Questioning

eMINTS
NATIONAL CENTER

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Purpose of the Module

In an inquiry-based lesson, questions form the foundation of student learning. Creating a classroom environment where students learn to ask good questions and know how to organize questions to guide inquiry can produce opportunities for the students to construct meaning and deep understanding from their inquiries. This session sets the foundation for student-generated questioning with deeper level questions in the classroom. It focuses first on establishing a classroom environment conducive to student-generated questions. Second, the session examines different types of questions that lead to factual knowledge as well as deeper thinking.

Expected Outcomes

- Teachers use effective questioning strategies with students to help guide and model inquiry-based learning in the classroom.
- Students are given opportunities in the classroom to develop and refine their own questions.

Essential Question

How do people learn?

Session Question

How can questioning guide inquiry and learning?

Questioning in the Classroom

Students generally encounter questions in the classroom as part of teacher-led discussions or as a means of teacher-directed assessment following instruction. Questions from the teacher during instruction often guide student thought or check student recall of content previously covered. If students pose questions, they are typically to clarify information presented by the teacher. Questions posed to students as a follow-up to instruction, or for assessment, typically probe for information recall.

Students, however, must learn to do more than simply recall information. Employer expectations for the 21st century are changing. Today's students must possess the ability to solve problems, make decisions and think creatively to succeed in tomorrow's workplace. To meet these demands, students must be able to ask the types of questions that will serve as springboards to inquiry and critical thinking. Good questions provide the basis for inquiry into real-world problems and decisions. Through inquiry into authentic problems, students can develop the skills they need to meet curriculum standards and to function in the workplace. Teachers who understand how to shift the balance of questions from themselves to their students—and who can help their students ask probing questions that lead to meaningful inquiry—will produce learners who can meet 21st century workplace expectations.

Identifying Different Types of Questions

Good questions engage students, guide the inquiry process and do more than just require an answer: they stimulate curiosity and thought. In his book *Developing More Curious Minds*, John Barell put it this way: "A good question reflects a genuine desire to find out, a deep feeling for wanting to know more than we already do" (2003). Many types of questions qualify as good questions, especially if they lead to hypothetical thinking, reflection, hunches or inquiries that help students plan investigations. Learning to generate different types of questions for different purposes helps students learn to ask questions that lead to knowledge, thinking that resides in the upper levels of Bloom's taxonomy and deeper understanding. Becoming familiar with the type of thinking or processing a question requires helps students plan and progress through the search for an answer. For example, when students understand that answering an inference question requires looking beyond the information given, they will not spend time looking for an explicit text-based answer to that kind of question.

Jamie McKenzie, editor of an educational technology journal, has identified 17 types of questions, including the following: overarching, big-idea questions, such as **essential questions**; questions that refine or illuminate answers to essential questions, such as **subsidiary questions**; questions that lead directly to specific information, such as **telling questions**; and questions that help students refine their investigation processes, such as **planning questions, organizing questions** and **probing questions**. McKenzie explains each type of question in his book *Beyond Technology: Questioning, Research and the Information Literate School* (2000) and in an online article available at http://www.fno.org/nov97/toolkit.html. To guide students in their use of different types of questions, McKenzie suggests that teachers post a questioning toolkit in the form of a matrix to which students can refer. Each cell of a questioning toolkit matrix can contain a different type of question. As students embark

on an investigation, they refer to the toolkit of questions to guide them as they develop their inquiries.

In his article "The Art of Questioning," Dennis Palmer Wolf identifies five types of questions: **inference**, **interpretation**, **hypotheses**, **transfer** and **reflection**. Wolf suggests that these types of questions foster higher-level thinking and that when teachers pose a variety of such question types in a questioning arch, "they pursue an investigation in which simple factual inquiries give way to increasingly interpretive questions until new insights emerge" (1987). An arch of questioning happens in an exchange between a student and teacher when the teacher uses a variety of question types to guide the student into digging deeper into thought to produce new insights. This type of questioning directly contrasts with questioning strategies in which the teacher poses multiple questions aimed at producing recall and factual answers from students. It also differs from questions posed to check student understanding.

