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Learning Science through Inquiry Approach for Arousing the Curiosity in Children

Bharti Dogra*

Abstract

Science teaching and learning is traversing the dimensions of analysis, synthesis, inquiry and metacognition. Science teachers across the country need to be able to use these techniques in their classroom pedagogy to provide every student with optimal learning environment. Learning science through inquiry helps students in constructing knowledge through observation, analysis, interpretation, explanation and finally making broader generalisations. The inquiry approach helps in finding answers to questions through investigation where students are treated as 'scientists in making'. This paper discusses use of inquiry approach in arousing curiosity of children while transacting the science curriculum.

Introduction

Let us consider here the case of Krishna, a Class VI student of a government school.

Krishna, a student of Class VI, while playing in the playground near his house accidentally finds a female dog very affectionately clinging to her babies (puppies). Now everyday he looks for these puppies in the playground and feels excited after locating them. Everyday, he observes them with curiosity and excitement. He finds these puppies slightly bigger in size. Finally one day he observes that puppies are as big as their mother.

This process provides him enough scope to think. Krishna, now wants some elders/teachers to help him in answering questions like:

- How do other baby animals grow up?
- Do babies always resemble their parents?
- Why do some animals like hen lay eggs? Why cannot hen give birth to babies?

* *Associate Professor*, IGNOU

Children love to share their experiences with their elders/teachers. Krishna too shares his experiences with his teacher and in return receives a positive reply from her. This reinforcement from a teacher, whom he loves and respects a lot, helps him in gaining his confidence. So, in this manner the learning process of Krishna continues and for this learning the curiosity must last.

Think of a situation where unlike Krishna's teacher, a teacher scolds, ignores or discourages a learner to ask questions and as a result the student will stop asking questions in future. Therefore, role of the teacher is very important as far as nurturing students' curiosity is concerned. How teachers view science and learning of science is crucial in this case. If teachers view science as inquiry and children as constructors of knowledge, then they will use strategies, by which they can engage them in the active construction of ideas and enhance their abilities to inquire. Inquiry based lessons need a lot of preparation on the part of the teacher. Teachers need to engage them in a lot of interesting activities at times using different materials in groups where they observe, record, discuss and collaborate with each other. Teacher facilitates, monitors, provides resources and focus wherever needed. This paper discusses role of inquiry learning in teaching science as well as in nurturing curiosity among children.

Constructivism Learning and Inquiry Learning

Constructivism is based on scientific observation and research and explains how children learn. They construct their own knowledge of the world around them through reflection on their experiences. When we are faced with new knowledge, we tend to relate it to our previous experiences and either modify our ideas or discard the new information. In the process we tend to create new knowledge by asking questions, explaining and assessing what we already know. In NCF (2005), the constructivist approach and its implications for practice have been brought out in great detail. Some of the key principles are summarised below:

- In the constructivist perspective, learning is a process of construction of knowledge.
- Learners actively construct their own knowledge by connecting new ideas to existing ideas on the basis of materials/activities presented to them (experience).
- The structuring and restructuring of ideas are essential features as the learners' progress in learning.
- The engagement of learners, through relevant activities, can further facilitate in the construction of mental images of the relationships (cause-effect).
- Collaborative learning provides room for negotiation of meaning, sharing multiple views and changing the internal representative of external reality.

Therefore, according to constructivism learners construct knowledge through experience, observation, documentation, analysis and reflection. Inquiry approach focuses on finding answers to investigative questions. According to Anderson, inquiry learning is very similar to constructivist learning. When students inquire into nature of science, its related concepts and problems, then their actually make meaning of their world. In other words, students construct meaning. Opportunities are given to students to elicit their conceptions and teachers become aware of their existing knowledge, life experiences and cultural background. So, teachers start with students' previous knowledge, listen to their ideas and relate learning to their life which makes them motivated and interested in the lesson. The teachers need to develop the ability to work with, children creatively to generate new ideas, new theories, new products and new knowledge. The engagement of the learner in the construction of classroom activity requires inputs from a reflective teacher and meticulous pre-planning before a unit is transacted in the class.

