraging students to design their own mnemonics • administering pre- and post-tests for factual information.	**Students may be:** • experimenting with the design principles of letter, pegword, and keyword mnemonics • creating their own mnemonics using the design elements of letter, pegword, and keyword mnemonics • memorizing content that is foundational in the subject being studied • applying memorized information to problem solving, inquiry, and higher order thinking.



Concept Formation

Information for Teachers

What Is Concept Formation?

Bennett and Rolheiser (2001) define *concept formation* as an inductive thinking process that "encourages students to organize information by having them group items, words, pictures, formulas, [or] processes into categories based on common characteristics (or attributes)" (p. 256). They suggest that "without an understanding of basic concepts – the building block of knowledge – it is more difficult to learn facts, develop principles, comprehend theorems, etc." (p. 260). As students go about sorting and classifying information, their inductive reasoning will reveal regularities, irregularities, and diversities within data sets (Klauer & Phye, 2008).

Concept formation is different from concept attainment because students assume greater control over data collection, classification, and analysis. Joyce and Weil (2004) state that the primary application of concept formation is to develop the thinking capacity of students. Klauer and Phye (2008) support this statement in their meta-analysis of studies involving students who are taught inductive reasoning skills. They report that, in all cases, students' cognitive functioning improved in the areas of increased fluid intelligence (thinking), and academic learning of classroom subject matter.

Concept formation moves through three phases:

1. Generate data.
2. Group the data and begin developing classifications.
3. Build hypotheses and generate skills and/or applications from the data.

Because students create and have the ability to modify their classifications, their learning is more meaningful. Identifying relationships and emphasizing interrelatedness between concepts by focusing on wholes as the sum of their parts is supportive of First Nations and Métis learners (Starnes, 2006; Klug & Whitfield, 2003). Rather than accept classifications at face value, students come to appreciate how things are classified and how those classifications affect our interpretation and use of conceptual material.

Concept Formation is:

- an inductive strategy
- a technique that puts the students in charge of data generation, classification, and hypothesis testing
- a habit of thinking that gives students the tools to deeply understand the material they are studying.

Teaching for Understanding

The inductive model [of concept formation] causes students to collect information and examine it closely, to organize the information into concepts, and to learn to manipulate those concepts. Used regularly, this strategy increases students' abilities to form concepts efficiently and increases the range of perspectives from which they can view information. (Joyce & Weil, 2004, p. 46)

Concept Formation in Practice

Classroom Example

A Grade 6 social studies teacher plans to frame the students' study of location, climate, and vegetation using the inductive processes within concept formation.

To prepare for class, the teacher assembles a variety of items to create two data sets:

1. He locates a number of pictures of each of the natural vegetation areas: desert, grassland, forest (mixed, deciduous, coniferous), rainforest, tropical forest, temperate forest, tundra, and savannah.
2. He creates a set of cards that indicate regions of the world and that list climate details for each (these concepts were studied in the previous unit).

To begin the class, the teacher informs the students that they are going to continue their study of location and climate by thinking about the types of vegetation that might be able to grow in different climates.

The teacher divides the class into small groups and distributes the natural vegetation area photos to each group. Students are asked to sort the photos in any way that seems logical. Students immediately set about sorting the photos using a variety of methods. Some students arrange the photos by dry and wet; some arrange the photos by the types of crops they can see; while some arrange the photos by the topography of the land. After students have arranged their photos, the teacher asks each group to explain the classification system it created. As each group presents, the other groups are invited to comment or to ask questions of their peers. This process causes a number of groups to rethink their classifications. For a couple of groups, the teacher questions some of their choices, which also causes them to rethink their classifications.

Next, the teacher distributes the cards that contain climate information for each of the major regions being studied. He asks the students to consider this new information in light of their classifications and to resort their pictures, if necessary. The students quickly match or modify their classifications to match the new cards the teacher has supplied.

The teacher then leads the students in a discussion regarding the significance of their findings. The students suggest that location and climate play a major role in the vegetation that can be grown. The teacher points out that the students have just generated a hypothesis and asks if they could make any other hypotheses based on their data. The students work together as groups again and come up with the following:

- *The closer you are to the equator, the more kinds of plants you can grow.*
- *Only certain plants will grow in certain regions of the world.*
- *More people can live where we can grow more plants or crops.*

The teacher asks the students to test the hypotheses their groups have created using reference material in class and some online sources. The groups report back that the first hypothesis is false while the other two are true. The class determines that climate and location play a significant role in the types of plants and crops that can be grown.

The teacher provides students a First Nations map of Saskatchewan (http://www.ainc-inac.gc.ca/ai/scr/sk/fni/pubs/fnl-eng.pdf). Pairs of students take turns picking a First Nation

from the map. The teacher ensures that the students choose First Nations from all areas of the province. The class goes to the computer lab, and students use Virtual Saskatchewan's interactive ecoregions map (http://www.virtualsk.com/maps/index.html#eco) to explore the ways each of the First Nations might have lived on the land in the past. What vegetation and wildlife were present to support each First Nation? How might the ecoregion have affected the way each First Nation hunted, located communities, developed tools, etc.? This opens a new set of inquiries as students begin to explore each of these questions. To support students in this work, the teacher suggests that students create mind and concept maps for each inquiry topic.

Planning for Concept Formation

While concept formation lessons look simple, they must be carefully designed and used a number of times in order for the process to become comfortable. Perhaps the most difficult part of designing a concept formation lesson is to ensure that one has thought through all of the possibilities in advance. Concept formation allows teachers to view students' thinking in action, so it is important that they have attempted to think ahead regarding what they might see!

Prior to asking students to use concept formation with curricular material, teachers may want to have them learn the skill using the method on some fun topics such as cookies, fruit, rides at the Exhibition, and cars. This allows students to learn the processes of collaboration, classification, and dialogue necessary to support their work. Some suggested steps to planning for concept formation follow:

1. Decide which curriculum outcomes your lesson will meet. Within those outcomes, what content of substance will you have students explore (e.g., styles of music, food groups, physical moves, types of conductors)?

2. Decide whether you will provide the items for the data set or if you will have students gather the items. For example, the teacher might supply a set of shapes to younger students for classification. A teacher with older students might ask them to search for data within a specific domain (e.g., rocks, leaves, flowers, songs, poems).

3. Introduce the process to students and ask them to begin collecting and grouping data, or to begin working with a data set. Encourage students to try a variety of options as they seek ways to classify their data. Have students keep logs of their thinking and their decisions as they go.

4. After students have classified their data, ask them to explain their thinking and their reasons for their classifications. Invite questions from other students. You will notice that students will move from gross classification systems to more refined classifications as they have an opportunity to collaborate and to respond to questions.

5. Suggest that students examine the relationships between their categories and encourage them to pose questions. What patterns do they see? Do any rules or formats seem to be emerging?

6. Based on their analysis of their categories, have students develop some hypotheses (e.g., most Baroque music uses a harpsichord).

7. When students have developed some hypotheses, ask them to either apply a hypothesis or to see if they can create another item (generate skills) in the category by using the rules within the hypothesis. For example, can students identify other characteristics of Baroque music?

Can they write a piece of music in the Baroque style based on the rules within their hypothesis?

The following tips are adapted from Joyce and Weil (2004) and Bennett and Rolheiser (2001):

1. Practise the inductive processes of concept formation often. Make this a habit in your classroom.

2. Communicate often that you are teaching your students how to learn, and emphasize that the processes being used can be applied to any subject.

3. Make sure that students are able to collect the data if you are not providing the data set.

4. Concept formation is often supported through the use of complex organizers such as concept and mind maps.

5. If student categories are not coming together or students are having difficulty discerning between items, you may need to take some of the items in the set and use a concept attainment process to focus their thinking.

6. Use groups of no larger than three students.

7. Remind students not to label before sorting the data. If they label their categories too early, it limits their flexibility.

Reflection

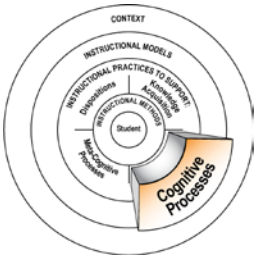
1. In what ways did concept formation engage students?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



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Guidance for Coaching

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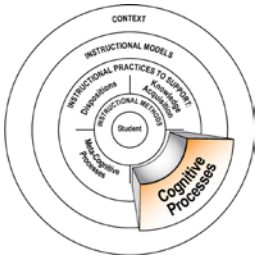
Examples of Questions	
Pre-Instruction • What content within the curriculum outcomes will students learn using concept formation? • Will you be creating the data set or will students be generating their own data? From what sources will students be generating data? • What will you be watching and listening for as students sort and classify their data? • How might you intervene to refocus students' thinking, if necessary? • How will students be documenting their thinking and learning? • How will students share and discuss their thinking? • How will students apply the concepts being explored?	**Post-Instruction** • As you consider your use of concept formation, what stands out for you regarding your use of this approach and student thinking? • How engaged were students during this process? • What have you learned about your students' thinking during this process? • What things will you change in your planning the next time you have students engaged in concept formation? • As you consider the collaboration of students, are there any processes you may want to add in the future to improve the quality of their collaboration?

Examples of Observations	
Teachers may be: • supporting students in generating different types of data • asking students to organize data sets according to their own rules • engaging students in discussion regarding their thinking and the thinking of their peers • questioning student thinking • questioning student hypotheses • encouraging students to formulate their own questions and hypotheses • encouraging students to work with and to apply the concepts they have discovered.	**Students may be:** • working in groups to generate data • working in groups to sort and to classify data • explaining their thinking to their peers and to their teacher • questioning one another's thinking • looking for items that fit the rules or categories created • creating items or products that fit the rules or categories discovered • discussing the significance of their discoveries • asking questions that lead to further inquiries.