In *Developing More Curious Minds*, Barell identifies three types of questions: **gathering, process** and **application**. Students can answer **gathering** questions by accessing information from resources. **Process** questions involve inference and analysis. They ask for similarities and differences, comparisons and hypotheses. **Application** questions involve using knowledge to develop answers. They include hypothetical "What if ... " questions.

Students do not need to know names for all of the different types of questions; teachers, however, do need to know all of the different types of questions and the types of thinking they elicit. Teachers need to know how to help students learn to use the different types of questions in the inquiry process. Students should understand that telling or gathering questions require looking for specific information in texts, charts or figures and that process or inference questions require looking at the information available and creating answers based on what they know.

Understanding Classroom Culture

Culture in the context of the workplace encompasses the shared values, attitudes, goals and practices of a company or corporation. The patterns and priorities for conducting business set by a specific group of people determine the culture of an organization. If a company values high-quality customer satisfaction, its attitudes, goals and practices will demonstrate this value. People within the company will go the extra mile to ensure that a customer is satisfied. If a company values problem-solving and creative thinking, its daily operations and business priorities will reflect these values.

How Does This Look in a Classroom?

Classroom communities each have a culture. Daily operations, expectations and attitudes reflect classroom values and the culture of the classroom community. "There are patterns within our separate classrooms. There are ways of going about our business, and there are also feelings and attitudes that we communicate to students. These patterns and attitudes or dispositions add up the central core values or priorities of the classroom culture. In a classroom where curiosity is valued most highly and where explorations of new territories like the World Wide Web will be commonplace, there need to be some changes in our behavior" (Barell, 2003).

If a classroom environment fosters, encourages and values questioning, students will feel comfortable taking risks and asking questions. Students will not worry about whether or not their questions have value but will realize that all questions contribute to the quest for knowledge and are integral to learning. In this setting, students will ask questions without hesitation.

In classrooms that value questioning, students become active learners and think deeply as they develop and refine their questions, rather than waiting for someone to tell them about the topic or ask them simple recall questions. When students wonder, ponder or reflect about something, they are engaged in learning. When students sit and listen to a teacher tell them about a topic, students are passive learners. Active learners have to wrestle with meaning to develop understanding and will retain what they learn. Passive learners comprehend information as someone presents it to them, but to retain it they must feel motivated to apply the information or connect it to previous knowledge.

For example, reflect a moment on a personal experience that raised questions about a circumstance or problem and was followed by the quest for an answer. People facing health issues, the loss of a loved one or a significant career change often ask many deep and probing questions. Consider how well the answers to such questions remain in long-term memory. Compare this learning experience to a situation in which someone provided information during a lecture.

Fostering a Classroom Culture that Values Questions

Teachers can use a number of strategies to encourage students to ask good questions and to foster a classroom culture that values questions. Employing these strategies in the classroom will help students develop positive attitudes toward questioning and, over time, will make asking good questions easier and more routine for students. The goal is to help students feel comfortable taking risks and asking questions.

Set High Expectations

The expectations set by parents and teachers have a tremendous influence on student outcomes. As Nobel Prize physicist Isidor Isaac Rabi once remarked: "My mother made me a scientist without ever intending to. Every other Jewish mother in Brooklyn would ask her child after school, 'So? Did you learn anything today?' But not my mother. 'Izzy,' she would say, 'did you ask a good question today?' That difference—asking good questions—made me become a scientist" (http://www.quotegarden.com/science.html). Rabi's mother fostered a culture that valued questions because she clearly communicated to her son her expectation that he ask good questions. When teachers expect students to ask good questions and clearly communicate this expectation, students will understand that asking questions has value and they will meet these expectations (Barell, 2003, p. 16).

