4.4: Teacher-Driven Inquiry

Student Objective

Students will observe and internalize the use of questioning processes in analyzing content material, as a result of teacher-modeling within the classroom.

Overview

The teacher is key to a classroom where inquiry is practiced, is expected, and serves as a foundation for deep learning. Teachers model the questioning process by posing open-ended questions to draw students into the content material and follow up with probing questions to guide them into deeper levels of thought. Questions and question frames for content-area topics provide examples from each of Costa's Levels of Thinking to use during classroom discussions and problem solving. As teachers learn to navigate among the levels, they can routinely model the thinking and questioning process with students.

Materials/Set-Up

- Teacher Resources:
  - 4.4a: Costa's Levels of Thinking: Math
  - 4.4b: Costa's Levels of Thinking: English
  - 4.4c: Costa's Levels of Thinking: Science
  - 4.4d: Costa's Levels of Thinking: Social Studies
  - 4.4e: Promoting Rigor Through Higher Level Prompts
  - 4.4f: Problem-Solving Example
- In advance of the activity, complete the following:
  - Prepare for a class discussion of content material (e.g., texts, quantitative problems, visuals, etc.) by determining the discussion's guiding question. This question is the "essential" or "big-picture" question that frames the discussion. AVID calls this the Essential Question. It should be stated or written for students at the beginning of the discussion.

Instructional Steps

1. Develop and present an open-ended question to the class in order to begin the classroom dialogue and generate students' thinking processes about the content topic.
2. Use the Costa's Levels of Thinking content-area question frames (in Math, English, Science, and Social Studies) as guides for the initial question and subsequent questions throughout the discussion.
3. After posing the introductory question and follow-up questions, allow a sufficient amount of time for the students to think about a correct or reasonable response before proceeding to additional steps or questions. The purpose of questioning is to provoke thinking, rather than to catch students unaware.

4. Acknowledge student responses and use them to guide additional questions in order to create a chain of questions that models the thinking process that students can use to analyze and problem solve in other areas.
5. Use follow-up questions that push students to think analytically. These might be requests for explanation, supporting information and examples, or "how," "why," and "what if" questions. See Promoting Rigor Through Higher Level Prompts for additional ideas and Problem-Solving Example for an illustration of the questioning process with a chemistry problem.
6. As much as possible, involve every student in the classroom by tailoring the levels of questions, as well as the supporting information in the questions, to the ability level of individual students and the class as a whole.

Extension

- To increase rigor:
  - Ask students to identify the Level of Thinking for teacher and student questions during class discussions.
  - As students become accustomed to the challenge of thinking versus recalling or memorizing information, include higher level questioning in appropriate degrees on Essential Questions, homework assignments, quizzes, and tests.
- To increase scaffolding:
  - After the class discussion has ended, reflect with students about the questions that were used and how they led to solving the problem presented or to concluding analysis of a text or visual.

Costa's Levels of Thinking: Math

LEVEL 1	LEVEL 2	LEVEL 3
• What information is provided? • What are you being asked to find? • What formula would you use in this problem? • What does _____ mean? • What is the formula for…? • List the…. • Name the…. • Where did…? • What is…? • When did…? • Explain the concept of…. • Give me an example of…. • Describe in your own words what _____ means. • What mathematical concepts does this problem connect to? • Draw a diagram of…. • Illustrate how _____ works.	• What additional information is needed to solve this problem? • Can you see other relationships that will help you find this information? • How can you put your data in graphic form? • What occurs when…? • Does it make sense to…? • Compare and contrast _____ to _____. • What was important about…? • What prior research/ formulas support your conclusions? • How else could you account for…? • Explain how you calculate…. • What equation can you write to solve the word problem?	• Predict what will happen to _____ as _____ is changed. • Using a math principle, how can we find…? • Describe the events that might occur if…. • Design a scenario for…. • Pretend you are…. • What would the world be like if…? • How can you tell if your answer is reasonable? • What would happen to _____ if _____ (variable) were increased/decreased? • How would repeated trials affect your data? • What significance is this formula to the subject you're learning? • What type of evidence is most compelling to you?

Daws, T., & Schiro, P. (2012). *AVID tutorial guide: Creating rigorous tutorials to increase student achievement in academic classes*. San Diego, CA: AVID Press.

Costa's Levels of Thinking: English

LEVEL 1	LEVEL 2	LEVEL 3
• What information is provided? • Locate in the story where…. • When did the event take place? • Point to the…. • List the…. • Name the…. • Where did…? • What is…? • Who was/were…? • Illustrate the part of the story that…. • Make a map of…. • What is the origin of the word _____? • What events led to…?	• What would happen to you if…? • Would you have done the same thing as…? • What occurs when…? • Compare and contrast _____ to _____. • What other ways could _____ be interpreted? • What is the main idea of the story (event)? • What information supports your explanation? • What was the message in this piece (event)? • Give me an example of…. • Describe in your own words what _____ means. • What does _____ suggest about _____'s character? • What lines of the poem express the poet's feelings about _____? • What is the author trying to prove? • What evidence does he/she present?	• Design a ____ to show…. • Predict what will happen to ____ as ____ is changed. • Write a new ending to the story (event)…. • Describe the events that might occur if…. • Add something new on your own that was not in the story…. • Pretend you are…. • What would the world be like if…? • Pretend you are a character in the story. Rewrite the episode from your point of view. • What do you think will happen to ____? Why? • What is most compelling to you in this ____? Why? • Could this story have really happened? Why or why not? • If you were there, would you…? • How would you solve this problem in your life?