Complex Organizers: Concept Mapping and Mind Mapping

Information for Teachers

What Are Concept Maps and Mind Maps?

Concept maps are visual organizers used to represent the relationships between abstract concepts. Concept maps are designed as a hierarchy, with the main concept at the top of the map and subordinating ideas falling below. The lines between concepts contain propositions that detail the relationships between the concepts. Joseph Novak was one of the first researchers to articulate a process for designing concept maps.

Concept maps allow students to negotiate the meaning and their understanding of concepts by testing relationships of subordinating elements. As students create a concept map, they will discover that their proposed relationships among concepts are either validated or reveal misconceptions. This reflective process helps to mediate students' thinking as they visually represent the concept being studied.

Concept maps can be used to surface prior knowledge, to help students identify key ideas, to provide a map for a large body of information, or to provide a summary for what has already been learned.

Mind maps use image and association to enable people to remember complex networks of ideas or concepts. Mind maps are a creative means for organizing, patterning, and making connections between ideas and concepts. Mind maps integrate the use of visual symbols, colour, codes, words, and connectors to increase the brain's ability to store and to recall information by activating both hemispheres simultaneously. The power of mind maps lies in the whole brain process of creating symbols as representations of key ideas. Tony Buzan maintains that most complex material can be reduced to a relatively small number of key ideas that are much easier to recall by symbolic association.

Mind maps are beneficial for all students, but are especially helpful in creating equitable opportunities for students with hearing impairments, students with dyslexia, and students who are learning English as an additional language. This equity is created because visual symbols are a universal language that can be accessed by all. The use of visual symbols keeps the focus on the concepts rather than on long, wordy texts.

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Cognitive meanings [or understandings], cannot be transferred into students. . . . Learning the meaning of a piece of knowledge requires dialogue, exchange, sharing and sometimes compromise.

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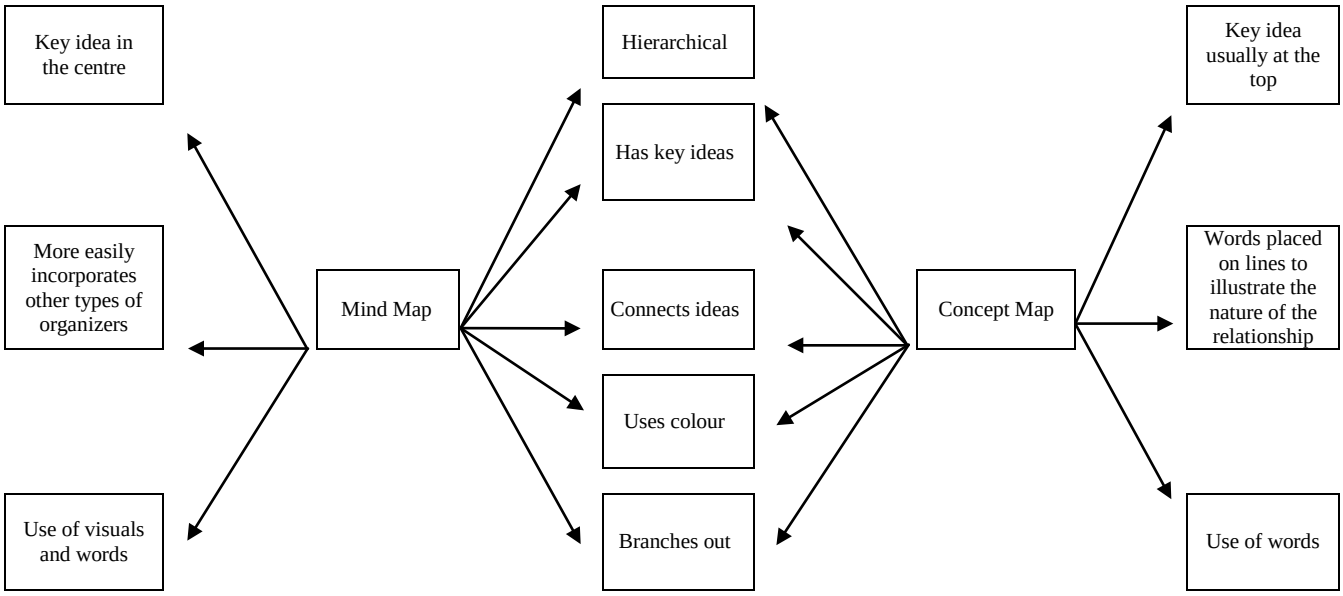
Concept Maps and Mind Maps are:

- valuable as visual tools for exploring the relationships between concepts
- useful at all points in the learning cycle
- useful for developing critical and creative thinking
- powerful learning approaches.

Similarities and Differences

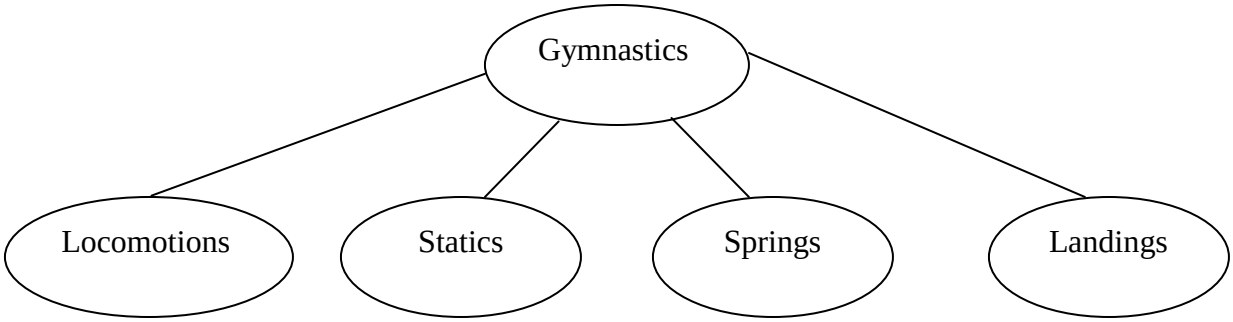


Bennett, B., & Rolheiser, C. (2001). *Beyond Monet: The artful science of instructional integration*. Toronto, ON: Bookation Inc. Reprinted with permission.

Concept Maps in Practice

Classroom Example

A Grade 8 physical education teacher has decided to use a concept map with students to explore the relationships between the components of educational gymnastics. He first teaches students the rules for designing concept maps and then provides the students with the following initial framework from which they will construct their concept maps.

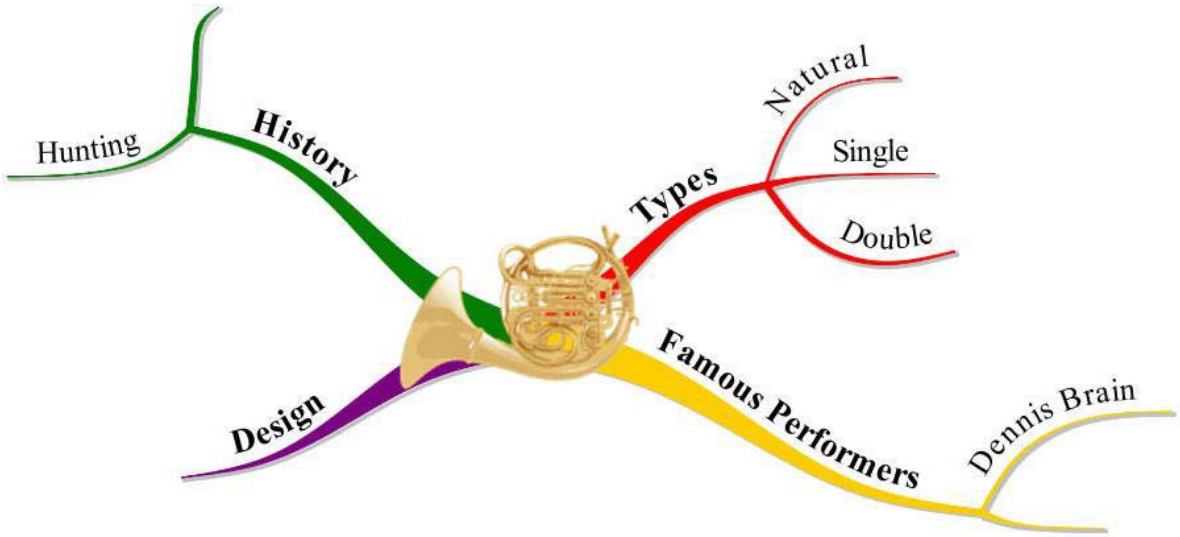


The teacher reminds students that they may change the layout of the diagram as their concept maps develop. Throughout the unit, the teacher has students add to their concept maps as students learn and apply each skill. The teacher encourages the students to make connections while designing their maps.

Mind Maps in Practice

Classroom Example

A music teacher is teaching a unit on the instruments of the orchestra. She decides to ask pairs of students to create a mind map for a variety of instruments. After introducing the instruments to the students, she allows groups to choose an instrument to explore. Students are asked to draw a picture of the instrument and to place it in the centre of their paper. Students then brainstorm different branches such as design, history, types, famous performers, listening, and critiquing.