Categorize Questions

Learning what constitutes a good question that will lead to knowledge is an important element in developing a culture that fosters questioning. Some questions will open the doors to inquiry; other questions will not. Good questions encourage thinking.

Teaching students to categorize questions based on specific criteria helps them learn to refine their questions and to understand what makes a good question.

To help students learn how to ask good questions, first record questions on a SMART Board, white board or chart paper. Next, categorize the questions based on the type of response the question will elicit. Sort questions based on those that will elicit recall or the retelling of information, as well as questions that require inference, analysis or the synthesis of multiple sources and types of information. Consider grouping the retelling or recall questions with the inference questions they support. For example, to answer the following question—"Is global warming real or just hot air?"—students will need to ask retelling questions about existing knowledge.

Questioning Strategies: Modeling for Students

Getting students to pose questions beyond those that will elicit the recall or retelling of information requires teacher modeling. If students observe teachers posing questions that require recall or retelling answers, students will tend to pose similar questions. To model questioning, teachers should plan for and capitalize on opportunities in which they can pose questions that require inference, analysis or synthesis. Modeling not only provides students with examples of good questions, it also communicates the expectations and importance of curiosity in the classroom.

Share Personal Questioning

Sharing personal thinking is an excellent strategy that is effective for modeling how to pose good questions. This strategy can be thoughtfully planned by selecting an article or book passage to read to students—inserting pauses in which the teacher poses questions. The questions posed are reflective of the teacher's thinking while reading and require more than recall-of-information answers. Alternately, teachers can pose questions that come to mind during discussions at times when the teacher or students are sharing information, or during casual conversation. For example, a teacher might share thought-provoking questions during casual conversation by stating something like, "I wonder if this unusually warm winter is related to global warming?"

Model Strategies Used by Field Professionals

Professionals use certain lines of questions to approach various circumstances. Mathematicians approach a complex problem with questions that help them clarify and define the problem. The questions these professionals ask drive their inquiry. Model the questioning strategies historians or mathematicians use when they approach problems. Consider confronting students with authentic, problematic situations similar to those situations experienced by professionals in the field. This process will stimulate student curiosity and offer students the opportunity to experience firsthand the questions professionals use as they approach problems (Barell, 2003).

Questioning Strategies: Questions with Students

During the early stages of trying to elicit student-generated questions, teachers may find that students often produce questions that can be primarily answered with factual or recall information. To help students move beyond asking fact-based or recall questions, teachers can employ guidance strategies for generating questions that require higher-level thinking to formulate answers. Posing questions with students through guidance strategies, such as providing question prompts or stems, will make

the process seem less risky to students. As a result, students will develop the confidence they need to generate questions that require inference, analysis or synthesis without guidance.

Develop Positive Scripts

Developing habits of mind where students naturally ask questions and are curious promotes a classroom culture that encourages inquiry. When students hear teachers ask questions aloud, the questioning strategies modeled by the teacher become mental habits for students. When teachers model certain types of questions aloud in front of students on a routine basis, the questions become positive scripts or examples that students will begin to use in their own thinking. Positive scripts are question stems that students can use to generate questions. In his book, Barell suggests the following question stems to guide student questioning:

- What I am curious about is …
- What I do not yet understand is …
- I really want to find out about …
- The mysteries and puzzles that really intrigue me are …
- If I could be somebody else … or visit another time period, this is what I'd want to discover …
- I really wonder why …
- What intrigues me is …

In addition, Barell proposes the following two questions to probe for deeper meaning: "How do you know? How do they know?" Challenge students by letting them know the classroom expectations are that they communicate their thinking, rather than provide one- or two-word answers.

Using Question Stems as a Basis for Student-Generated Questions

Another strategy for using question stems with students is to pose an authentic situation, problem or broad topic and provide question stems to students. Students use the question stems to generate questions related to what was presented to them. This provides students with a starting point for question development and helps them develop questions that go beyond factual or recall answers.

