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 (inferring), 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

**HYPOTHEIZING**

- 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 taken 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