Planning for Concept Mapping and Mind Mapping

Concept Mapping

Applications

1. Documenting prior knowledge
2. Providing a map of upcoming instruction
3. Making sense of new learning inquiry activities, and other experiences
4. Extracting meaning from printed texts
5. Pre-writing

Essential Characteristics (Bennett & Rolheiser, 2001; Buzan, 2008)

1. Start with a major term or idea from which the next term or idea extends, either in a hierarchical or radiating format. Concept maps usually start at the top.
2. Shift is from a more complex to less complex idea or from a major idea to a minor idea. It often ends with an example.
3. Connecting line is drawn between concepts. Label the relationship on the line between the two concepts.
4. Links that cross between one segment of the concept hierarchy or classification and another.

Steps

1. Brainstorm.

2. Sort and classify ideas.

3. Create diagram.

4. Add connecting lines with words to indicate types of relationships.

5. Look for cross links.

Mind Mapping

Applications

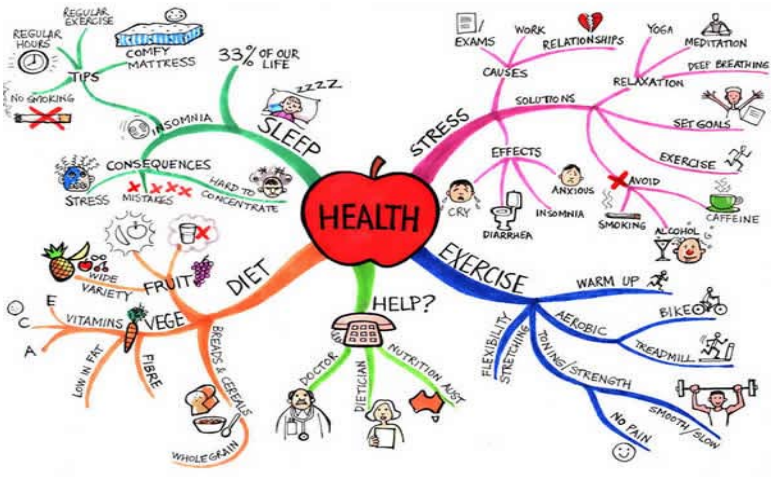
1. Organizing information
2. Making the structure of abstract concepts and thinking visible
3. Visually thinking (i.e., mapping ideas as they are explored)

Essential Characteristics (Bennett & Rolheiser, 2001; Buzan, 2008)

1. A central image that represents the subject being mapped.
2. Main themes radiate like branches from the central image.
3. Branches have a key image or key word printed on an associated line. Place only one word on each branch.
4. Larger branches are larger ideas and support smaller branches with more specific information.

Steps

1. Generate an idea.
2. Create a symbol of the central object.
3. Free associate from the central symbol.
4. Apply key words to each associating line.
5. Organize and add codes and symbols.
6. Look for cross links.



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Reflection

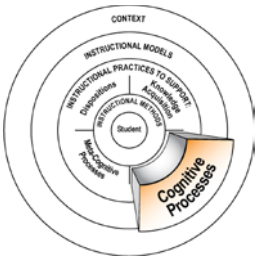
1. In what ways did my planning change to include either a concept map or a mind map?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



Complex Organizers: Concept Mapping and Mind Mapping

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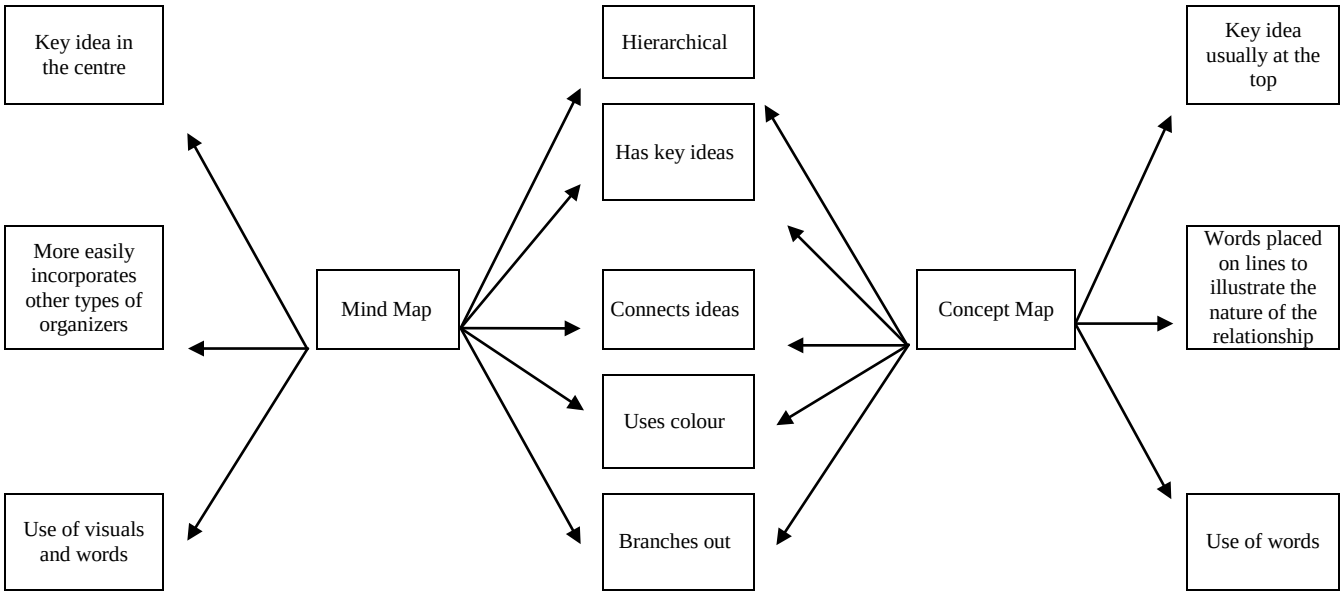

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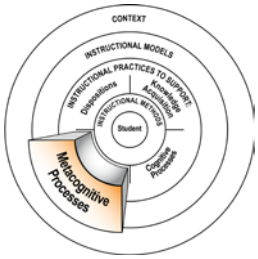
Guidance for Coaching

As administrators support teachers who are integrating concept and mind mapping into their instructional repertoire, they may meet with teachers prior to or after they have used the practice. Carefully planning the questions that administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where concept and mind maps are being used effectively follow:

Examples of Questions	
Pre-Instruction • For what purpose(s) are you planning to use a concept or mind map? • Which of the maps seems to be more suitable for supporting student achievement of the outcomes? • Will you assign the topic for exploration or will students be able to choose a topic within the area of study? • How will you introduce the map to your students? • What resources will you provide for students if their mind or concept maps reveal misconceptions? • Will the map be created by individual students, by small groups, or by the class as a whole?	**Post-Instruction** • As you consider your use of concept maps and mind maps, what stands out for you regarding your use of this practice and students' engagement? • What factors contributed to what you have described in your use of this practice? • What will you keep the same the next time you use this practice? What would you like to change? • In what ways did the concept maps/mind maps you used help make student thinking visible? • In what ways were you able to deepen and to support students' thinking? • Which of your ideas do you plan to implement the next time you use this practice?

Examples of Observations	
Teachers may be: • teaching how concept and mind maps are designed and having students construct them • expressing ideas and concepts visually and encouraging students to do so as well • asking students questions regarding the relationships they have identified within the maps they are constructing or completing • providing resources to remediate student misconceptions.	**Students may be:** • designing or completing concept maps and mind maps • practising using maps in a fun way • thinking deeply about and discussing the decisions they have made regarding the relationships within the content they are studying • inquiring more deeply and broadly.



Section IV: Metacognitive Processes

Metacognition

Information for Teachers

What Is Metacognition?

Metacognition refers to the thought processes that people continually use. Anytime individuals consider the ways in which they are thinking as they work to learn or to do something, they have engaged in metacognition.

Costa (2008) suggests that metacognition "is our ability to plan a strategy for producing what information is needed, to be conscious of our own steps and strategies during the act of problem solving, and to reflect on and evaluate the productiveness of our own thinking" (p. 35). Foster, Sawicki, Schaeffer, and Zelinski (2002) define *metacognition* as "knowing how we learn best and consciously controlling our learning" (p. 5). Joyce and Weil (2004) would concur and suggest that metacognition is "having 'executive control' over our own learning" (p. 14).

Teachers can support metacognitive thought implicitly through the classroom environment they create, and explicitly by paying attention to their instructional decision making and the roles they occupy during student learning.

The activities of metacognitive thought generally encompass three phases:

1. planning for learning
2. monitoring thinking and learning
3. reflecting on thinking and learning.

Foster et al. (2002) suggest that "teachers encourage metacognition when they recognize the viability of several approaches to complete a task. Those who always insist on a single approach – probably that which works best for them – discourage metacognition." Students should be encouraged to identify alternative learning strategies and to employ a learning strategy that works for them.

1. Planning for Learning

Students' metacognitive thinking can and should be engaged at the beginning of the instructional cycle. Rather than have students in a passive role, involving them in clarification of the goals of instruction and setting personal goals for their own learning ensures that they enter their learning as active participants.

Foster et al. (2002) suggest that students be encouraged to consider how they might go about addressing the task, and what abilities they will require or need to develop in order to do so (p. 18). As well, they suggest that teachers provide students with choice regarding the learning processes they employ as they work to achieve their goals.

2. Monitoring Thinking and Learning

Engaging students in monitoring their thinking and learning is a task shared by teachers and students. Teachers can support students in monitoring their thinking and learning in the ways they present curriculum to students. It is important to break the cycle of presenting a single

correct method followed by a solution or answer (Ritchhart & Perkins, 2000). Students should be encouraged to apply multiple methods or to create their own techniques for learning material.