In some classrooms, teachers post question stems for students to refer to as they develop questions. If students are asking only one type of question, the teacher can refer to the posted question stems to help the students develop a variety of questions. Question stems serve as a stepping stone that students can use as they learn to develop questions on their own.

Encourage Quality Peer Interaction

Much of the classroom dialog during instruction occurs between the teacher and a student. Encouraging students to respond to each other with questions, as opposed to just the teacher, promotes inquisitiveness. "It is peer interaction within the classroom that can not only foster and develop more inquiry, but it can also generate high quality problem solving and decision making and, therefore, deeper understanding of complex issues" (Johnson & Johnson, 1979).

In some classrooms, teachers foster peer interaction by providing students with scripted response stems as a method for teaching them how to respond to each other

during a discussion. For example, when Tom has a question about Judy's statement, Tom responds with the following stem, "I understand what Judy is saying, but I wonder … ." When working with older students, the importance of an open culture becomes even more essential. Techniques for helping older students work with scripted response stems involve more teacher modeling and open discussion of the value of using the stems.

To further encourage quality peer interaction, have students work in cooperative groups on real-world problems and situations. Depending on the students' levels of peer-interaction skills, it may be necessary to model this type of interaction for students so they develop the skills needed to interact appropriately during small-group discussions.

Questions Driving Inquiry: Questions by Students

The word inquiry implies searching to find answers to questions. Inquiry-based learning is driven by student-generated questions. Teachers face the challenge of designing units and lessons that both meet curriculum standards and are developed in such a way that student-generated questions guide the investigations. As a necessary first step in meeting this challenge, teachers need a thorough knowledge of the curriculum standards for which they are responsible. With this information in place, they can guide students toward the desired goals. Engaging students in the process of inquiry begins with an authentic problem or situation and thought-provoking questions, all of which relate to curriculum standards. The process continues with students generating multiple types of questions, followed by a quest for answers. In this quest, students wrestle with meaning and develop a deep understanding of concepts and principles all while the teacher carefully monitors student work to ensure that the curriculum standards are being met as the inquiry process unfolds. Gentle redirection—by guiding students into the most important areas of study—may be necessary to meet curricular goals.

Engage Students to Elicit Questions

For students to create good questions that can serve as a sound basis for inquiry, they must be motivated or engaged in a situation. Teachers can use any of several strategies to engage or hook students into generating good questions.

Ask Overarching Questions

Organizing instruction around overarching questions engages students in the process of inquiry. Overarching questions open doorways for students to ask additional questions and engage them in uncovering important ideas. Many sources refer to overarching questions as essential questions. Future modules will cover essential questions in more depth.

Create Dissonance

In his book *Beyond Technology: Questioning, Research and the Information Literate School,* Jamie McKenzie suggests creating dissonance by posing differing options or situations side-by-side or presenting situations that are unusual, troubling or contrary to what students may normally have encountered. McKenzie states that by presenting situations in this manner, "We are thrown off balance. Our minds are intrigued, our curiosities awakened. We want to resolve the dissonance, bring things back into harmony and resonance" (2000).

Find Authentic Situations

Posing an unusual or problematic situation, circumstance or object can engage students and elicit questions. According to Barell, "This is what gets us started asking questions: some occurrence, observation, or encounter that seems strange, puzzling, or somehow perplexing to our way of understanding the world. These doubts, difficulties, and uncertainties create questions in our minds" (2003).

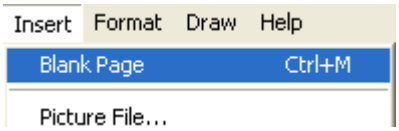
Questioning Strategies Supported by Technology

Technology supports questioning strategies in several ways—such as by providing an efficient means for visualizing and manipulating questions or information to enhance thinking. Software programs enable users to move objects, making it easier to group "like" ideas. Flexibility and divergent thinking, when developing questions and pursuing answers, are supported through electronic editing features such as highlighting. Editing marks can be altered as thinking changes without requiring the user to re-write or re-type text. Technology also supports questioning by providing tools that make tasks related to questioning less tedious and time-consuming than employing similar strategies using non-electronic methods.

