Science Process Skills and Scientific Attitudes

By Common Resources | Jan 2, 2013

The summary of ‘Science Process Skills and Scientific Attitudes’ as given in the book ‘UNESCO Sourcebook for Science in the Primary School’ and curated by Chandrika Muralidhar:

**Aims of Science Education**

The Position Paper by the National Focus Group on Teaching of Science says that science education should enable the learner to:-

* Know the facts and principles of science and its applications, consistent with the stage of cognitive development
* Acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge
* Develop a historical and developmental perspective of science and to enable her to view science as a social enterprise
* Nurture the natural curiosity, aesthetic sense and creativity in science and technology
* Cultivate ‘scientific temper’ – objectivity, critical thinking and freedom from fear and prejudice

Keeping the above in mind, the book being referred to, “UNESCO Sourcebook for science in the primary school” states the a set of objectives for learning science which can be expressed formally as:

* Concepts – to develop an understanding of the scientific aspect of the world around
* Process skills – deals with a part of a whole called scientific investigation. [Hypothesizing, raising questions, observing (comparing, classifying), measuring and calculating, manipulating materials and equipment effectively, devising and planning investigations, designing and making, communicating effectively, finding patterns and relationships(infering), predicting]
* Attitudes – arise from the willingness to – collect and use evidence, change ideas in the light of evidence, review procedures critically

In this article we will be focusing on Science process skills and scientific attitudes:

**Science Process Skills**

- The interaction of children with their environment in a scientific manner happens through process skills such as handling, manipulating, observing, questioning, interpreting etc.
- Process skills are thus the route by which children explore and gain evidence which they use in developing ideas
- Scientific processes would include guessing, predicting and hypothesizing. A prediction is generally substantiated by ‘evidence’ either in current or past experience. A hypothesis is a statement which attempts an explanation of an event or relationship. A scientific hypothesis is one which can be tested scientifically. The quality of tentativeness is another feature of a hypothesis, as it is a possible explanation. Hypothesizing can be encouraged in situations where there is more than one obvious and possible reason for something happening.

**Indicators of Process Skills**

How are indicators valuable?

- For teachers to use in observing children and deciding the extent to which they are engaged in the actions that indicate that process skill are being used.
- For guiding the evaluation and adaptation of activities, such that the children are likely to be involved in the actions described by the indicators
- For suggesting how children can be helped to develop their process skills
- For indicating the kinds of tasks that can be used to assess children’s use of process skills

**The Indicators**

**OBSERVING**

- Using the senses to gather information
- Identifying differences between similar objects or events
- Identifying similarities between different objects or events
- Recognising the order in which sequenced events take place

**RAISING QUESTIONS**
- Asking questions which lead to inquiry
- Asking questions based on hypothesis
- Identifying questions which they can answer by their own investigation
- Recognizing that some questions cannot be answered by inquiry

**HYPOTHESIZING**
- Attempting to explain observations or relationships in terms of some principle or concept
- Applying concepts or knowledge gained in one situation to help understanding or solve a problem in another
- Recognising that there can be more than one possible explanation of an event
- Recognizing the need to test explanations by gathering more evidence

**PREDICTING**
- Making use of evidence to make a prediction (as opposed to a guess which takes no account of evidence)
- Justifying how a prediction was made in terms of present evidence or past experience
- Making use of patterns to extrapolate to cases where no information has been gathered

**FINDING PATTERNS AND RELATIONSHIPS**
- Putting various pieces of information together and inferring something from them
- Finding regularities of trends in information, measurements or observations
- Identifying an association between one variable and another

**COMMUNICATING EFFECTIVELY**
- Using writing or speech as a medium for sorting out ideas or linking one idea with another.
- Listening to others’ ideas and responding to them
- Keeping notes on actions or observations
- Displaying results appropriately using graphs, tables, charts, etc.
- Reporting events systematically and clearly
- Considering how to present information so that it is understandable by others

**DEVISING AND PLANNING INVESTIGATIONS**
- Deciding what equipment, materials, etc. are needed for an investigation
- Identifying what is to change or be changed when different observations or measurement are made
- Identifying what is to be measured or compared
- Deciding the order in which steps should be take in an investigation

**MANIPULATING MATERIALS AND EQUIPMENT EFFECTIVELY**
- Handling and manipulating materials with care for safety and efficiency
- Using tools effectively and safely
- Showing appropriate respect and care for living things
- Assembling parts successfully to a plan
- Working with the degree of precision appropriate to the task in hand

**MEASURING AND CALCULATING**
- Using an appropriate measure in making comparisons or taking readings
- Taking an adequate set of measurements for the task in hand
- Using measuring instruments correctly and with reasonable precision
- Computing results in an effective way

**Scientific Attitudes**

**Indicators**

**WILLINGNESS TO COLLECT AND USE EVIDENCE**
- Reporting what actually happened, even if this was in conflict with expectations
- Querying and checking parts of the evidence which do not fit into the pattern of other findings
- Querying an interpretation or conclusion for which there is insufficient evidence
- Setting out to collect further evidence before accepting a conclusion
- Treating every conclusion as being open to challenge by further evidence

**WILLINGNESS TO CHANGE IDEAS IN THE LIGHT OF EVIDENCE** (Flexibility combined with open mindedness)
• Being prepared to change an existing idea when there is convincing evidence against it
• Spontaneously seeking alternative ideas rather than accepting the first one which fits the evidence
• Relinquishing an existing idea after considering evidence
• Realizing that it is necessary to change ideas when different ones make better sense of the evidence

WILLINGNESS TO REVIEW PROCEDURES (Critical Reflection)

• Willingness to review what they have done in order to consider how it might have been improved
• Considering alternative procedures to those used
• Considering the points in favour and against the way in which an investigation was carried out
• Spontaneously reflecting on how the procedures might have been improved
• Considering alternative procedures at the planning stage and reviewing those chosen during an investigation, not just at the end


Supporting documents:

• New UNESCO Source book for Science Teaching
• A workshop approach to teacher education by Wynne Harlen and Jos Elstgeest

Category: Teacher Development
Subject: Science & Technology
Board: All boards
Grade/Standard: Class 1-2
Class 3-5
Class 6-8
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