Metacognition

Metacognition is an integral part of the learning process. Students learn better when they have the time and the skills to understand the intention of the lesson and to reflect on and assess their learning. Rather than just focusing on the subject content, students need to reflect on how they understood concepts through the use of thinking and social skills and learning strategies. When students know their strengths and weaknesses in learning, they can focus on skills and strategies that will be most helpful to them. Metacognition also fosters problem-solving skills and a deeper understanding of concepts.[1]

While cognition involves *automatically* reflecting on one's learning at naturally logical points in the work, metacognition involves *deliberately* being aware of behaviours and thought processes one is engaged in while learning. There are three components of metacognition:

- *knowledge of person*, including how people process information and one's own learning process
- *knowledge of task*, including the task itself and the demands it will place on the individual
- *knowledge of strategies*, including cognitive and metacognitive strategies, as well as when and where to apply these strategies.[2]

Teaching Metacognition

As an instructional strategy, metacognition involves guiding students to reflect on their learning during activities, and then encouraging students to reuse these behaviours and thought processes on their own when opportunities present themselves. Some argue that the ultimate goal of teaching metacognition is to move students towards cognition—automatically knowing how to learn and applying the right strategies at the right time.[3]

Regardless of the instructional methods that teachers choose, learning is enhanced when students have the opportunity to

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1. Gardner, 2004.
2. Livingston, 1997.
3. Gardner, 2004.

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identify, reflect on and assess how they learn, and—most importantly—how they can use skills, strategies or concepts in the future. Teachers may begin to implement metacognition as a teaching strategy by planning to include three phases in their lessons:

- Phase 1: Students should know the **intent** of the lesson. For example: *What are the learning goals or objectives? What do I already know and how can this help me? How will I approach my tasks?*
- Phase 2: At strategic points in the lesson, students should **reflect** on their behaviours and thought processes. For example: *Discussing the material in a group allowed me to get different perspectives on the topic; Using this graphic organizer helped me clearly categorize information;* or *I need to change this graphic organizer to categorize information more effectively.*
- Phase 3: At the conclusion of the lesson, students should **assess** the usefulness of the skills and strategies and how they will apply their learning in the future. For example: *How can I use this skill in a different class?* or *I could plan my project better next time by using a graphic organizer.*

The following sections provide sample questions that could be used to implement the phases of metacognition within three common instructional methods: inquiry-based learning, cooperative and collaborative learning, and interdisciplinary learning. Sample questions are also provided to support the Theory of Multiple Intelligences*,* which may be infused into other teaching methods. These lists are not meant to be exclusive, but to illustrate the types of questions students might ask themselves. Teachers may select questions from the various tables, or use these examples as a model for developing questions that match their own instructional methods.

Metacognition and Inquiry-based Learning

In inquiry-based learning, students learn by asking questions, solving problems, reflecting on processes, and forming their own theories and conclusions. For more information, see Inquiry-based Learning. As part of developing an inquiry-based lesson, teachers need to consider metacognitive factors, including important themes and ideas that connect the lesson to previous lessons; how students will reflect on the processes and strategies they are using; and how students will think about ways to use skills, strategies or concepts in the future.

The chart below provides examples of questions that students may ask themselves in the three phases of metacognition. Initially, teachers may need to encourage this type of questioning and/or ask students the questions directly as part of the activity.

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Intent	Reflect	Assess
• How does this topic connect to what I already know?	• Which information would I consider to be the most controversial so far?	• Are there theories or ideas that can be applied to other subjects or disciplines?
• What do I know that can help solve the problem?	• Which learning strategy has been the most effective? Do we need to use more than one strategy to solve the problem?	• How does this subject deal with change in areas such as technology?
• What thinking skills should I use? Which graphic organizer have I been most comfortable with and can I use it here?	• What combination of thinking skills has worked the best to investigate the parts of the problem?	• How can I use these skills, strategies or concepts in the near and far future?
• What learning strategies will work best to solve this problem?	• Are there multiple strategies that would be equally effective to solve this problem?	• What were the major ideas that were related to one another and where else do I think they may apply?

Metacognition and Cooperative or Collaborative Learning

Cooperative or collaborative learning is when students work together to accomplish a task. In effective cooperative/collaborative learning, students have a clear understanding of the task, set common goals, and assume roles and responsibilities for the creation, development and completion of the task. For more information, see Cooperative Learning.

In successful cooperative learning, students also engage in metacognition by reflecting on and assessing their progress. Teachers can improve group effectiveness by instructing students to reflect at strategic points during their group work. Students will improve their performances as they reflect on their experience and create new goals based on those reflections.