This requires that the teacher occupy a different role in the classroom – that of co-inquirer or co-discoverer. Students must be explicitly taught how to monitor their thinking and learning processes so that their reflection and inquiry remain focused on the learning outcomes.

As students are monitoring their learning processes, errors should be expected and accepted as they provide opportunities for inquiry and growth. In environments where errors are punished as wrong, students cease to inquire and mindlessly apply the learning strategies or tactics they have been assigned. Students need to learn how to work through errors and to use what they have learned to improve their skills and to deepen their understanding of the material they are studying.

The conscious use of thinking strategies is central to student metacognition. Explicitly teaching and modelling thinking strategies help students to build a repertoire of strategies they can use in their learning.

3. Reflecting on Thinking and Learning

At the completion of the learning process, students should be given an opportunity to reflect upon their thinking and learning so new knowledge can be integrated with old and so they can evaluate their personal strengths and challenges from the previous learning experience. McMillan and Hearn (2008) state:

> Reflection helps students think about what they know or have learned while they identify areas of confusion, so they can create new goals. Evaluating what they learned, what they still need to work on, and how they can get there can all support deeper understanding rather than superficial knowledge. (p. 46)

Kallick (as cited in Costa, 2008) reminds us that the "ultimate purpose of reflection is to get us into the habit of thinking about our experiences" (p. 166). There are a variety of ways for teachers to engage students in thinking about their experiences, including involving students in self-assessment, journalling, and dialogue employing paraphrasing and clarifying questions. All student reflection must occur in the context of clear criteria that has been made public during the learning process.

The habits of reflection must be taught and practised. Teachers can support students by modelling reflective thinking and by asking students to model their reflective thinking as they discuss their work, what they have learned, the significance of their learning, and future applications of their learning.

Teaching for Understanding

Students need the opportunity to look back at their work and learn how to look forward to the next work with new plans and strategies for improvement. Too often, we hear students say – "I already finished that work!" as if doing the task, rather than experiencing learning from the accomplishment of the task, is what is most significant. . . . We want to see students develop a love of learning and not feel solely dependent on the judgment of others to determine the value of what they are learning. (Costa, 2008, p. 59)

Planning to Support Students' Metacognitive Thinking

1. Planning for Learning

Begin with learning outcomes and indicators identified in the curriculum. Decide in collaboration with your students in what ways they might demonstrate their understanding/application of the outcomes – what should students know and be able to do? Remember – the learning activities are to help students achieve the learning outcome. Setting clear goals, defining criteria for meeting those goals, and creating a plan to get there are key elements of metacognition.

2. Monitoring Thinking and Learning

A variety of thinking strategies to support students' monitoring of their thinking and learning follow (not in order of priority):

1. Think alouds. Both teachers and students should practise the habit of thinking aloud as they work to solve problems and reason. As teachers think aloud, they allow students to see in what ways they are thinking. Having students think aloud makes their thinking visible, allowing for feedback and reflection.
2. Modelling thinking strategies. Teachers should model and have students model thinking strategies as they work. Consciously using strategies gives students a repertoire of tools from which to choose as they go about their work.
3. Use of thinking routines (Ritchhart, 2002). Thinking can be made visible by asking the following two questions: "What is going on here?" and "What do you see that makes you say so?"
4. Making explicit the types of thinking used or required. When designing assignments, listing the type of thinking required allows students to mediate their own thinking and strategy selection. Having students indicate the type of thinking they engage in while working allows them to make their thinking visible and enables them to monitor their thinking as they work.
5. Modelling recovery strategies. Central to metacognitive thinking is the ability to remediate the gaps one recognizes in one's own thinking or strategy use. Having teachers and students model their recovery strategies is another way to encourage metacognitive thinking in students.

3. Reflecting on Thinking and Learning

Engaging students in metacognitive thought throughout the learning process requires reflective thinking at all points in their learning. Taking time at the end of instruction to encourage students to reflect over the entire learning process is important for developing students who are self-directed learners.

The type of reflection undertaken at the end of instruction can be supported through a variety of methods including:

- self-assessment
- design of prompts and questions to stimulate reflection and metacognition
- journals and learning logs
- dialogue.

Student self-assessments should occur within the boundaries of clear criteria. Students should be encouraged to assess their work against criteria and to indicate the next steps in their learning based on those criteria.

A practice to use might be to ask students to complete stems such as "I have met this criterion, my next steps will be . . ." or "I have not met the following criteria: _____. In order to meet the criteria, I need to do the following: _____."

Student self-reflection can be encouraged through the design of questions and prompts that ask students to comment on various aspects of their learning. Questions and prompts should align with curriculum outcomes and indicators, student-identified goals, and the criteria for the work. Prompts and questions can be used in a variety of tools such as reflection worksheets, exit passes, journal entries, learning logs, graphic organizers such as a PMI chart, and portfolios.

When designing reflective questions, students may reflect on strengths, areas in need of development, and future actions. Some examples might include:

1. As you consider your work, of what are you most proud? Why?
2. Think of the goals you set for yourself at the beginning of the unit:
    a. Which goals were successfully met? What actions on your part helped you to achieve those goals?
    b. Which goals have yet to be attained? What will you do now to achieve those goals?
3. What thinking and learning strategies did you find to be the most effective during this unit of study? In what ways might you apply them in your future work?
4. What knowledge and skills do you anticipate needing as you move further in the work we have begun?
5. What is the most significant thing you plan to take away from this learning experience?
6. In what ways will you apply the skills and knowledge you have acquired to future learning?

Gregory, Cameron, and Davies' (2000) book, *Self Assessment and Goal-Setting*, contains many examples of exit passes and reflective questions for use with students.

Journals and learning logs are valuable when one wishes to have students reflect over an extended period of time. Students can reflect upon their learning throughout a unit of study, a number of units, or the length of a course. Provision of reflection sheets or rubrics that connect student reflections to criteria are necessary for keeping students focused on curricular goals and the criteria for demonstrating achievement of those goals.

Engaging in reflective dialogue with students is another way to support their metacognition. When engaging in dialogue with students, be mindful to listen, to paraphrase, and to ask questions to clarify meaning. Adding spoken or written comments reduces students' ability to accurately self-assess their own performance. Costa and Garmston (as cited in Costa, 2008) report that in situations where teachers added their own observations to students' reflections, "the ability to accurately self-assess declined as students become more dependent on the teacher for an assessment of their behaviours" (p. 138).

The goal of all student reflection is to allow students to more carefully consider their work and the ways in which it fits with what they are learning across the curriculum. Constructing opportunities for this type of reflection encourages students to be more metacognitive and self-directed in their learning.

Reflection

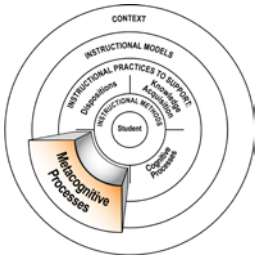
1. In what ways was my planning changed by considering ways to support students in their metacognitive thinking?

2. In what ways did students engage with the opportunities for metacognition? Who found this difficult? Who welcomed the opportunity?

3. In what ways was students' thinking made visible? What did I discover about my students?

4. When I do this again . . .

5. Student learning seemed to be . . .



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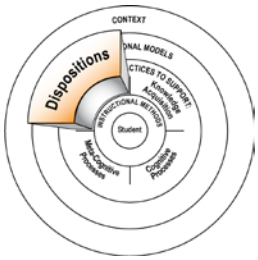
Guidance for Coaching

As administrators support teachers in using this approach, they may meet with teachers prior to or after they have encouraged student metacognition. Carefully planning the questions that administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms that are using metacognition effectively follow:

Examples of Questions	
Pre-Instruction • In what ways are you planning to engage students in a discussion of how they might demonstrate their understanding of the outcomes and indicators you are going to teach? • What types of strategies are you considering modelling and using to support students' thinking? • In what ways will students be reflecting on their work?	**Post-Instruction** • As you consider the metacognitive processes you used with your students, what stands out for you? • Which students seemed to benefit the most? • Which metacognitive processes seemed to have the most impact on student learning? • What feedback did you receive from students? • In what ways was your planning and teaching affected by including space and process for student metacognition?

Examples of Observations	
Teachers may be: • asking students to put outcomes and indicators in their own words • encouraging students to articulate the ways in which they will demonstrate their understanding • modelling thinking and recovery strategies • accepting a diverse range of products • asking students to make their thinking visible • engaging in reflecting conversations with students.	**Students may be:** • rewriting outcomes and indicators in their own words • suggesting ways in which they will demonstrate their understanding • working in groups of various sizes to create many different demonstrations of understanding • engaging in reflection with their peers and their teacher.

Most importantly, you may see and hear a very different classroom environment where the emphasis is put on the students' decisions regarding the ways in which they engage with the material being taught rather than receiving information being transmitted solely by the teacher.



Section V: The Self-System (Dispositions)

Efficacy

Information for Teachers

What Is Efficacy?

We've all heard the refrains: "I can't do this," "I'm not smart like the other kids," or "I'll never be able to do this!" These statements are the product of students with low perceptions of self-efficacy. Students of all ability levels make these types of statements. Tileston (2004) defines self-efficacy as "the extent to which individuals believe that they have the resources, ability, or power to change a situation based on past experiences" (p. 14). Szente (2007) suggests that self-efficacy "reflects how confident individuals are in their ability to perform certain tasks" (p. 450). Our perception regarding our abilities affects our behaviour, the choices we make, and the time we invest in achieving goals. It is important to note that one can perceive that one has high self-efficacy in one situation and very low self-efficacy in another. For example, some students might perceive that they can be much more successful when writing as opposed to making a presentation in front of the class.