SMART Notebook Software

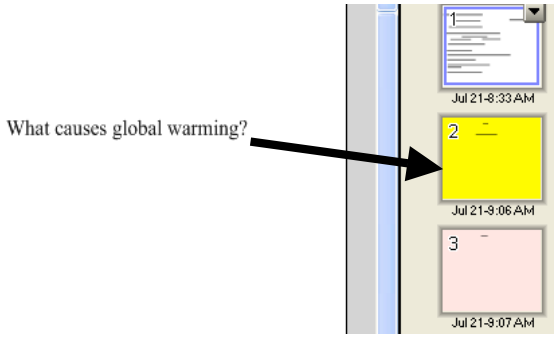
Questions generated and written on a page in SMART Notebook will appear as movable objects. Once students have generated multiple questions and recorded them in a SMART Notebook page, questions with similar qualities or themes can be identified. Headings based on identified themes may be listed in an existing SMART Notebook page or in subsequent pages. Sorting occurs by clicking on a question to select it and then dragging it to the appropriate location. To move a question to a subsequent SMART Notebook page, follow these steps.

1. **Note to Windows users:** make sure the Auto-hide box on the Page Sorter sidebar is not checked. If a checkmark appears in the box, click on the box to uncheck it.
2. Create additional pages by selecting **Insert > Blank Page** from the menu bar or selecting the **New Page** icon on the toolbar.



New Page icon

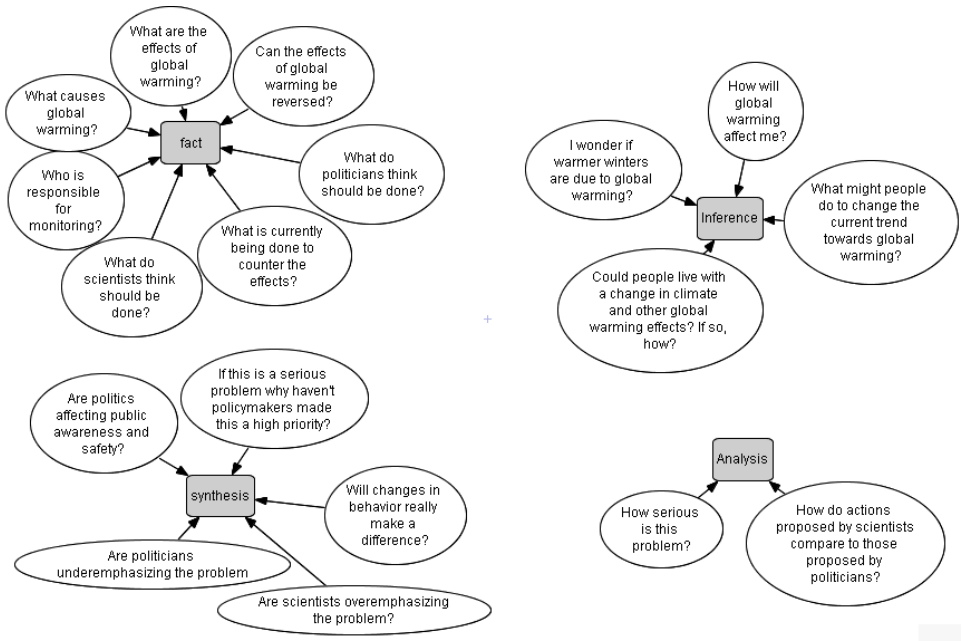
3. Title the new page with an identified theme.
4. If desired, provide a page background color for ease in identifying a particular page on the Page Sorter Sidebar. Select **Format > Background Color** from the menu bar to add a background color to the page. Continue in this manner until all identified themes have an associated Notebook page.
5. Select the SMART Notebook page that contains generated questions. Click and drag a question from the current page to the appropriate page located on the **Page Sorter** sidebar.



