

INQUIRY AND ARGUMENTATION IN SCIENCE CLASSROOMS

The crucial role of teacher's questions

Aisha Kawalkar and Jyotsna Vijapurkar

Homi Bhabha Centre for Science Education,
Tata Institute of Fundamental Research, Mumbai, India

Teacher's questions are important because...

- ♦ They influence the nature of students' thinking
- ♦ They determine the quality and level of students' participation



They can be indices of quality teaching

However, it's not how many questions you ask but what kind of questions you ask that matters...

The quality of questions determine the quality of classroom interactions ...

- ♦ **In traditional teaching -**

The teacher asks a question (usually closed-ended)

A student responds

The teacher accepts or corrects the answer

- ♦ **To see how this is different from teaching science as inquiry -**

let's look at what the teacher's follow-up moves could be

When a student gives a correct answer

When a student gives an incorrect answer

When a student asks a question

Asking merely
for factual recall

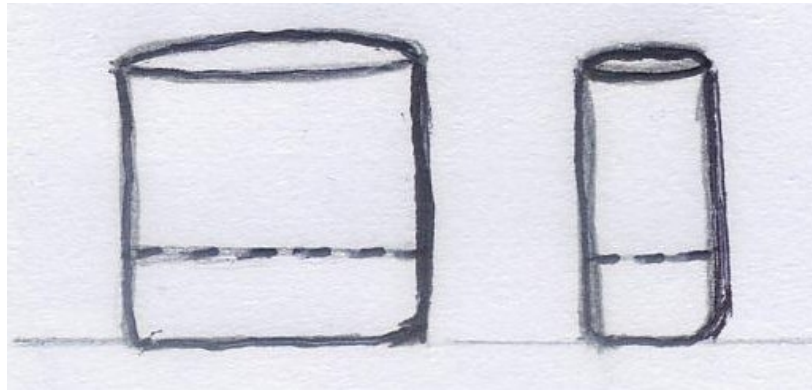
85% of questions
asked by school
teachers in our
study were of
this kind



An illustration from an inquiry class

Questions asked by a teacher at the outset while teaching a unit on measurement of rain -

- ♦ Odd, isn't it, that rain should be measured in units of length
- ♦ Does the cross sectional area of the rain gauge matter?



The context: Classes conducted for the 'Middle School Curriculum Development and Research' project at HBCSE (Dr. J. Vijapurkar)

A students' conjecture: Raindrops may not all be of the same size...



so, do even same-sized containers get the same amount of rain?

The teacher's response...

Designing experiments to test -

1. Do raindrop sizes indeed differ in a given rain shower?

(Any guesses? The teacher tried exposing an absorbent material in a rain shower for a brief period of time... it turned out, indeed, that there is a wide variety of raindrop sizes at any given time!)

2. Will the average (over time) wash out the “difference”?

The teacher thought of an activity that students could do in class to find this out



Sprinkling drops on a brown paper sheet –
simulating a shower of rain per second



Tracing the drops on transparency sheets



Compiling the transparencies



Time-averaging...

This, and related activities, were fun and students clearly enjoyed them.

But...

Did they get the answer to the question they started the unit with?

"Does the cross-section of the rain-gauge matter?"

The teacher had to guide a long class discussion* to construct a coherent picture.

She did this with a series of questions -

Calling for reasoning

Asking for explanations,
guesses, inference

Driving towards the focal point

Directing attention to aspects missed

Drawing on what has been observed

Encouraging wider response

Providing hints

Pointing out flaws in the argument

Asking for justification

Helping to make connections

* For full transcript see Kawalkar & Vijapurkar (2011c)

Implications for Teacher Professional Development Programs...

- Build a clearer picture of what inquiry looks like in the science classroom with concrete examples from teaching
- Make tacit teaching strategies in inquiry-oriented classrooms explicit
- Persuade teachers to reflect on their roles in the classroom in order to move towards more constructivist practices



Reading between the lines

What this vignette says...



- Interesting demonstrations and experiments **alone** do not help students to learn concepts
- Students need explicit support and guidance in building conceptual understanding along with hands-on activities
- Teachers can provide this support and guidance through their questions -

Questions that build on students' ideas and guide student thinking play a pivotal role in this scaffolding.