Nelson and Manset-Williamson (2006) comment that "students with low self-efficacy in specific academic areas are likely to avoid tasks within those areas, put forth minimal effort, and tend to give up when encountering difficulty" (p. 214). Students' coping responses are also affected by their perceptions of self-efficacy (Chan, 2007). In some cases, perceptions of self-efficacy are determined by what Whiting (2006) terms "scholar identity" (i.e., when students "view themselves as academics, as studious, as competent and capable, and as intelligent or talented in school settings") (p. 48). Consciously attending to students' perceptions of self-efficacy can enable them to be more successful in all academic situations.

Margolis and McCabe (2006) suggest that there are four sources of self-efficacy information:

1. Enactive mastery – students' recognition of the degree to which they succeed on tasks. The tasks given must be of moderate difficulty or within their ability range, or students will give up.
2. Vicarious experiences – having an opportunity to observe peers model and explain how they go about completing a task or process allows those struggling to see how it is done.
3. Verbal persuasion – this is the information we give students regarding their performance on a given task. Verbal feedback must be tied to specific things learners are doing that produce success. Honest appraisals of what they are not doing are also very important. It is important to note that verbal feedback should never focus on the personal qualities of the learner.
4. Physiological reaction or state – students with low self-efficacy can feel sick, be anxious, act out, or be rehearsing negative statements fuelled by irrational thoughts. Teaching students relaxation techniques and challenging irrational thoughts can help to calm students' physiological responses. (pp. 219-220)

Increasing perceptions of efficacy will:

- focus students on what they do as the primary determinant of success
- increase student motivation, attention, and persistence
- require honest feedback regarding student work
- open space for inquiry.

Teaching for Understanding

Students' attributions about success or failure can often have more impact than the reality of that success or failure. There can be deleterious effects on feelings of self-efficacy and performance when students are unable to relate the feedback to the cause of their poor performance. . . . There is considerable evidence that feedback that attributes performance to effort or ability increases engagement and performance on tasks. (Hattie & Timperley, 2007, p. 95)

Increasing Perceptions of Efficacy in Practice

Classroom Example

Chad is a struggling writer in his Grade 9 English language arts class. Chad has previously experienced little success in his writing. Due to his shyness, he never mustered the courage to ask his teachers for help – he simply forged on, hoping that he would someday figure out this mystery called *writing*. Chad's poor writing skills were attributed to the fact that he is a boy who seemed to prefer sports and video games to academic work.

When his Grade 9 teacher announced the first essay, Chad was immediately anxious. He remembered completing a questionnaire at the beginning of the semester where he had written, "I'm no good at writing." He thought to himself, "Typical, they never read those things." Chad steeled himself to read another boring book and muddle through an essay on which he would do poorly.

In fact, the teacher had read the student questionnaires and Chad was not the only student who had indicated a sense of low efficacy in writing. The teacher saw this unit as an opportunity to teach the students some writing skills they could use during the rest of their high school studies.

On the first day of the unit of study, the teacher says, "Over the next two weeks, you will be accessing a variety of resources and writing an essay on the topic of 'Taking Risks: Setting Limits'. Before we begin, I want to focus your attention on the learning strategies we will be using." She then directs students' attention to the following:

You will be practising the behaviours of effective, active readers by focusing on the following before, during, and after reading strategies:

- Before:
  - Draw on prior knowledge and experiences by considering what you know and need to know about the topic.
  - Ask questions.

- During:
  - Make connections to prior knowledge and experiences (i.e., relate text to self, text to other texts, and text to world).
  - Create visual images.
  - Recognize the narrator's and author's points of view.

- After:
  - Recall and relate, in your own words, major ideas and their supporting details.
  - Relate what was read to personal experience or needs.
  - Recognize how text contributed to your own understanding of self, roles in society, and relationships with others.

When writing the essay, you will be focusing on the following behaviours of effective writers:

- Before:
  - Consider and value your own observations, experiences, ideas, and opinions as sources for authentic writing.
  - Generate and explore ideas by brainstorming, clustering, discussing, dramatizing, representing, reading/listening/viewing, and experiencing.

  - Plan, organize, and sequence ideas to fit purpose, point of view, and format (e.g., chronological, enumerative, problem/solution, cause/effect, compare/contrast).
  - Create and follow a pre-writing plan.
  - Set and manage deadlines.

- During:
  - Shape and develop pre-writing into written drafts using the appropriate format and keeping purpose and audience in mind.
  - Seek out teachers, peers, and others with specific strengths for writing conferences.
  - Share writing-in-progress and final drafts in various ways (e.g., author's circle, peer response), and respond sensitively and constructively during conferences.
  - Identify relevant comments and suggestions that will direct revision.

- After:
  - Revise final drafts to ensure that compositions have effective beginnings, adequately developed middles, and appropriate conclusions.
  - Revise and polish final drafts using pre-established criteria appropriate to chosen task, purpose, and format.

The teacher asks the students, "What do you notice about our learning strategies?" The students note that both reading and writing include before, during, and after strategies. Students also comment that many of the activities ask them to draw on their own experiences.

Chad is beginning to feel some hope. He understands the concept of before, during, and after and likes the framework this provides for his reading and writing. He is also heartened by the notion that he might get to write about snowboarding, his favourite risky sport.

The teacher refocuses students' attention on their topic, "Taking Risks: Setting Limits." She asks the students to make a list of all the things they consider risky. Following the creation and discussion of their lists, the teacher takes students to the library where the teacher-librarian has pulled a variety of resources on the topic of risk. Chad is thrilled because he actually gets to choose the resource he will review! He immediately scoops up a magazine article about snowboarding. He quickly reads the introductory paragraph and cannot wait to read the entire article.

Once students have chosen their resources, the teacher has them quickly skim the resource and ask questions they might like to have answered. Chad has many questions he would like answered.

Next, the teacher models for students how to create a mind map. She places their topic, "Taking Risks; Setting Limits" at the centre of the map and adds some branches from a video she has recently viewed, thinking out loud as she works. Following this, she gives students an opportunity for guided practice in creating a mind map. She then asks students to create a mind map while they review their resource. She informs them that there are no right answers and that they should locate the ideas they find significant. She asks that students indicate what each branch tells us about the author's point of view on the topic of taking risks. She returns to her mind map and labels one of the branches "risk is necessary."

At first, Chad struggles with what to add to his mind map as he is accustomed to looking for the right answer. The teacher reads the first section of the article with him and helps him create two branches. Throughout the process, she continually affirms his good choices and points out the places where he is misapplying the process. Chad soon feels comfortable and continues reading the rest of his article.

After students have completed their review, the teacher models how to use a Venn diagram for comparing and contrasting ideas. She thinks out loud through the entire process. She asks the students to compare and contrast their list of risky experiences with those from their resource. Underneath their Venn Diagrams, she asks students to answer the following question: "What does this help you to understand about yourself and your relationship with others?"

Chad finds many connections between his life and the article, and can see many of his relationships reflected in the characters. He finds he has many ideas to write down.

The teacher asks students to think about the resources reviewed, their mind maps, Venn diagrams, and connecting questions. She asks students to create a personal essay topic they would like to explore.

Chad absolutely freezes. He recalls all of his previous negative experiences and begins to convince himself that he has nothing worth writing about. The teacher notices that Chad has not written anything down. She goes to his desk to speak with him. Chad explains, "I can't come up with ideas. I'm no good at getting ideas. I never have been." The teacher directs Chad's attention to the work he has done so far. She reminds him that he has come up with this information because he has applied a strategy to frame his thinking and idea generation. She shows him all of the ideas he has generated so far. Chad reluctantly agrees that he has many ideas. He reviews them and decides on a topic: "Risk Helps Us Discover Our Limits."

From this point on, Chad and his classmates are immersed in the writing process of brainstorming, creating work plans, setting criteria, peer and self-editing, and working on revisions and final drafts.

Throughout the process, the teacher finds she needs to refer Chad to his earlier successes in order to keep him moving toward the goal. She occasionally pairs Chad with a partner to help walk him through parts of the writing process that he is having difficulty understanding. She regularly reminds him to keep working step by step through the plans and processes that have been provided. She continually tells him, "You can write; you can do this!"

Chad works hard throughout the process. He becomes more open to feedback as he recognizes that his teacher is honest in her assessments of his work. He also recognizes that she has definite standards for his work that she is not willing to compromise. He begins to understand that his ability as a writer is not a personal quality, but a set of skills that he can master over time.

By the time Chad has written his personal essay, he is fairly confident that he has done well. He knows he has met the criteria and he has valued the multiple opportunities for self and peer feedback. He soon discovers that his personal assessment of his work is correct when he receives his essay back with an 'A' and an attached list of criteria met. Chad is pleased and is feeling more confident about his next opportunity to write.

Planning to Increase Perceptions of Efficacy

The following tactics, adapted from the writing of Linnenbrink and Pintrich (2003) and Margolis and McCabe (2006), are useful when planning to increase students' perceptions of self-efficacy:

1. Plan tasks that are appropriate to students' abilities.
    - Try not to assign tasks that trigger a fear of failure or are frustrating. At the same time, tasks should not be so easy that students do not have to try.
    - Regularly assess levels of achievement, and ensure that tasks stay within reasonable levels. It is appropriate to increase the difficulty of tasks over time.

