

# Background: Scoring of Student Questions in the Science Classroom

## Introduction

The notion that question asking is fundamental to learning is intuitive. One has only to think about eager pre-school children, filled with curiosity and wonderment about every new situation they encounter, to realize that questions play a key role in this stage of their development. Unfortunately, children's curiosity is frequently stifled when they enter school, where conformity is emphasized and where it is not acceptable for them to ask their many questions spontaneously and unimpeded by the explicit and implicit restrictions of the classroom. One could say that such classrooms do not provide a "culture of questions."

Previous research has shown that in the typical classroom teachers ask most of the questions. This situation is ironic, as the question poser (the teacher) is not seeking new knowledge, whereas the students, who do not ask many questions, are the ones seeking new knowledge. What results from this situation is that "children everywhere are schooled to become masters at answering questions and to remain novices at asking them" (Dillon, 1990, p. 7). The procedure of this assignment addresses the concern that there are few instances of student-generated questions in the classroom.

## A Framework for Scoring Student Questions

### 1. Peripheral Questions

At the lowest level, there are some questions whose meaning is impossible to decipher or which are wholly unrelated to either the instructional context or concepts. They might arise from prior occurrences or off-topic student conversations. The identification of such questions is unproblematic. At a slightly higher sub-level, yet unrelated to the concepts being considered, there are questions that relate to the instructional context. Of a slightly different nature within the same categorization level are questions that relate to the presented story used in the lesson.

#### a. Level 1 (P1)

- i. Nonsensical: Impossible to decipher a meaning
- ii. Irrelevant: Unrelated to learning outcomes or context  
Example: How much time is left?

#### b. Level 2 (P2)

- i. Related to learning context  
Question prototype: When, Who, Where, What (happened), I wonder if ...?  
Example: I wonder if Sarah would want more wind farms?

### 2. Factual Questions

Factual questions correspond to what Collingwood calls "unscientific" questions. These questions are necessary to the learning process; therefore, their presence should not be viewed negatively. Factual questions indicate engagement with the instructional concepts at the simplest level. Low-level factual questions require only simple quantitative or qualitative responses. Factual questions at a higher level demand additional information or formalization of information.

#### a. Level 1 (F1)

- i. Quantitative: seeks a numerical fact  
Question prototype: What is (value)?  
Example: How many turbines are on the wind farm?
- ii. Qualitative: seeks basic factual information  
Question prototype: Yes / No question;  
What is ... ?  
Example: Who invented the first windmill?

#### b. Level 2 (F2)

- i. Procedural: describing a process  
Question prototype: How (to) ... ?  
Example: How do you attach the blades?
- ii. Definition  
Question prototype: What is (definition) ... ?  
Example: What are EM waves?
- iii. Simple reasoning  
Question prototype: Would (such and such) happen ... ?  
Example: Would the birds that died from the windmills most likely go endangered?

### 3. Conceptual Questions

Conceptual questions relate to scientific explanation, clarification, hypothesizing, and testing. Concept clarification questions are explanation and clarification type questions. At a slightly higher level, concept elaboration questions have the potential to lead to further inquiry. The further inquiry, prediction, or factor to be investigated should be named or implied in the question.

#### a. Level 1 (C1)

- i. Clarification or elaboration  
Question prototypes: How (does it work) ... ?  
How do we know that (questioning explanation) ... ?

Why (is it that way) ... ?

Examples: How does a solar panel get electricity?

Why are there low pressure areas?

ii. Speculative

Question prototypes: What would happen if ... ?

Is it possible that ... ?

Example: If you could put a cage around it, is it possible that windmills could be enclosed?

**b. Level 2 (C2)**

i. Hypothesis or prediction generating

Question prototype: What if ... ?

Example: Would a windmill work if it had 100 blades that were small?

ii. Hypothesis or prediction testing

Question prototype: If (condition)... then?

Example: If you had the perfect wind-catching angle with 3 blades, would you produce more energy with 6?

**4. Philosophical Questions**

Philosophical questions indicate the highest level of thinking and, certainly, that critical thinking is at work. The lowest sub-level questions challenge relative presuppositions. The second sub-level questions challenge absolute presuppositions that are normally taken for granted and form the starting point for further analysis.

**a. Ethical (E1)**

Question prototypes: How should we (act based on evidence, judgment, and values) ... ?

Why (do it that way in view of foundational value) ... ?

Example: Why can't they move wind farms where there are no animals?

**b. Epistemological (E2)**

Question prototypes: How do you know that (questioning foundational presupposition) ... ?

What is (foundational concept) ... ?

Example: How do you know that electrons are real?

**Scoring Framework Values**

Numerical scores have been assigned to each framework category (see Table). These values reflect the de-

gree of sophistication that each rating level represents.

The values are interpreted as a ranking scheme for the questions. For the factual and conceptual categories, yielding scores that range from one through four, the ranking is unproblematic because each successive category represents an increased level of sophistication in scientific reasoning. Level one of the peripheral category is ranked at zero, as the respective questions are either irrelevant or undecipherable. Level two of the peripheral category is ranked equal to level two of the factual category because these questions generally show simple curiosity or reasoning that we consider above the level of simple factual questions but not at the level of elaboration or clarification. A question such as "What would Sarah do?" (peripheral 2) is deemed as being at approximately at the same level of sophistication as "How do you attach the blades?" (factual 2), as each asks for information that requires a context but does not ask for elaboration. Questions in level one of the conceptual category are ranked equal to those in level one of the philosophical category because each requires elaboration or explanation: in level one of the conceptual category, scientific concepts are elaborated or clarified (e.g., "Why are there low pressure areas [behind the blades]?"), and in level one of the philosophical category, ethical or moral issues are examined or questioned (e.g., "Why can't you move the wind farms where there are no animals [birds]?"). The former asks for an explanation of a concept with scientific implications, and the latter asks for an elaboration of the reason for a particular action with ethical implications.

**References**

Dillon, J. T. (1990). *The practice of questioning*. London: Routledge.

**Background: Scoring of Student Questions in the Science Classroom** was written by Stephen Klassen and Don Metz of the University of Winnipeg and Barbara McMillan of the University of Manitoba. This publication reflects only the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

**TABLE: Scoring Values Assigned to Framework Categories**

	Peripheral	Factual	Conceptual	Philosophical
Level 1	P1: 0	F1: 1	C1: 3	E1: 3
Level 2	P2: 2	F2: 2	C2: 4	E2: 5