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Costa's Levels of Thinking: Science

LEVEL 1	LEVEL 2	LEVEL 3
• What information is provided? • What are you being asked to find? • What formula would you use in this problem? • What does _____ mean? • What is the formula for…? • List the…. • Name the…. • Where did…? • What is…? • When did…? • Describe in your own words what _____ means. • What scientific concepts does this problem connect to? • Draw a diagram of…. • Illustrate how _____ works.	• What additional information is needed to solve this problem? • Can you see other relationships that will help you find this information? • How can you put your data in graphic form? • How would you change your procedures to get better results? • What method would you use to…? • Compare and contrast _____ to _____. • Which errors most affected your results? • What were some sources of variability? • How do your conclusions support your hypothesis? • What prior research/ formulas support your conclusions? • How else could you account for…? • Explain the concept of…. • Give me an example of….	• Design a lab to show…. • Predict what will happen to _____ as _____ is changed. • Using a scientific principle, how can we find…. • Describe the events that might occur if…. • Design a scenario for…. • Pretend you are…. • What would the world be like if…? • What would happen to ___ if _____ (variable) were increased/decreased? • How would repeated trials affect your data? • What significance does this experiment have for the subject you're learning? • What type of evidence is most compelling to you? • Do you feel _____ experiment is ethical? • Are your results biased?

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Costa's Levels of Thinking: Social Studies

LEVEL 1	LEVEL 2	LEVEL 3
• What information is provided? • What are you being asked to find? • When did the event take place? • Point to the…. • List the…. • Name the…. • Where did…? • What is…? • Who was/were…? • Make a map of….	• What would happen to you if…? • Can you see other relationships that will help you find this information? • Would you have done the same thing as…? • What occurs when…? • If you were there, would you…? • How would you solve this problem in your life? • Compare and contrast _____ to _____. • What other ways could _____ be interpreted? • What things would you have used to…? • What is the main idea in this piece (event)? • What information supports your explanation? • What was the message in this event? • Explain the concept of…. • Give me an example of….	• Design a _____ to show…. • Predict what will happen to _____ as _____ is changed. • What would it be like to live…? • Write a new ending to the event. • Describe the events that might occur if…. • Pretend you are…. • What would the world be like if…? • How can you tell if your analysis is reasonable? • What do you think will happen to _____? Why? • What significance is this event in the global perspective? • What is most compelling to you in this _____? Why? • Do you feel _____ is ethical? Why or why not?

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Promoting Rigor Through Higher Level Prompts

	VERBS	TEACHER PROMPTS *(Note the actual VERB need not be in the prompt)*
LEVEL 1 – INPUT (GATHER/RECALL)	**COUNT**	How many apps are on your phone?
	COMPLETE	The primary element for life on Earth is _____.
	DEFINE	What is a mineral?
	DESCRIBE	What does the city look like in the winter?
	IDENTIFY	Label the parts of the cell.
	LIST	What are the prime numbers in this set? (1, 3, 4, 6, 7, 16, 17, 20, 21, 23)
	MATCH	Which sentence best describes this equation?
	NAME	Find the name of the river that separates Haiti from the Dominican Republic.
	OBSERVE	Watch the fish in the tanks and record your observations.
	RECALL	Write down what the weather was like last August.
	RECITE	What is the first line of the US Constitution?
	SCAN	Look at the schedule and determine how often buses run.
	SELECT	Which of these words cannot be both a noun and verb?
LEVEL 2 – PROCESS	**ANALYZE**	Determine the additional information you will need to solve this problem.
	COMPARE	How are fish and amphibians similar?
	CONTRAST	Culturally, how were the 60s and 80s different?
	DISTINGUISH	Describe the features that might make you think this building was designed by Frank Lloyd Wright.
	EXPERIMENT	What are some ways you might test your idea?
	EXPLAIN	How has the smartphone changed our society?
	GROUP	How might you separate these 15 minerals into groups?
	MAKE ANALOGIES	How are the systems of a car like that of a cell?
	ORGANIZE	Rearrange this information so it is more easily accessed.
	SEQUENCE	Arrange the following events from earliest to most recent.
LEVEL 3 – OUTPUT (APPLY)	**APPLY**	How does surface tension help a water skipper stay afloat?
	EVALUATE	Decide if the Giant Mudskipper is a fish or amphibian.
	FORECAST	It is a “La Niña” year; would you expect it to be wetter or drier than usual? Why?
	GENERALIZE	Describe the risks for all small companies starting with very little capital.
	HYPOTHESIZE	What will happen to this marshmallow if we put it in a vacuum chamber?
	IMAGINE	What would communication be like if there was no sound?
	JUDGE	Is the Bill of Rights or Declaration of Independence more important for our democracy? Why?
	MODEL	Build a model of a plant cell.
	PREDICT	Considering what you know about macro-economics, what might happen to US economy if the euro suddenly decreased in value?
	SPECULATE	All copper, halite, and diamond have suddenly disappeared. How will this impact our environment physically and socially?