2. Use peer models.
   - Margolis and McCabe (2006) suggest that there are two types of peer models: mastery and coping.
     - Mastery models flawlessly demonstrate a targetted skill or learning strategy.
     - Coping models demonstrate how to learn the skill or strategy and when to apply it.
   - Models in both situations must audibly correct students' mistakes and attribute their successes and failures to controllable factors – "I followed all the steps and didn't quit" or "I missed this step."

3. Teach specific learning strategies.
   - Decide on one or two learning strategies that are essential for the students' success, such as note-making, pre-writing, showing their work, etc. It is important to not overwhelm students with strategies – keep the menu of choices small.
   - Ensure that students understand when and why to apply the strategy that you are introducing. Encourage students to suggest other times where they might employ the strategies.
   - Help students to learn the strategy to automaticity. They should be able to apply the strategy or tactic without having to refer to the explanation.

4. Encourage student choice.
   - Provide tiered assignments.
   - Allow students to choose their own books, based on interest and reading ability.
   - Allow students to set their own goals and to create work plans in relation to the learning outcomes for the lesson or unit.
   - Involve students in the creation of assessment criteria.

5. Reinforce effort and correct strategy use.
   - Encourage students to try. Often having them experience success on one step in a process can lead to more attempts.
   - Stress recent success by:
     - comparing new work to work where students succeeded in the past
     - applying learned strategies to new work
     - discussing with students the reasons for their success.
   - Give frequent, focused, **task-specific** feedback – detail what students have done correctly and what still needs improvement. Be honest and forthright about what you observe.
   - Be mindful of how students perceive credibility when giving feedback to students or discussing their work. If you are praising work that students know is poor or is a result of very low effort, or encouraging students that they can complete an impossible task, the credibility of your remarks are greatly reduced (McCabe, 2006). Feedback and discussion should provide an honest reflection of student work and progress, both successful and unsuccessful. All feedback and discussion should engage students in deciding what steps to take to move forward in their learning.

6. Help students understand that ability is a controllable aspect of learning.
   - Success is due to controllable factors, such as limiting the range of strategies upon which to draw, following the steps in a process, effort, and maintaining concentration.
   - Failure can be due to misapplication of specific learning strategies, insufficient effort, or quitting. All of these can be remediated by developing a repertoire of strategies, reflecting on the usefulness of strategies, spending more time on a task, and not quitting.
   - Failure is not due to permanent limitations or personal qualities. Students need to know that over time, they can and will improve.

Reflection

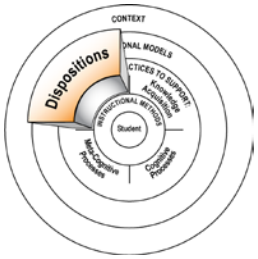
1. In what ways was my planning changed by considering ways I might increase student perceptions of efficacy?

2. Which students needed the most help? Which of the tactics seemed to work the best?

3. In what ways did students respond to the tactics I employed?

4. When I do this again . . .

5. Student learning seemed to be . . .



Efficacy

Information for Administrators

What Is Efficacy?

We've all heard the refrains: "I can't do this," "I'm not smart like the other kids," or "I'll never be able to do this!" These statements are the product of students with low perceptions of self-efficacy. Students of all ability levels make these types of statements. Tileston (2004) defines self-efficacy as "the extent to which individuals believe that they have the resources, ability, or power to change a situation based on past experiences" (p. 14). Szente (2007) suggests that self-efficacy "reflects how confident individuals are in their ability to perform certain tasks" (p. 450). Our perception regarding our abilities affects our behaviour, the choices we make, and the time we invest in achieving goals. It is important to note that one can perceive that one has high self-efficacy in one situation and very low self-efficacy in another. For example, some students might perceive that they can be much more successful when writing as opposed to making a presentation in front of the class.

Nelson and Manset-Williamson (2006) comment that "students with low self-efficacy in specific academic areas are likely to avoid tasks within those areas, put forth minimal effort, and tend to give up when encountering difficulty" (p. 214). Students' coping responses are also affected by their perceptions of self-efficacy (Chan, 2007). In some cases, perceptions of self-efficacy are determined by what Whiting (2006) terms "scholar identity" (i.e., when students "view themselves as academics, as studious, as competent and capable, and as intelligent or talented in school settings") (p. 48). Consciously attending to students' perceptions of self-efficacy can enable them to be more successful in all academic situations.

Margolis and McCabe (2006) suggest that there are four sources of self-efficacy information:

1. Enactive mastery – students' recognition of the degree to which they succeed on tasks. The tasks given must be of moderate difficulty or within their ability range, or students will give up.
2. Vicarious experiences – having an opportunity to observe peers model and explain how they go about completing a task or process allows those struggling to see how it is done.
3. Verbal persuasion – this is the information we give students regarding their performance on a given task. Verbal feedback must be tied to specific things learners are doing that produce success. Honest appraisals of what they are not doing are also very important. It is important to note that verbal feedback should never focus on the personal qualities of the learner.
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Increasing perceptions of efficacy will:

- focus students on what they do as the primary determinant of success
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Teaching for Understanding

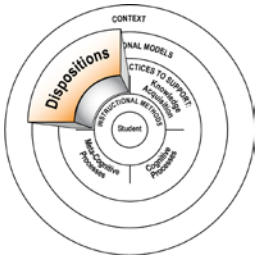
Students' attributions about success or failure can often have more impact than the reality of that success or failure. There can be deleterious effects on feelings of self-efficacy and performance when students are unable to relate the feedback to the cause of their poor performance. . . . There is considerable evidence that feedback that attributes performance to effort or ability increases engagement and performance on tasks. (Hattie & Timperley, 2007, p. 95)

Guidance for Coaching

As administrators support teachers in increasing students' perceptions of self-efficacy, they may meet with teachers prior to or after they have worked with students. Carefully planning the questions that administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where teachers are increasing students perceptions of self efficacy follow:

Examples of Questions	
Pre-Instruction • As you think about your upcoming instruction, which students may need support in their perception of self-efficacy? • What tactics or processes do you anticipate you will need to employ to change their perceptions? • In what ways will you support student reflection, develop students' repertoire of learning strategies, give choice, and provide tiered assignments? • Will you, the students, or both be modelling the use of strategies and processes? • What elements of your feedback will you focus on to increase students' self-efficacy?	**Post-Instruction** • How accurate were your predictions regarding which students would need support? • Did the students surprise you in any way? • As you consider the tactics or processes you used to increase perceptions of self-efficacy, which seemed to connect with students? • In what ways did this process allow you to differentiate instruction? • How did students respond to having choice in materials and assignments? • What elements of this practice will you modify or adapt to support students' self-efficacy?

Examples of Observations	
Teachers may be: • directing students' attention to past successes • helping students see that they have the ability to succeed • giving expanded feedback regarding students' successes and failures and the next steps for their work • modelling learning strategies and processes • engaging students in a variety of ways to learn • thinking out loud • adapting tasks and providing choice for students.	**Students may be:** • initially anxious or frustrated • discussing the attributes of their work habits that have led to success • choosing materials and assignments • working on different materials and assignments as they work towards the same goal • modelling strategies or processes or coaching peers • communicating their needs to their teachers.



Cooperative Learning

Information for Teachers
What Is Cooperative Learning?

Cooperative learning is defined by Johnson, Johnson and Holubec (1994) as "the instructional use of small groups that allows students to work together to maximize their own and each other's learning" (p. 3). Cooperative learning is much more than attending to the seating arrangement of students; it is a process that encourages collaboration and reduces isolated effort and competition.

Cooperative learning is rooted in social constructivism which suggests that students construct their knowledge as they interact with their peers. Lin (2006) suggests three purposes for using cooperative learning are "to develop students' social and communication skills, increase tolerance and acceptance of diversity, and improve academic achievement" (p. 35). Antil, Jenkins, Wayne, and Vadasy (1998) report that "achievement is mediated by productive student interactions – that is, giving and receiving conceptual explanations and receiving assistance in mastering skills and factual knowledge" (p. 446). Cooperative learning is one of the most powerful instructional approaches available to teachers.

Johnson et al. (1994) have articulated five essential components of cooperative learning:

1. Positive interdependence – the notion that one cannot succeed unless everyone else succeeds. Each member's effort and contribution not only help him or her but all other group members. Students need to work together to ensure that everyone succeeds.

2. Face to face interaction – students promote one another's learning through assisting, encouraging and providing effective feedback to one another. Groups should be structured so that effective dialogue can take place.

3. Individual accountability – learners are assessed individually and held accountable for equally sharing and contributing to the mastery of learning goals (Lin, 2006, p. 35).

4. Interpersonal and small-group skills – students must be taught the skills required for effective teams such as leadership, communication, and conflict management. One cannot assume that a group of people working together inherently possess these skills.

5. Group processing – group members reflect upon their work and discuss what they need to do both in terms of meeting the outcomes set for them as well as how they are working as a group.

Cooperative Learning is:

- a constructivist process that encourages students to construct their knowledge with their peers
- one of the most powerful instructional processes
- an effective practice for all subjects at all grade levels.

Teaching for Understanding

"By having learners treat each other as resources and requiring learners to go beyond only superficial engagement with the learning materials, cooperative learning provides the social context for students to actively learn and make deeper connections among facts, concepts and ideas."

Lin, E. (2006). Cooperative learning in the science classroom. *The Science Teacher*, *73*(5), 34-39.

Cooperative Learning in Practice

Classroom Example

An Agriculture 30 teacher has decided to use cooperative learning processes to support his students' exploration of "Module 2: Production Networks from Producer to Consumer."

