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Research Article

Science Process Skills in Class-VI Science Textbook approved by Government of Assam: An Analytical Study

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Abstract

Science can be defined from two basic perspectives- process of science and product of science. Science process skills come under process aspect of science. These process skills help in learning science in true sense. So science textbooks should cover the process skills in the contents. The present study aims at analysing the Government of Assam approved class-VI science textbook with respect to science process skills. Descriptive survey method is adopted in this research. The views of the teachers are taken regarding the inclusion of science process skills in the textbook of class-VI. Content analysis is used to analyse the inclusion of process skills in the activities, exercises and suggested projects. The population of teachers in the present study comprises of all the science teachers of upper primary schools under Barbaruah Block of Dibrugarh district in the state of Assam. The teachers having D.El.Ed. or B.Ed. degree are selected as sample using purposive sampling technique. The study revealed that different activities, exercises and suggested projects are included in the science textbook of class-VI approved by Government of Assam that help the students to develop the Basic Process Skills like observation, classification, measurement, etc. However, no such activities are included in the textbook that may help in developing the Integrated Process Skills.

Keywords: Science Process Skills, Basic Process Skills, Integrated Process Skills.

Introduction

In this modern world of science and technology the importance of science needs no emphasis. We are dependent on science directly or indirectly in every sphere of life. Each individual must know the basics of science. So in the primary level of school, science should be included in the curriculum as a compulsory subject. In India, science has been made a compulsory subject for the first ten years of schooling.

One of the most important aims of schooling is to teach the students to think. Science and all the other school subjects should contribute in reaching this aim (Padilla, 1990). Science education aims at educating individuals who can think critically (Aktamis & Yenice, 2010).

When we talk about science we have to mention its dual nature. Science is both a body of knowledge- product and the process of acquiring it. Science can be viewed as methods and processes as well as the products consisting of the facts, concepts, principles, laws that form the body of science (Nworgu & Otum, 2013). Through science process skills students can learn by doing, experiencing and associating science with day today activities. They make learning science easier, develop curiosity among the students and help to make them active (Ozturk, Tezel & Acat, 2010). Science process skill based learning has a positive effect of developing critical thinking skill (Pradana, Nur & Suprapto, 2020). Science process skills provide direct experience with objects and events around children which is essential for the mental and intellectual development (Osman, 2012). They serve as important tool to gather scientific knowledge (Temiz, Tasar & Tan, 2006). Science process skills provide an understanding about the nature of science (Feyzioglu, Demirdag, Akyildiz & Altun, 2012). Science Process Skills (SPS) can be enhanced through outdoor school ground activities and the SPS help to solve day to day problems (Ting & Siew, 2014). Students' regular visit to science centre has positive effect on developing science process skills (Cigrik & Ozkan, 2015). Science process skills and academic achievement have a positive relationship (Aktamis & Ergin, 2008 and Deleni & Kesercioglu, 2012). Students possessing process skills can think analytically and solve new problems (Oloyede & Adeoye, 2012).

Method of teaching also plays a significant role. Application of the science process skills is also dependent on the ability of the science teacher and hence effective SPS improvement programmes should be developed for the teachers (Karsli & Sahin, 2009). Science process skills can be developed in class by the teachers if they organize learning activities and teach how to acquire scientific knowledge (Abd Rauf, Rasul, Mansor, Othman & Lyndon, 2013). Primary teacher education programme should be such that the primary teachers acquire the competence in basic process skills of science (Foulds & Rowe, 1996).

Science process skills should not be an exception or addition to the content but the content should be such that it is developed with SPS as means to cover it (Wilke & Straits, 2005). It is not needed to teach process skills separately, they are developed when experiments are performed in a meaningful way (Roth & Roychoudhury, 1993).

American Association for the Advancement of Science (AAAS, 1967) has identified thirteen process skills of science. The first eight are termed as Basic Process Skills and the rest five are termed as Integrated Process Skills. The process skills are shown below:

A) Basic Process Skills:

- Observation: Process of gathering data by using the basic senses- sight, hearing, taste, touch, smell.
- Measurement: Comparing some attribute of system to a reference standard.

- Classification: Grouping objects on the basis of different traits or characteristics.
- Quantification: Expressing observations in numerical forms instead of qualitative forms.
- Inferring: Process where assumption of cause is generated to explain an observed event.
- Predicting: Process of projecting events based on data.
- Relationship: Process of interaction of variables of a system.
- Communication**:** Process that represent systematic reporting of data.

