Augustana College

EDUC 245 – Educational Psychology & Measurement

Concepts addressed:
Major Cognitive Processes Associated with Student Learning

Critical thinking requires higher-order thinking. One of the main objectives of school is to create critical thinkers. It involves the ability to evaluate information by thinking logically and systematically. Students who develop critical-thinking skills are more productive and on-task, have increased retention and performance, and are better able to make rational decisions then students working on rote memorization tasks. It should be embed in the curriculum, not taught as a separate entity.

Critical thinking involves the following steps:
1.) define and clarify the problem (what are the central issues, identify similarities and differences, what is relevant and irrelevant)
2.) judge information related to the problem (differentiate between fact and opinion, recognize bias, propaganda, and emotional factors, check for consistency)
3.) solve the problem and draw conclusions, encourage students to offer a rationale for their answer

Students need practice in critical thinking to become adept at it. Exposure to dilemmas, propaganda, advertisements, and logical and illogical arguments fosters critical thinking. Elementary students will need to work with concrete examples. Facilitate higher-order thinking by giving all students a copy of Bloom's Taxonomy to refer to in their notebooks. Encourage students to be open-minded when hearing other's ideas.

Questions that encourage critical thinking:

- What advice do you have for future students about this project?
- What did you learn in another class this week that you could use in this class?
- Demonstrate the main point of today' s lesson to a classmate.
- List the events that we just studied in the order they happened. Now change the order of one event and tell what the new outcome would be.
- What qualities caused the people in today's lesson to succeed?

In our increasingly complex world, it is becoming imperative that students are capable of thinking creatively. This involves the ability to solve problems in new and unusual ways (brainstorm, answer "What if. .. ?). Creative thinking requires higher order thinking skills. Elementary students will benefit from concrete examples.

Encourage students to:
1. not rush to the obvious conclusion
2. consider various solutions to a problem (break the pattern)
3. relax (a classroom climate where everyone's ideas are accepted)
4. carefully analyze the problem

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5. emphasize thinking skills such as:

- thinking of unusual ideas
- generating multiple ideas (gather specific and general facts)
- plan a strategy
- map various possibilities for solutions to problems (try new combinations)
- organize the facts and concepts
- identify the problem in a clear manner
- allow time for reflection (let it simmer)

Bloom's Taxonomy in the Cognitive Domain offers a guide to levels of thinking. Knowledge and comprehension thinking skills are considered lower-order thinking. Application, analysis, synthesis, and evaluation thinking skills require higher-order thinking. Elementary students need concrete examples to engage in higher-order thinking. The following is Bloom's Taxonomy:

Knowledge - recall the information - define, list, repeat
Comprehension - understands the information - paraphrase, explain, describe
Application - use the information - exhibit, demonstrate, simulate
Analysis - critical thinking, deductive and inductive - test, interpret, scrutinize
Synthesis - original thinking, divergent - compose, design, formulate, invent
Evaluation - judgment with rationale, offering an educated opinion - assess, determine.

Strategies to encourage higher-order thinking:

1. Encourage discovery, invention, and artistic/literary creation.
2. React to curiosity and new ideas with enthusiasm.
3. Expose learners to new twists on old problems and invite looking at old problems from new angles.
4. Constructively critique new ideas; fine-tune.
5. Alter expectations so students realize there will be trial and error when working with new ideas.
6. Invite contrary, or opposing, positions (new possibilities are often discovered in this way).

Inductive thinking is the process of reasoning from parts to the whole, from examples to generalizations. Hilda Taba suggested there are 3 parts to inductive thinking: 1) concept formation, 2) interpretation of data, and 3) application of principles. Intuitive thinking is required and best guess is encouraged. An example of inductive thinking would be seeing a blue jay, sparrow, robin, and eagle fly so a generalization is made that all birds fly. This generalization is challenged when a penguin is seen. Discovery learning embeds an inductive approach to learning.

Deductive thinking - reasoning moves from the whole to its parts, from generalizations to underlying concepts to examples. Examples of deductive thinking would be having students look at various commercials that contradict each other and then weigh the evidence from other sources or debating the right to ride a bike to school (younger children may work in pairs).

Inductive and deductive thinking both require higher-order thinking and are branches of logical reasoning. Students that are familiar with a topic are more likely to engage in deductive and

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inductive thinking. To develop deductive and inductive thinking students must be given regular opportunities to engage in activities that require it.