The teacher divides students into "family farms." Each family farm has a variety of commodities that must be moved from producer to consumer. The teacher has designed a description of each family farm that details its size and the commodities it produces. Each farm is a mixed farming operation with a specialization such as cow-calf, seed production, dairy, and chickens.

Each family farm must detail "the series of activities in production networks including producing, marketing, transporting, processing, grading, packaging, storing, merchandising, wholesaling, and retailing" of the commodities its farm produces (Saskatchewan Education, 1998).

The teacher begins by assigning students to a family farm. He takes care to ensure that groups are heterogeneous combining students of both sexes and a variety of ability levels. Once each family is assembled, he demonstrates the format of a family meeting he wants them to use as they work together. One of the first orders of business is for each family to create a set of norms that govern the ways in which members communicate, carry out their duties and resolve conflict.

Following the family meeting, each group is given the description of its farm that provides significant detail regarding the number of hectares of land farmed as well as an inventory of the livestock on the farm and which are bred or breeding. The groups meet and are charged with the task of dividing up responsibilities for each farm along with the production network activities. Each group is informed that the success of its farm is dependent on each person fulfilling his/her responsibilities. As the groups work through their simulations, each person will need to detail how his/her decisions have resulted in revenue (or loss) for the farm. Each student will need to report his/her individual income or loss and each group will need to calculate the farm's total income or loss. Students quickly realize that a divide-and-conquer strategy will not work. They will need to combine their efforts to ensure that each part of the farm operates efficiently.

Conflict soon arises as differing opinions regarding the allocation of resources and the overall plan for each farm are being designed. The teacher has expected this and introduces strategies for students to use as they discuss the conflicts that have arisen. Students practise the skills of conflict resolution and consensus building.

Over the course of the simulation, the teacher distributes "situations" to each farm that will affect the production network on the farm. Situations might include disease in crops or animals, rising fuel prices, damaging weather, changes in commodity prices or changes in marketing rules. Students must respond to each situation and detail how they would have to change the activities of their farm in order to keep it productive and profitable.

Throughout the simulation, students access a variety of resources such as commodity reports, information on each component of the production network, information on creating budgets, world news reports, and information on improved production methods for each area of their farm. Students realize they must combine the information they are gathering and analyzing in order to create a whole-farm plan that is workable.

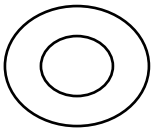
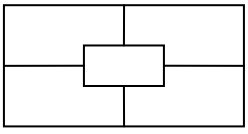
Following the simulations, students meet for their final annual meeting. Each family farm must produce a report that details what they learned, how they responded to the situations they faced, what they learned about working together, a summary of their strengths and weaknesses as a 'family,' and what they would do differently if they could repeat the simulation.

Students noted that there was no competition between the farms. It was essential that all farms be successful.

Using Cooperative Learning

Cooperative learning processes vary from short simple tactics to complex processes as detailed in the previous example. What makes a tactic or process cooperative learning is the ways in which it requires students to build knowledge collaboratively. It is important that students honour the contributions of every group member. Even the seemingly insignificant offering can prove to be of great use (Cajete, 2005; Yatta, 2002). Following is a listing of some cooperative learning processes ranging from simple to complex. The reference list includes resources that offer more information.

Simple Cooperative Learning Tactics

Think-Pair-Share	Think-pair-share is a three step discussion strategy. After the teacher has asked a question, students are given time to think individually. They then pair with another student to discuss their responses and then each pair shares their response with the whole group (Lipton & Wellman, 2000).
Inside/Outside Circles 	Students form two concentric circles, each with the same number of students. The teacher introduces a topic or asks a question and pairs of students discuss the topic or questions. When signalled, both circles rotate so that everyone has a new partner. The discussion either continues or a new question or topic is introduced.
Jigsaw	Students begin in home groups of three to six. Each member of the home group receives a portion of what is to be studied/discussed. Students from each group with the same material form expert groups and meet together to discuss and learn the material. Finally, the home groups are reassembled and each expert must teach his/her peers their portion of the material. All students are responsible for all of the material they have learned as a group.
Four Corners	The teacher announces a topic and gives students four alternatives for responses. For example, “If you were a cookie, what type would you be? Chocolate chip, peanut butter, shortbread, or oatmeal raisin?” Students go to a corner of their choice and find a partner to discuss why they chose that corner. This activity helps students to appreciate individual differences or varying viewpoints.
Three-Step Interview	Divide students into groups of three and have them label themselves as A (interviewer), B (interviewee) or C (reporter). Before, during, or after a unit of study, students take turns interviewing one another while the other takes notes. The reporter’s job is to summarize the interview he or she has just witnessed. Once everyone has had a chance to occupy each of the three roles, students combine their reports and share their information with the larger group.
Place Mat 	A piece of paper has a topic or question in the middle and the remainder is divided into 3-6 sections. Students gather around the paper, individually respond, then share their response with the rest of the group. Students have a visual record of their work and their thinking to guide their conversation.

Complex Cooperative Learning Processes

Team-Games-Tournament

This strategy is typically used to check for understanding. Students form home teams of three and review the material learned and label themselves A, B, and C. Next, the A's gather in groups of three and are quizzed regarding the material. Following the quiz, each person tallys his or her score and then returns to the home team to combine the scores.

A detailed explanation of this strategy can be found in *Beyond Monet; The Artful Science of Instructional Integration* by Bennett and Rolheiser, 2001.

Student Teams-Achievement Divisions

Assign students to teams of mixed ability. Administer a pretest or quiz to see what students already know about the topic and to set a base line. Provide whole-class instruction on the material to be learned. Team study then occurs with teams working on the assignment or questions as a group to best learn the material. Students are then given individual quizzes. Points are given to teams based on each individual's improvement from his or her base line or pre-test score.

A detailed explanation of this strategy can be found in *Classroom Connections: Understanding and Using Cooperative Learning* by Abrami et al., 1995.

Johnson & Johnson Five Elements

Design a cooperative learning task (like the example in this document) attending to the following five elements:

1. positive interdependence
2. face to face interaction
3. individual accountability
4. interpersonal and small-group skills
5. group processing.

A detailed explanation of this process can be found in *Beyond Monet; The Artful Science of Instructional Integration* by Bennett and Rolheiser, 2001.

Reflection

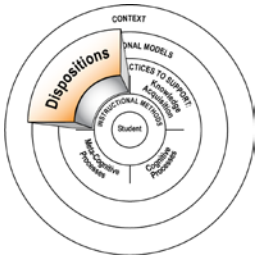
1. In what ways did cooperative learning support the development of student reasoning and understanding? In what ways were students' social skills enhanced?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



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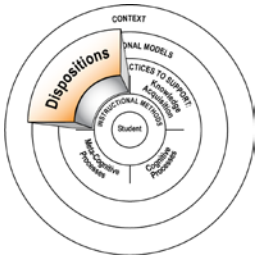
As administrators support teachers in integrating this approach, they may meet with teachers prior to or after they have used cooperative learning. Carefully planning the questions that administrators will ask teachers is essential as they support the thinking of teachers. Examples of questions that administrators may ask and what they may observe in classrooms where cooperative learning is being used effectively follow:

Examples of Questions	
Pre-Instruction • In what ways are you planning to use cooperative learning? • By what methods will you create student groups? • How have you detailed the roles each student will assume during his or her study? • In what ways will your assessments capture both individual and group achievement?	**Post-Instruction** • As you consider your use of cooperative learning what did you notice regarding students' engagement? • In what ways were student thinking enhanced by the use of cooperative learning? • Which of your students seemed to benefit the most from the use of cooperative learning? • What things will you keep the same the next time you use cooperative learning? What things would you like to change?

Examples of Observations	
Teachers may be: • assigning roles to students • encouraging students to talk, dialogue, and question • teaching students how to mediate conflict • creating situations where conflict will arise • holding individual students accountable for their actions within a group • holding groups accountable for the actions of individuals • teaching team-building and communication skills.	**Students may be:** • working in small groups to solve problems • assuming different roles as they work on their studies • Disagreeing respectfully with one another as they share opposing ideas with one another or navigate group processes • applying group processes to their groups and in the mediation of conflict • "competing" with other groups.



Structured Academic Controversy

Information for Teachers

What Is Structured Academic Controversy?

Johnson, Johnson, and Smith (2000) offer the following definition of *structured academic controversy*:

> . . . an instructional procedure that combines cooperative learning (in which students work together in small groups to develop a report on an assigned topic, for example) with structured intellectual conflict (in which students argue the pro and con position on an issue in order to stimulate problem-solving and reasoned judgment). (p. 30)

Structured academic controversy is similar in format to a formal debate and encourages dialectical thinking in students. This type of thinking is necessary in order to create a reasoned argument.

Controversy of any type arouses curiosity in people. Johnson et al. (2000) report that students engaged in structured academic controversy "read more library materials, reviewed more classroom materials, more frequently watched an optional movie, and more frequently requested information from others" (p. 34). Student motivation is increased as students engage in structured academic controversy because they often want to create the best argument possible in preparation for presentation to their peers.

On the surface, structured academic controversy may seem to be a competitive process, but the converse is true. Chen and Tjosvold (2002) suggest that "cooperative, but not competitive or independent, goals provide a foundation for team members to discuss their opposing ideas openly and constructively within the classroom" (p. 49). Ensuring that academic controversy is non-competitive and ends in consensus building is important.

Bennett and Rolheiser (2001) caution that students must have an understanding of or experience with the topic and possess well developed collaborative skills such as "taking turns, no put downs, suspending judgment, actively listening, paraphrasing, disagreeing in an agreeable way, and accepting and extending the ideas of others" (p. 311).