The chart below provides examples of questions that students may ask themselves in the three phases of metacognition.

Intent	Reflect	Assess
• What are my responsibilities in my new role? What skills do I already have that will help me accomplish this task?	• Which part of my role do I find the most fun? What did I do to deal with the most challenging responsibility in my role?	• When was I most effective in my role? When was I least effective? What was the best part about working with the group and how can I recreate this positive outcome with groups in the

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Intent	Reflect	Assess
		future?
• What communication skills do I have that will help me to contribute my ideas to the group? What communication skills do I need to work on?	• How did I feel when I was communicating with the group? How did I make others feel about their contributions to the group?	• What was the best way to communicate in the group? Which communication strategies will I use again when working in groups?
• What thinking skills and learning strategies will be useful for this task?	• What combination of thinking skills is working for our task or project?	• Which thinking skills were the easiest to use? How can I use the skills in the future?
• What strategies or information do I already know that would be useful to share with my group?	• Which learning strategy has been the most effective so far? Do we need to use more than one strategy to explore our topic?	• Which learning strategy was essential to complete the task? Where would I use this strategy again?
• How much time do I have to complete my task?	• Have I monitored the time required effectively to ensure that the task will be completed? How much time is required for the remaining tasks?	• Was time a factor that was difficult to manage? What was the most challenging part to get done on time? How could I do things differently next time?
• How will we resolve conflict in our group?	• How have conflicts been resolved so far? What has been the best part about working with a group and what has been the most challenging part?	• What was the best way to resolve conflict in the group? Was this conflict resolution method effective enough to use again?

Metacognition and Interdisciplinary Learning

Interdisciplinary learning is a teaching approach that combines the curricular objectives and methods from more than one discipline by focusing on a central theme, issue, problem or work. Because it generally engages students in higher-level thinking and decision making, interdisciplinary learning stresses the importance of knowing how to learn. For more information, see Interdisciplinary Learning.

The chart below provides examples of questions that students may ask themselves in the three phases of metacognition. The questions relate to activities such as mathematics, researching or reading—activities that may occur in a variety of interdisciplinary projects. Because interdisciplinary learning often overlaps with other instructional strategies, many of these questions could also apply to inquiry-based or cooperative learning activities.

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Intent	Reflect	Assess
• What do I already know about this topic, issue, theme or problem?	• How have I broken down the topic, issue, theme or problem? Am I going in the right direction to complete the task?	• How does the information I learned apply to a real-world context? What parts of my learning can I use in the future?
• Which thinking skills will work best: analysis, synthesis or evaluation? Can I use a graphic organizer to help me with this process?	• Has the graphic organizer that I chose helped me to think through my work and allowed me to go to the next step?	• What thinking skills and strategies will I be able to use in the future?
• How should I read this kind of text?	• What reading strategy has been most useful to help understand the text?	• Which reading strategy would you recommend to others?
• Which computational skills that I know will be required in this lesson? Which computational skills do I need more practice with?	• Which computational skills have I had the most success with? Which computational skill need more practice?	• In the future which computational skills will I use again when studying within the same disciplines? Can I think of a real-world example of using this computational skill?
• What do I know about what is required when developing and completing a product; e.g., essay, production, recital, project, note-taking, poster? What will be the steps required to complete the product?	• Which part of the product has been the most interesting so far? Which has been the most challenging?	• Which part of the product has been the most interesting to produce? Where would I use this process again?
• From the strategies that I have which one(s) will I use to participate in class? Which strategy do I need to know more about so I can participate in class better?	• Which participations strategy is working well and why?	• Where is another place the participation strategy could help me? Which new strategy would I like to become more comfortable with in the future?

Metacognition and the Theory of Multiple Intelligences

In his *Theory of Multiple Intelligences*, Howard Gardner argued that every person has a unique profile of the following nine intelligences.[4]

1. **Verbal-Linguistic Intelligence**: well-developed verbal skills and sensitivity to the sounds, meanings and rhythms of words

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4. Gardner, 2004.

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2. **Mathematical-Logical Intelligence**: ability to think conceptually and abstractly, and capacity to discern logical or numerical patterns

3. **Musical Intelligence**: ability to produce and appreciate rhythm, pitch and timber

4. **Visual-Spatial Intelligence**: capacity to think in images and pictures, to visualize accurately and abstractly

5. **Bodily-Kinesthetic Intelligence**: ability to control one's body movements and to handle objects skillfully

6. **Interpersonal Intelligence**: capacity to detect and respond appropriately to the moods, motivations and desires of others

7. **Intrapersonal Intelligence**: capacity to be self-aware and in tune with inner feelings, values, beliefs and thinking processes

8. **Naturalist Intelligence**: ability to recognize and categorize plants, animals and other objects in nature

9. **Existential Intelligence**: sensitivity and capacity to tackle deep questions about human existence, such as what is the meaning of life, why do we die, and how did we get here.