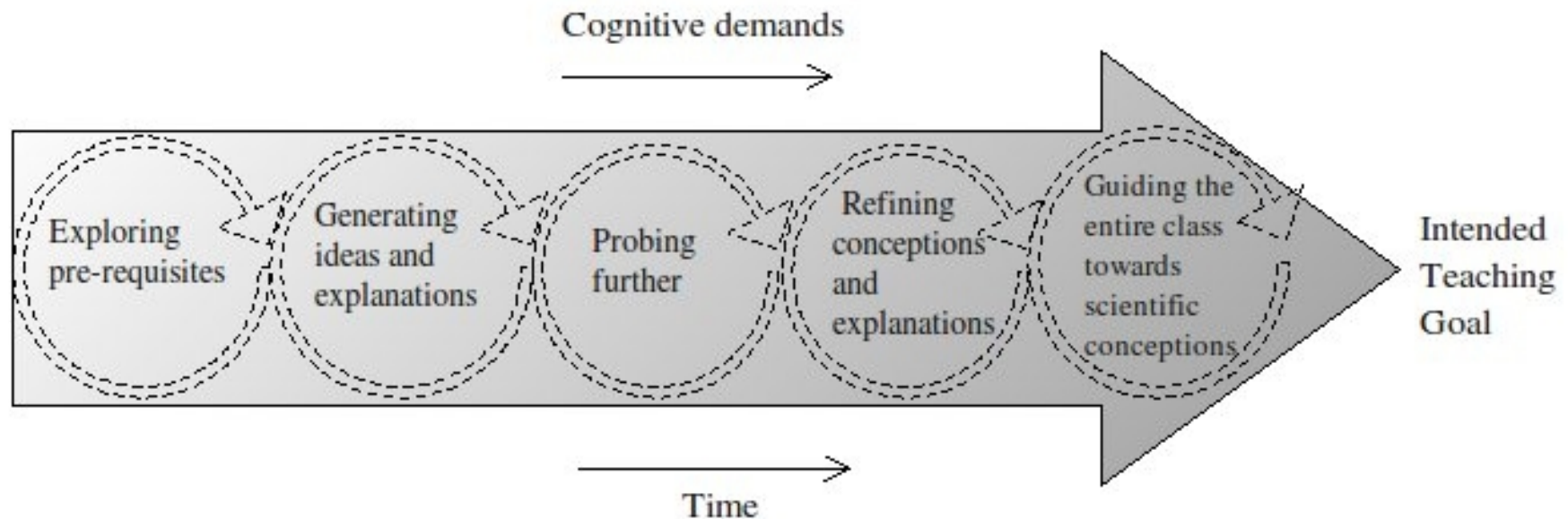
- Teachers need to ask a variety of open-ended questions that elicit, challenge and support students' thinking

(Merely asking many closed-ended questions demanding just factual recall amounts to playing 'guess the answer in my head' game – it does not help develop understanding)

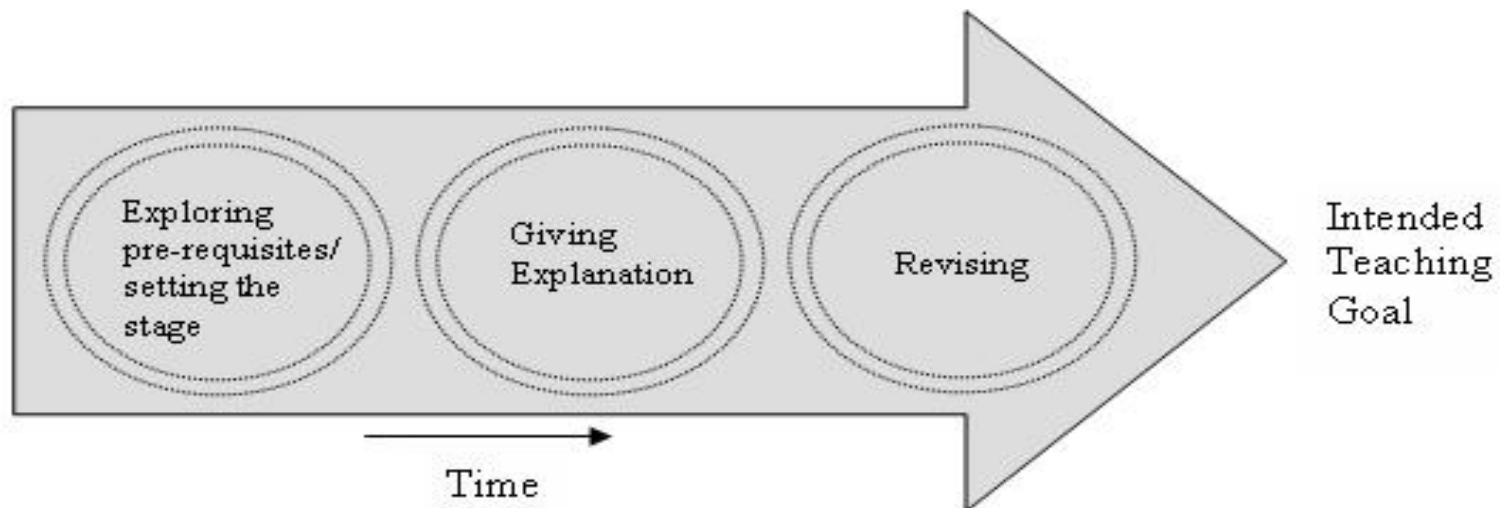
In our study:	
	% of open-ended questions
School teachers	15 to 19
Teacher-researchers who taught through inquiry	85 to 92

- For this purpose, teacher's lesson plans need to be tentative and flexible to incorporate students' questions and ideas and deal with their difficulties

What the progression of questioning needs to be for inquiry and argumentation to happen...



instead of the usual...



This presentation is based on

- Kawalkar, A. & Vijapurkar, J. (2011a). Science Talk in the Inquiry Classroom: An Analysis of Teachers' Questions and Purposes. In S. Chunawala & M. Kharatmal (Eds.) Proceedings of epiSTEME 4 -- International Conference to Review Research on Science, Technology and Mathematics Education, p. 144-149. India: Macmillan.
- Kawalkar, A. & Vijapurkar, J. (2011b). Scaffolding science talk: The role of teachers' questions in the inquiry classroom. International Journal of Science Education, DOI: 10.1080/09500693.2011.604684.

aisha@hbcse.tifr.res.in

jyotsna@hbcse.tifr.res.in