Academic Controversy:

- is a way to encourage dialectical thinking
- stimulates innovative thinking among participants
- increases student motivation and interest
- deepens students' understanding as they work to strengthen their side of the argument.

Teaching for Understanding

"What we found [in 30 years of research studies] is that the intellectual challenge inherent in constructive [academic] controversy results in the use of higher-level reasoning strategies, the development of more complex and coherent conceptual structures, and more critical thinking. All this leads to greater subject learning, more accurate retention, higher-quality decisions, and sounder, more creative solutions to complex problems (for which different points of view can plausibly be developed." (Johnson, Johnson, & Smith, 2000, p. 34)

Structured Academic Controversy in Practice

Classroom Example

In an English Language Arts B10 class, students have been exploring issues associated with the "Equity and Ethics" unit. Students have been considering the rights and responsibilities that one has in a lifetime and how people take responsibility for their actions in order to do what is right. Students have also explored how and why people act upon their knowledge, values, and abilities for the well-being of others. During the unit, students have considered how characters such as Lady Macbeth in Shakespeare's *Macbeth* have to accept responsibility their actions. They have been considering such questions as the following:

- What is the relationships between rights and responsibilities?
- Who decides what is right?
- What would have been the right thing for Lady Macbeth to do?
- How does one become an ethical person? (Ministry of Education 2011, p. 15)

The teacher plans to use a structured academic controversy to have students explore Lady Macbeth's role in the play.

The teacher has all of the students write their names on slips of paper and then randomly draws names creating groups of six with three students labelled as A1, A2 and A3 and three students labelled as B1, B2 and B3.

To demonstrate the process to the students, the teacher has them practise on the statement – *Nap time should be scheduled every day at 1:30*. The students work through the entire process in approximately 20 minutes. Following their practice, the teacher reviews the steps, key points regarding collaboration, and the purpose for using structured academic controversy. He provides them with a handout outlining the steps in the process and asks the students if they have any questions about the process before they continue.

The teacher writes the following statement on the board: *Lady Macbeth is responsible for the ruin of Scotland*. He reminds the students that the A's are to argue in favour, while the B's are to argue against the statement. He informs the students that they will have the remainder of the day's class and the whole class the following day to prepare their arguments. He reminds them to consult their notes, journals, and reflections from class and tells them they will have access to a variety of print and Internet resources in the library. The students begin crafting their arguments. During the research process, the teacher notices that students are poring over their notes and journals and are also accessing a variety of other sources – Internet critiques, other translations, and essays written about the play. The energy of the students is noticeable. Near the end of the research period, the teacher has students return to their groups to begin crafting their argument.

The next day, groups debate the issue. The A's begin, and each person plays a role in sharing his/her position with the other side. The teacher notices that one of the A groups is arguing that all of Macbeth's actions were masterminded by Lady Macbeth. When the B's make their presentation, they assert that Lady Macbeth cannot be responsible because she did not fully control Macbeth's free will. Each team listens attentively and takes notes while the other team presents.

Following the presentations, the teams meet to craft their rebuttals. Students share their notes and look for weaknesses in the other team's argument. The teacher notices that students seem energized by this prospect.

The teams return to their debating positions and the B's have the first opportunity to supply their rebuttal. Logically, they attempt to refute the A's position by asserting that Lady Macbeth slowly went insane and ultimately committed suicide long before Macbeth was finished his campaign of terror. The A's offer their rebuttal and argue that Lady Macbeth's manipulative skills were so powerful that she essentially owned Macbeth's free will. The teacher notices that the students are very enthusiastic and there is much laughter and camaraderie in the room.

Following the rebuttals, the teams move to the opposite chairs and begin working on the opposing viewpoint. Many students find this to be an interesting prospect and somewhat of a challenge after the energy they have invested in their original argument.

Again, each side presents its argument followed by rebuttals. The teacher notices that the arguments are becoming more sophisticated and that the sides are coming closer together. The students are looking even deeper into their materials to find specific examples of what they are arguing. Students are developing very clear pictures of the characters of Macbeth and Lady Macbeth.

The sides are dissolved, and students are given time to reflect and to write down what they are thinking at this time. They also reflect on how their thinking has changed. The groups of six are reassembled with their chairs in a circle. Each student is given an opportunity to share their thinking and how it has changed. The teacher is pleased by the level of insight he hears in students' responses. He is also hearing language that indicates students are considering many sides to the issue in their decision.

After each student has shared, the groups are asked to try to come to consensus on the original statement. Most groups achieve consensus, but a few cannot and offer more than one response. The students comment that they enjoyed the process and found it interesting that they could say so much about one statement. All students feel comfortable in understanding the motivations of Lady Macbeth and Macbeth.

Using Structured Academic Controversy

The following eight steps for designing a structured academic controversy have been adapted from the work of Bennett and Rolheiser (2001, p. 312).

1. Identify the controversy.
    - State the controversy in the positive. For example, "Every Canadian family should be limited to one vehicle so that Canada can meet its carbon emissions targets."

2. Create groups of four to six.
    - Equally divide the students between the pro and con side of the argument. Randomly assign students to groups in order to create diversity among the groups. Bennett and Rolheiser suggest having students number themselves as A1, A2, B1, B2, etc. provides a means for individual accountability if the teacher informs students that all students will be called upon to present equally.

3. Allow time to plan.
    - When introducing this process to students, begin on a topic for which they need to do no research so that they get used to their roles. The amount of planning time given depends on the purpose of using the process and the complexity of the subject matter being discussed. Some groups of students may function more efficiently if the research materials are provided, while other students may wish to source their own materials.

4. Allow time for each group to share.
    - Presentations must be timed and should be quite short – less than two minutes in length. The opposing side should be listening actively and taking notes for their rebuttal. There should be no interruptions as each side shares its position.

5. Plan the rebuttal.
    - Each group meets to plan its rebuttal by locating the areas of the other side's argument where they perceive gaps or flaws. Active listening in step four determines the success of groups in designing a rebuttal.

6. Present the rebuttal.
    - Following the initial sharing of each group, the B side begins with the rebuttal first. Again, responses should be timed and are typically not longer than 90 seconds.

7. Change seats and change your mind.
    - Have students physically change places and repeat steps 3 to 6. Again, the amount of planning time given will be determined by the purpose of the process, the age of the students and the complexity of the material.

8. End with a round robin.
    - Students are no longer assigned to either side of the argument and each share where he or she now stands on the issue being discussed. Providing students with time to reflect and to write prior to sharing helps support their thinking. Students may also want to share in what ways their thinking changed as they participated in the structured academic controversy.

    - After students have shared, see if the groups can come to consensus on the issue at hand. After groups have worked towards consensus, have a spokesperson share the group's thinking.

Reflection

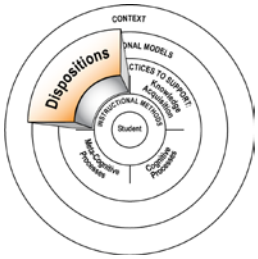
1. In what ways did using structured academic controversy support the development of student reasoning and understanding?

2. My students responded . . .

3. I noticed . . .

4. When I do this again . . .

5. Student learning seemed to be . . .



Structured Academic Controversy

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On the surface, structured academic controversy may seem to be a competitive process, but the converse is true. Chen and Tjosvold (2002) suggest that "cooperative, but not competitive or independent, goals provide a foundation for team members to discuss their opposing ideas openly and constructively within the classroom" (p. 49). Cajete (1994) states that "placing students in situations in which they constantly have to examine assumptions and confront preconceived notions is a regular practice of Indigenous teachers." Ensuring that academic controversy is non-competitive and ends in consensus building is important.

Bennett and Rolheiser (2001) caution that students must have an understanding of or experience with the topic and possess well developed collaborative skills such as "taking turns, no put downs, suspending judgment, actively listening, paraphrasing, disagreeing in an agreeable way, and accepting and extending the ideas of others" (p. 311).

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Guidance for Coaching

As you support teachers in integrating this process, they may meet with teachers prior to or after they have used structured academic controversy. Carefully planning the questions that administrators will ask is essential in supporting the thinking of teachers. Examples of questions that administrators may ask and what they may see in classrooms that are effectively using structured academic controversy follow:

Examples of Questions	
Pre-Instruction • What topic will your students explore using structured academic controversy? • In what ways have you taught students the collaborative skills required? (taking turns, no put downs, suspending judgment, actively listening, paraphrasing, disagreeing in an agreeable way and accepting and extending the ideas of others) • How will you have students practise this process before using it? • How will you be selecting teams? In what ways will you ensure that groups are mixed? • How much time have you set aside for students to plan their arguments? • How much time have you set aside for this process? • In what ways do you plan to assess students throughout this process?	**Post-Instruction** • As you consider your use of structured academic controversy, what stands out for you regarding your use of this process and students' engagement? • In what ways did the use of structured academic controversy support the development of students' reasoning, dialectical thinking and understanding? • Did students access more resources than normal during this process? If so, what types of resources seemed to be most valuable for students? • Which of your students seemed to benefit the most from the use of structured academic controversy? • How engaging was the topic for students? • What might you change the next time you engage students in a structured academic controversy?

Examples of Observations	
Teachers may be: • assigning students to teams • giving students provocative questions or topics to explore • supporting students' research and argument development • providing students time to research • engaging students in reflection regarding their thinking.	**Students may be:** • passionately arguing a position • practising the skills of collaboration • researching from a variety of sources • crafting arguments and rebuttals • discussing issues from both sides • reflecting and talking about their thinking processes.

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