Each type of intelligence reflects a different way of interacting with the world; allowing students to work and interact using the various intelligences creates more authentic learning experiences. Ensuring that metacognition is included as part of the learning process enhances the level of active engagement when working with the intelligences.[5] As students use each of their intelligences, they need the opportunity to reflect on and assess their learning, including which intelligences are strongest and which require development.

When lessons focus on one or more of the multiple intelligences, teachers may implement the three phases of metacognition in their lessons. The chart below provides examples of questions that students may ask themselves in the three phases of metacognition.

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5. Gardner, 2004.

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Intent	Reflect	Assess
Verbal-Linguistic Intelligence		
• How will I need to communicate with others? • What techniques do I already know that will allow me to communicate well? • How will I use my voice to emphasize information?	• Have I communicated with others clearly? What strategy worked the best so far? • What communication techniques have I used so far? Are there other techniques I could use? • How have I used my voice to communicate so far?	• Which ideas did I communicate with others most effectively? • Which techniques made the communication clearer? When can I use these techniques again? • Are there other voice techniques I could use in the future?
Mathematical-Logical Intelligence		
• What do I know about this idea or concept? Is there an example I can think of? • Based on my past experience, what order of operations or tasks do I think will work here?	• How does this idea or concept compare to similar ideas or concepts I know about? • Is the proposed order working or not? Why? How should I change the proposed order?	• How can I use this new idea or concept in the future? • How might I apply this order of operations to other situations or problems?
Musical Intelligence		
• What sound clips or music have I used or heard before that could be adapted to enhance this presentation? What should I listen for when I am choosing sounds?	• How have the sound clips or music affected me so far? Which sound clip or music do I think will have the most impact on the audience? Why?	• What were the best sound clips or music and why? How could I use sound differently in the next presentation I give?
Visual-Spatial Intelligence		
• What does the image or picture make me think of? • How can I create a visual image or representation of my idea? What will be the challenges?	• Are the images or pictures helping me to understand new concepts? • What are the best parts of the visual representation so far? How am I solving the challenges?	• How well did I understand the image or picture? Would I use different strategies to interpret the image next time? • What part of the visual representation would I do differently next time?
Bodily-Kinesthetic Intelligence		
• How will I handle this object? Are there any safety issues or concerns?	• What steps should I use to handle this object safely?	• What advice would I give to someone about the safe handling of the object?

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Intent	Reflect	Assess
• How will I move carefully to be effective and/or safe?	• What is the most difficult movement so far? How did I ensure my safety?	• What was my favourite part of the movement? What part would I change next time?

Interpersonal Intelligence

Intent	Reflect	Assess
• What do I predict will be the mood, motivation and desire of the character?	• What are my first impressions about what the character wants? Can I think of a similar situation and what were the results in the end?	• Based on my own experience and the character's mood and motivation, do I think the results were realistic? What have I learned from the results that I could apply to my life?

Intrapersonal Intelligence

Intent	Reflect	Assess
• How do I feel about the task or situation? What would make me feel different?	• What made me feel good about the task or situation so far? What was most difficult?	• How do I feel about the results of the task or situation? What would make me feel different?
• What do I value the most about the task? Why?	• What is the most valuable part of the task so far? Why?	• What was the most valuable part of the task? Why?
• How will what I believe impact my choices?	• Have I been true to what I believe during the discussion?	• How will what I believe impact my future choices?

Naturalist Intelligence

Intent	Reflect	Assess
• Do the selected plants, animals or other objects in nature remind me of any other element in nature?	• Which graphic organizer has assisted me the most so far when categorizing the similarities and differences between plants, animals or other objects?	• How did I know to categorize plants, animals or other objects the way I did? Would my method of categorizing be useful elsewhere?

Existential Intelligence

Intent	Reflect	Assess
• Why are humans able to think, feel and live differently than other species on the planet?	• What proof have I found to support that animals react on instinct rather than thought?	• How can I be sure that humans are more thoughtful than animals?
• What do I know about artificial intelligence? How can I find out more?	• What is the most interesting fact about artificial intelligence used in computers and robots? Where else can I search for information?	• What do I think scientists could focus on next in the field of artificial intelligence to make a difference in the world?

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