Questioning and Inquiry Teaching

Source:
Bybee, Trowbridge
Becoming a Secondary School Science Teacher
Merrill Publishing Company
1990

Decide the following before you devise your question

- What talents are you going to try to develop?
- What critical thinking processes will you try to nurture?
- What subject-matter objectives do you want to develop?
- What types of answers will you accept?
- What skills do you wish to develop?
- What attitudes and values do you wish to emphasize?

Types of Questions

- Educational Objectives and Questions
- Processes of Science and Questions
- Convergent and Divergent Questions
- Teleological and Anthropomorphic Questions
- Talent-Oriented Questions

Educational Objectives and Questions

- Questions requiring responses from the higher levels of the hierarchy are more desirable because answering them involves more critical and creative thinking and indicates a better understanding of the concepts.

Using Bloom's Taxonomy to Classify Questions

Classification	Sample Question
Knowledge	How many legs has an insect?
Synthesis	What hypotheses would you make about this problem?
Application	Knowing what you do about heat, how would you get a tightly fitted lid off a jar?
Analysis	What things do birds and lizards have in common?
Comprehension	Operationally define a magnet
Evaluation	If you were going to repeat the experiment, how would you do it better?
Valuing	What is your interest in earth science now compared to when you began the course?
Valuing	What do you value about this film?
Receiving	Do you watch science show on television?
Responding	Do you talk to your friends about science?

Processes of Science and Questions

- This approach ensures that the basic structure of science and critical thinking is taught.
  - Hypothesizing
  - Inferring
  - Measuring
  - Designing and experimenting
  - Observing
  - Setting up Equipment
  - Graphing
  - Reducing experimental error

Classifying Using Science Processes

Classification	Sample Question
Observing	What do you observe about the landscape?
Hypothesizing	What do you think will happen to the solution when I heat it?
Designing an experiment	How would you determine the absorption of the different wavelength of light in water?
Graphing	How would you graph these data?
Setting up equipment	Obtain the following equipment and set it up as directed.
Reducing experimental error	How many measurements should be made to report accurate data?
Inferring	What conclusions can you make from the data?

Convergent and Divergent Questions

- Questions allowing for a limited number of responses and moving toward closure or a conclusion are called convergent
- Questions allowing for a number of an answers are called divergent. They provide for wider responses plus more creative, critically consider answer.
- In an inquiry discussion, it is generally desirable to start with very divergent questions and move toward more convergent ones if the students appear to be having difficulties.

- The fundamental purpose in using the inquiry approach is to stimulate and develop critical thinking, creative behavior, and multiple talents.
- Convergent question, particularly those requiring only yes or no answer should be avoided because they allow for fewer responses, thereby giving students little opportunity to think critically.

Questioning Procedures

- Wait-Time Affects Quality of Responses

  An analysis of student responses revealed that teacher with longer wait-times (three seconds or more) obtained greater speculation, conversation, and argument than those with shorter wait-times.
- Good Discussions Are Student-Centered

Wait-Time Affects Quality of Responses

- Dr. Rowe found further that when teacher were trained to wait five seconds, on the average, before responding the following occurred:

1. Student gave longer and more complete answers instead of short phrases.
2. There was an increase in speculative, creative thinking.
3. The number of suggested questions and experiments increased.
4. "Slow" students increased their participation.
5. Teachers became more flexible in their responses to students.
6. Teachers asked fewer questions, but the ones they asked required more reflection.
7. Students gave a greater number of qualified inferences.
8. Teacher expectations for student performance changed; they were less likely to expect only the brighter students to reply.