Problem solving is a 5-step process:

1. Identify the problem
2. Review material on the problem and define goals
3. Collect data or information
4. Analyze information
5. Determine conclusions and discussion

Students can be taught problem solving strategies. Provide practice with a variety of problems to increase the probability that students will be able to solve real-life problems. Give problems that require algorithm (set procedure for solving a problem) and heuristic (general problem solving strategies) skills to increase problem-solving abilities. Encourage students to identify important information and discarding extraneous facts. Graphics (diagrams, flowcharts) may be helpful in representing the problem.

Functional Fixedness (inability to think in creative ways) and Response Set (responding in the most familiar way) make it difficult to problem-solve.

Developmentally appropriate problem solving:
Lower elementary students are developmentally capable of identifying the problem, reviewing material on the problem, and defining goals (steps 1 and 2). Upper elementary students are developmentally ready to collect data or information (step 3). Fifth and sixth grade students are developmentally ready to analyze information and determine conclusions (steps 4 and 5) when concrete examples are used.

Inventions are open-ended problem-solving tasks. Students that engage in inventing are in the process of creating something to fill a need. Discovery is an integral part of inventing. Inventing requires critical, creating thinking.

Students learn to invent through their own active involvement. At both the elementary and secondary level the teacher should provide the materials and encourage students as they progress. Students observe, make hypotheses and test their inventions. The teacher should not guide students through the process.

Steps in Invention:

1. Choose a situation you want to make better or a new product you want to create.
2. Decide specifically what you want your invention to do and make a model, sketch or outline.
3. Develop the product.
4. Revise (carefully consider how it could be improved).

Example: Create a new toy for younger children.

Memorization and recall - rote memory involves remembering information by repetition or mnemonics (techniques for remembering). Memorizing information is used when little meaning is attached to the material (order of the planets, state capitals). Techniques for remembering:

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1. Memorize part of a list and then continue to add more items to the list
2. Repetition
3. Acronyms
4. Chain mnemonics (associate 1 thing with another - when two vowels go a walking, the first one does the talking)
5. Keyword method (connect a word with a mental picture - often used in teaching foreign language vocabulary - elementary students need concrete pictures)
6. Loci method (list items by placing them in familiar locations)
7. Peg word method (images link new information to a familiar group of words or numbers)

The brain easily remembers 7 bits of information (kindergarteners usually can remember 5 bits of information, capabilities expand during the elementary years). Chunking allows larger quantities of information to be remembered. By combining bits of information (l and 4 becomes 14) more can be committed to memory.

Elaboration - the most effective method of storing and retrieving information is for the information to be meaningful and connect with prior knowledge.

Social reasoning refers to the ability to accurately assess an interpersonal situation and take the correct course of action. To encourage social reasoning:

1. Provide age-appropriate dilemmas for students to explore (elementary - sibling rivalries, stealing, cutting in line, hogging the ball)
2. Present opportunities for students to take the perspective of others (simulations, role play) and demonstrate consideration for individual differences (primary children have a great deal of difficulty taking another's perspective, between 7 and 12 years old children are developmentally able to take another person's perspective)
3. Help students make connections between their verbal expressions and their actions (discuss inconsistencies)
4. Encourage students to listen to each other (model this behavior, keep groups small)
5. Communicate the expectation that students monitor their own behavior in a group
6. Promote interactive communication
7. Support students in reflecting on their own thoughts

There are three types of long-term memory: semantic, episodic, and procedural.

Semantic (declarative) memory is memory for meaning. These memories are stored as propositional networks, images, and schemas.

1. Propositional Networks: set of interconnected concepts and relationships stored in long-term memory. They are bits of information that are connected to each other (John has a new bike, it's red. Proposition 1: John has a new bike; Proposition 2: the bike is red) Recall of one proposition can trigger the recall of other related propositions.
2. Images - representations based on the physical appearance of information (a visual image of a friend's face, your cat)
3. Schemas - concepts, patterns of information (schema of a dog - large and small, dog-food, animal, barks, leash, person's best friend, Fido).

Episodic Memory - memory tied to an event, a particular time and place (first day in kindergarten, seeing the movie "Top Gun"). Many episodic memories are difficult to retrieve

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because they have happened so frequently over a lifetime (driving to the grocery store). Flashbulb memories tie high emotion to an episodic memory in our life and are easy to remember (9/11, the Challenger disaster).

Procedural Memory - how to do things, in particular physical tasks (throw a ball, ride a bike, handwriting).

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