Arousing Curiosity of Children about the World

According to NCF-2005, one of the most important objectives of science teaching is to arouse the curiosity of children about the world (natural environment, artifacts and people). Children are curious by nature and they observe their environment and look for explanations of various observed phenomena. Although they are born with some inherited tendencies but an environment that stimulates learning and development is necessary to ensure children reach their learning potential. How to arouse the curiosity of the children? Provide them ample opportunities to ask questions as well as to express their views. We should always encourage the learners to express their views even if these views

Children observe drying of clothes at home and ask a question, "Where has water disappeared?" Similarly, when they observe boiling of water and conversion of water into water vapours (steam), they again ask where water has disappeared. Even they observe drying of ponds during summer.

Then they find that water droplets appear on the outside walls of the glass containing cold water. They observe condensation of water on the bathroom mirror, visible breath during winter, thick fog during early morning and evening during winter.

Children need answers of all these questions. Where has water gone? How has water surfaced again?

These questions cannot be answered by just giving half-baked information. Provide ample opportunities to them to experiment and arrive at the conclusions. Wherever needed teacher/elders can act as facilitators and can help them in providing resources, removing blocks and providing required information.

are completely absurd. Do not provide them readymade answers. Parents and caretakers can nurture children's development through understanding the importance of what children experience in the world around them and providing experiences that arouse their curiosity and interest. There are many approaches and methods which are used for teaching science but inquiry learning plays a very important role in nurturing and sustaining curiosity of children.

Inquiry Approach for Science Learning

Inquiry is an approach to science teaching focusing on understanding the world by questioning, investigating, observing, and explaining the order of the world around us. When science is taught by inquiry approach, it provides a teacher with many opportunities to interact with each student, to guide and challenge them to acquire and understand a scientific view of the world, and to develop the abilities and attitudes they need to inquire on their own.

In simple words, inquiry is an approach to learning that involves exploring the world and that leads to asking questions, testing ideas, and making discoveries in the search for understanding. There are many degrees of inquiry, and it may be helpful to start with a variation that emphasises a teacher-directed approach and then gradually builds to a more student-directed approach. "Fruitful inquiries evolve from questions that are meaningful and relevant to students, but they also must be able to be answered by students' observations and scientific knowledge they obtain from reliable sources." In an inquiry classroom, the teacher plays an important role in helping students identify questions that can lead to interesting and productive investigations, questions that are accessible, manageable, and appropriate to students' developmental level. A great way to encourage questioning is to provide students with interesting objects to stimulate their curiosity. As stated by Doris Ash, "Curiosity drives the inquiry process—it generates questions and a search for answers" (1999, p. 754). Teachers can provide students interesting objects like watermelons, pumpkins, leaves, seashells, plant galls, seeds, potatoes, pinecones, plastic animal models, inexpensive plastic toys and fossils. After students have had a chance to carefully observe, to wonder, and to share their questions with others, you can use the question-sorting activity that follows as a springboard to inquiry investigations.

One of the most important skills students can develop in science is to understand which questions can be answered by investigation and which cannot. The teacher plays a critical role in guiding the kinds of questions the students pose. Students often ask why questions, which sometimes cannot be addressed by scientific investigations in school setting. For example, "Why does gravity make things fall towards

Table 1: Showing Sample Research Questions and Testable Questions

Research Questions	*Testable Questions*
Why are watermelons red?	Are there more lines on bigger watermelons than on smaller ones?
How big was the biggest watermelon ever grown?	Do larger watermelons have larger seeds than smaller watermelons?
Where do watermelons grow?	Do larger watermelons have more seeds than smaller watermelons?
How do you make watermelon pie?	How much less does a watermelon weigh after it has been carved?
	What happens to a carved pumpkin after one month? after two months?

Earth?" is a question that would be impossible to answer in the school setting. Testable questions, on the other hand, generally begin with how can, does, what if, or which and can be investigated using controlled procedures. For example, encourage students to ask questions such as "How can you slow the fall of an object?", "Which object falls faster, a marble or a basketball?" or "What materials work best for constructing a toy parachute?" guides them toward investigations that can be done in the classroom.