	POSSIBLE STUDENT TASKS (WICOR)	WHAT DOES LEARNING LOOK LIKE AT THIS LEVEL?
LEVEL 1 – INPUT (GATHER/RECALL)	With a partner, using a graphic organizer, identify, describe, and provide examples of the characteristics of minerals. (WICOR) Label the parts of the cell on the diagram provided. (WR) Observe the fish in the tank and record what you see in your interactive notebook. Share your observations with your group. (WICOR)	At Level 1 the learner is asked to simply access definitions, principles, and concepts from short- and long-term memory. This rote level learning doesn't require any processing or manipulation of the information being accessed. Answers to Level 1 questions are concrete and readily available in the text or resources being referenced. A series of Level 1 questions can be used to guide students in gathering the data they will need to process to answer a follow-up Level 2 or Level 3 question. Answers here are usually short. Often they consist of one or two words or a short sentence.
LEVEL 2 – PROCESS	Working in teams of three, create a Venn Diagram comparing fish to amphibians. (WICOR) In teams of five, review the characteristics of each of the 15 minerals provided and then put them in groups based on similar characteristics. Come up with a name for each group and what makes it unique. (WICOR) Working in pairs, draw a car and label the parts of the car as they would best correspond to the parts of the cell. Consider similarities in form and function of each part as you work. (WICO)	At Level 2 the learner is asked to access definitions, principles and concepts from both short- and long-term memory and process or manipulate that information to come up with the answer. To answer Level 2 questions, learners must read between the lines and assemble and relate multiple pieces of information to come up with the answer. Answers here usually require at least a sentence or two.
LEVEL 3 – OUTPUT (APPLY)	Watch the video and then review all of the materials provided describing the physiology of the Giant Mudskipper. Decide whether it is a fish or amphibian and elaborate on what factors lead to your decision. (WIOR) You and your team will use the bag of Legos provided to build a plant cell model. Once complete you will label all of the parts and be prepared to report out on each part's function. (WICOR) Write a science fiction story about a world where these minerals suddenly disappear and then read it to a student at the local elementary school. (WICR)	At Level 3 the learner is asked to apply knowledge of the relationship between disparate concepts in a novel situation. The question should invite the learner to think creatively, using imagination and judgment to arrive at an answer. Answers to Level 3 questions cannot be found in the text or resources being referenced. Often they require the learner to form an opinion, create something new, make a prediction, or generalize a concept and then back it up with evidence. Answers here tend to be longer, ranging from a multiple sentence paragraph to a full length essay.

Problem-Solving Example

Level 1 thinking skills, such as defining, listing, and describing, are like higher order thinking skills in that they are essential in understanding concepts. Modeling problem-solving requires multiple levels of thinking and questioning to be used. Posing open-ended questions, as well as using students' responses to guide additional questioning, engages students in their thinking processes, so they are not simply sitting and watching you solve problems.

Example Problem

How many centimeters are equivalent to 2.0 feet?

Speaker	Question or Response	Costa's Level
Teacher	As we begin solving a problem, we should identify the information that's provided and the information for which we are searching. What information is given?	1
Student	2.0 feet.	
Teacher	In solving with the dimensional analysis process, we should identify the unit of the final answer, so we'll know where we're headed. What is that unit?	1
Student	Centimeters.	
Teacher	How are we going to get from feet to centimeters? Is there a conversion factor or relationship between these two units?	2
Student	I don't know a conversion between feet and centimeters, but I do know one between inches and centimeters: 2.54 centimeters equals 1 inch.	
Teacher	Are there other relationships that might help solve the problem?	2
Student	I know there are 3 feet in a yard.	
Teacher	Right! If we use the feet-to-yards information, what steps would you take to solve the problem?	2
Student	We could change 2.0 feet to yards, and then to inches, and then to centimeters.	
Teacher	Excellent. What could be the sequence if you didn't know how many feet were in a yard?	2-3
Student	Uh, maybe change feet to inches, and then inches to centimeters?	
Teacher	Absolutely! Does it matter which method we choose?	3
Student	No, as long as we know the conversion between inches and centimeters, we could go feet-yard-inch-centimeter or feet-inch-centimeter.	
Teacher	Great thinking! Let's set it up and solve the problem.	