Click and drag a question to the appropriate SMART Notebook page.

Concept-mapping Software

Concept-mapping software allows users to rapidly record questions as they are being generated. During brainstorming, each question can be recorded as a separate movable object. When brainstorming is complete, questions may be sorted based on similar themes. Click and drag questions with like themes to an identified area of the work space. If desired, questions may be connected or linked to theme titles to sort and organize student-generated questions as shown in the example below. Detailed information about using concept-mapping software such as SMART Ideas will occur in a future session.



Word-processing Software

Finding information, creating questions and developing answers can all be supported with technology. Because of the flexibility of word-processing software, students can effectively gather relevant information into one location. To gather information, students can list categories of questions in word-processing software such as Word. As they locate information in online and offline resources, students can place notes under the appropriate question the information answers and add citation references. The advantage of using word-processing software over traditional paper or note cards is that information chunks can be added or deleted without requiring extensive erasures

or cross-outs rendering the document unreadable. In addition, information from different sources can be placed in close proximity to each other to aid in triangulation and analysis.

As students begin analyzing information editing features, such as an electronic highlighter in the word-processing software, can be used to color code congruent information. Students can locate similar highlighted information quickly through visual cues and concentrate on how they will use the information to formulate statements that will answer questions.

What causes global warming?
United States Environmental Protection Agency. Global Warming – Climate. Last modified January 7, 2000. Retrieved from http://yosemite.epa.gov/oar/globalwarming.nsf/content/climate.html.
National Academy of Sciences, the Earth's surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is new and stronger evidence that most of the warming over the last 50 years is attributable to human activities. Human activities have altered the chemical composition of the atmosphere through the buildup of greenhouse gases – primarily carbon dioxide, methane, and nitrous oxide.

United States Environmental Protection Agency. Global Warming – Emissions. Last modified April 23, 2006. Retrieved from http://yosemite.epa.gov/oar/globalwarming.nsf/content/emissions.html.
Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.
Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock.
Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.
Very powerful greenhouse gases that are not naturally occurring include *hydrofluorocarbons* (HFCs), *perfluorocarbons* (PFCs), and *sulfur hexafluoride* (SF6), which are generated in a variety of industrial processes.

Union of Concerned Scientists. Global Warming. Last updated September 7, 2005. Retrieved from http://www.ucsusa.org/global_warming/science/.
Global warming is caused by emissions of carbon dioxide and other heat-trapping gases that are emitted primarily by the burning of fossil fuels and the clearing of forests These gases remain in our atmosphere for decades or even centuries.

National Resources Defense Council. Global Warming Basics. Last updated January 9, 2006. Retrieved from http://www.nrdc.org/globalWarming/f101.asp#1.
Carbon dioxide and other air pollution that is collecting in the atmosphere like a thickening blanket, trapping the sun's heat and causing the planet to warm up. Coal-burning power plants are the largest U.S. source of carbon dioxide pollution -- they produce 2.5 billion tons every year. Automobiles, the second largest source, create

Online Tools

Online tools provide students with more options for collecting and organizing information related to their questions. NoteStar, an online tool developed by the Advanced Learning Technologies in Education Consortia (ALTEC), provides students with a robust note-taking and organizational tool that allows them to do the following:

- Create subtopics for research topics
- Assign topics to group members
- Take notes
- Track source information
- Organize notes and sources to create printable notes and bibliography (NoteStar, http://notestar.4teachers.org)

Teachers have access to student work in NoteStar and can use the application to do the following:

- Create, assign and manage projects
- Check sources for authenticity
- Track each group's progress
- Send messages to students
- Help students organize their notes (NoteStar, http://notestar.4teachers.org)

How to Select Resources that Support Questioning

When determining how technology will be used to support questioning, teachers need to consider criteria such as efficiency, availability and learner need. Selecting technology resources for use with questioning based on these criteria will ensure that the selected tool helps the student and teacher effectively formulate questions, use the questions to guide inquiry and complete the task.