The Role of the Teacher in Inquiry Teaching

Teaching science through inquiry requires that the teacher takes on a different role than the traditional science teacher. "In the inquiry classroom, the teacher's role becomes less involved with direct teaching and more involved with modeling, guiding, facilitating, and continually assessing student work" (Ash and Kluger-Bell, 1999, p. 82). One way to guide students and assess their progress as they are engaged in inquiry processes is to ask thoughtful probing questions. Some suggested questions to ask students while they are involved in inquiry are:

1. What would happen if you ...?
2. What might you try instead?
3. What does this remind you of?
4. What can you do next time?
5. What do you call the things you are using?
6. How are you going to do that?
7. Is there anything else you could use or do?
8. Why did you decide to try that?
9. Why do you think that will work?
10. Where could you get more information?
11. How do you know?
12. What is your evidence?

After going through the entire exercise related to inquiry, students must share the results of their investigations with each other through a poster session. Scientists, engineers, and researchers routinely hold poster sessions to communicate their findings. Here are some suggestions for poster sessions:

1. Posters should include a title, the researchers' names, a brief description of the investigation, and a summary of the main findings.
2. Observations, data tables, and/or graphs should be included as evidence to justify conclusions.
3. The printing should be large enough that people can read it from a distance.
4. Students should have the opportunity to present their posters to the class.

Let us take the case of different types of flowers. The teacher can start a lesson by:

1. *Introduction*: Have you seen flowers? Are they of different colours? When do plants have flowers? Are they seen in a particular season? Why is blooming of flowers seen in spring? What is spring? What are different seasons? Which season comes after spring? What kind of clothes you wear during spring season?
2. *Providing different types of flowers to learners*: Divide now whole class into groups and each group consisting of two students. Each group is then provided a bunch of 10 flowers. Providing them instructions to observe the flowers, what is fascinating about flowers? How are these flowers similar and alike? What are various dissimilarities between these flowers?

Discuss your observations and record them. Teacher moves in the class and observes different groups. Children observe flowers and find that some flowers are red, some are pink and others are yellow. All the flowers have green coloured leaves like structures at the base of the flowers. They want to know why it is so. Why some flowers have long elongated structure/s in the middle of the flower? Why are flowers so brightly coloured?

3. *Guiding learners to investigate questions*: Teacher accepts their questions and guides them to investigate questions like which flowers are alike? Why are they alike? What are the dissimilarities between different types of flowers? Learners then classify flowers on the basis of their similarities and dissimilarities forming piles of similar type of flowers. In this way five piles were made. Teacher moves in the class and discusses similarities and differences of the flowers with different groups of children.
4. *Discussion in the whole class*: Teacher reminds children of the initial question, how are flowers alike and different? Children then discussed what they noticed about the flowers in different piles and what observations made them wonder. Teacher explains that these flowers were collected from five plants and flowers collected from same plant are alike i.e., they have similar colour, shape, size etc. So, children conclude that flowers from different plants have different colours, shapes and sizes.

5. The audience in a poster session should examine the evidence, ask thoughtful questions, identify faulty reasoning, and suggest alternative explanations to presenters in a polite, respectful manner.

Now let us see what are the basic features of an essential inquiry lesson.

1. A question about the natural world that could be investigated was asked.
2. Children were helped by the teacher in gathering data through observations relevant to the investigative question.
3. The observations were used as evidence for making generalisations, interpretations and explanations to answer the question.

Summing up

Children are curious by nature and love to ask questions. What if science curriculum is driven by their questions as well as natural curiosities? Inquiry approach encourages children to ask questions, gather information, conduct research and make discoveries on their own. But inquiry learning calls for more synergies in the classroom rather than mere individual participation. The teachers need to develop the ability to work with learners creatively to generate new ideas, new theories, new products and new knowledge. Inquiry approach makes use of multiple ways of knowing and taking on new perspectives when exploring issues, content and questions. In an inquiry-based classroom, learners ask questions, design investigations and seek solutions. Inquiry approach helps learners in understanding that there is no one place or one resource for answers, but that many tools are useful for exploring problems. During inquiry approach, learners are actively involved in making observations, collecting and analysing information, synthesising information, and drawing conclusions which help them in acquiring useful problem-solving skills. These skills come for their rescue in future "need to know" situations that they will encounter both at school and at work.

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