Efficiency

Selecting a tool based on efficiency ensures thinking will not be hindered by a tedious process. When selecting a tool, ask the following: "How is this tool going make the task easier and quicker?" "What makes this tool superior over another option?" Although questions such as these may seem fairly simple, people sometimes get caught in the novelty of a technology tool and select it for a task simply because it is available regardless of whether it will complete the task more efficiently.

For example, when choosing a tool to quickly record questions generated by students, a teacher may select concept-mapping software over SMART Notebook software because the concept-mapping software automatically creates new objects each time the Enter or Return key is tapped on the keyboard. This makes it much easier and quicker to record questions during a brainstorming session, thus enhancing efficiency. Selecting software such as Word to record student-generated questions could be cumbersome and a less desirable option because typed text is not automatically displayed as a movable object, making it difficult to sort and organize questions based on similarities. Students and teachers need to think about the task they need to accomplish and choose a tool that meets that need in the most efficient manner.

Availability

The availability of a technology resource in relation to the task will play a role in selecting the appropriate technology tool. If accessibility to a resource such as NoteStar is not reliable, a better tool selection may be Word. In addition, teachers need to consider the number of computers with appropriate software available in relation to the number of students who will need access to the software in a given period of time. Thinking about resource availability will ensure technology supports questioning.

Learner Needs

Considering learner needs when selecting a tool will ensure that the needs of individual students are met. Concept-mapping software offers diagram or outline view options to display questions, thus meeting many organizational style preferences. Color and audio options are additional features that may meet various learning styles. Alternately, instead of selecting one tool for all students to use, teachers may provide more than one option, such as Word or NoteStar, to collect information related to student-generated questions. Teachers need to identify the learning needs of their students and consider those needs when making technology tool selections.

When a teacher considers the availability of a technology tool, whether it enables efficient task completion and how well it meets diverse learner needs, the teacher is taking a positive step toward ensuring the tool selected is the most appropriate choice

for the task. The teacher is making sure technology will enhance learning as students formulate and answer questions.

Putting into Practice

Use the implementation plan developed during the professional-development session to guide learning with student-generated questions.

Resources

Future Skills

North Central Regional Educational Laboratory. *Skills and Competencies Needed to Succeed in Today's Workplace.*
http://www.ncrel.org/sdrs/areas/issues/methods/assment/as7scans.htm

Partnership for 21st Century Skills. *The MILE Guide: Milestones for Improving Learning & Education*.
http://p21.org/documents/MILE_Guide_091101.pdf

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McKenzie, J. (1997). A Questioning Toolkit. *From Now On: The Educational Technology Journal, 7(3).*
http://www.fno.org/nov97/toolkit.html
Jamie McKenzie's description of 17 different types of questions and the goal for each type.

McKenzie, J. (2003). Questioning as Technology. *From Now On: The Educational Technology Journal, 12(8).*
http://www.fno.org/apr03/qtech.html
Part I explores the importance of student-generated questions in the classroom. Part II discusses the development of a classroom culture in which students readily ask questions.

McKenzie, J., & Davis, B. (1986). Filling the Tool Box. *From Now on: The Educational Technology Journal.*
http://www.fno.org/toolbox.html
An article that details instructional strategies in which students ask questions to guide inquiry.

The Question Mark
http://questioning.org
An educational journal devoted to questions, questioning, sound intelligence, strategic reading and quality teaching.

Youth Learn. *Asking Questions*. Education Development Center, Inc.
http://www.youthlearn.org/learning/teaching/techniques/asking-questions/asking-questions

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