B) Integrated Process Skills:

- Interpreting data: Process of recognizing patterns and associations within bodies of data.
- Controlling variable: Any attempt to isolate a single influent of a system to infer its role.
- Operationalizing: Defining the terms in measurable and observable forms.
- Hypothesising: It is a pre-assumed solution to a problem or specific research question.
- Experimenting: It is the process of solving a problem systematically which is similar to scientific method.

Learning by doing is of much necessity in learning science. Process aspect of science can fulfil it. Science textbooks can help learning science as process by providing the content such that they involve process skills. By going through a number of studies on science process skills, it was found that many of the researchers had conducted studies on different aspects of science process skills. But only a few conducted researches on science process skills included in science textbook. It was hardly seen that research on science process skills of textbooks approved by Government of Assam had been conducted. This made the researcher think on the topic and analyse the content of class-VI science textbook approved by Government of Assam with respect to science process skills.

The class-VI science textbook is developed by NCERT (National Council of Educational Research and Training), New Delhi, India. This book is adapted by SCERT (State Council of Educational Research and Training), Assam in different mediums and is approved by Government of Assam. The book is published by the Assam State Textbook Production and Publication Corporation Limited, Guwahati for free distribution since 2011. The textbooks are developed or adapted on the basis of new philosophy and approaches covering various issues as per National Curriculum Framework, 2005 as well as Right to Education, Act 2009.

Review of Related Literature:

Aziz & Zain (2010) in their investigation of science process skills (SPS) in the 10^{th}-12^{th} grade physics textbook found that process skills of observation was mostly involved in all the three textbooks and a variation in the inclusion of integrated process skills was observed. Yilmaz Senem (2013) investigated the extent in which science process skills are included in 9th grade physics curriculum and 9th grade physics textbook, and revealed that the 9th grade physics curriculum emphasizes collecting-interpreting data whereas disregards predicting, experimenting and inferring; 9th grade physics textbook highly includes collecting-interpreting data and measuring but ignores hypothesizing and defining-controlling variables. Aydin (2013) analysed the conditions of representing science process skills in 10th grade, 11th grade and 12th grade Chemistry curricula and reported that in all the three grades integrated process skills are more included than the basic process skills. Zeitoun & Hajo (2015) studied the level of inclusion of basic and integrated science process skills in Lebanese national science text books for cycle 3 and revealed that the percentage of basic skills in the textbooks was higher than that of the integrated skills. Aslan (2015) analysed the activities of the science coursebooks used at middle schools in Turkey and revealed that the SPS recommended in science curriculums are not reflected in the science coursebooks used at middle schools. Karadan & Hamid (2016) analysed the 8^{th} and 9^{th} grade Chemistry curricula to see the extent of representation of science process skills and found that both basic and advanced science process skills were sufficiently included. Yumusak (2016) in their analysis of science curricula that found that the basic science process skills are emphasized more in the curricula compared to integrated science process skills. Antrakusuma, Masykuri & Ulfa (2017) analysed the science process skills in three different textbooks of chemistry grade XI and found different science process skill criteria in the three different chemistry textbooks. Alayasrah & Yahyaa (2017) investigated the essential and integrated science process skills in the science textbooks of the first three grades of the primary education in Jordan and reported that among the basic process skills observation is most frequently included and among the integrated process skills experimentation is most frequently included. Duruk, Akguna, Doganb & Gulsuyuc (2017) reported in their study that representation rate of science process skills for science curriculum of Turkish secondary school varied with grade level and unit.

Akinbobola & Afolabi (2010) analysed the physics practical examinations in Nigeria for a period of 10 years with respect to SPS and found that basic process skills are in a higher percentage than the integrated science process skills. Ongowo & Indoshi (2013) analysed the Biology practical examinations in Kenya for a period of 10 years with respect to science process skills and found a higher percentage of basic process skills as compared to integrated process skills. Elmas, Boidner, Aydogdu & Saban (2018) in their analysis of the 8^{th} grade science and technology questions with respect to science process skills found that there is a difference in the frequency of inclusion of basic and integrated process skills.

Bati, Erturkb & Kaptan (2010) studied the awareness level of pre-school teachers about science process skills and found a low awareness level. Miles (2010) made a study to see the familiarity, interest, conceptual knowledge, performance of in-service elementary teachers on science process skills. The findings of the study showed high familiarity with the SPS but

moderate interest of the teachers on the skills. It was also found that the conceptual knowledge of the teachers was very low but their performance was good in the performance test. Mbewe, Chabalengula & Mumba (2010) investigated about the familiarity, interest and conceptual understanding on science process skills of the pre-service teachers and found higher familiarity and interest but low conceptual understanding. Chabalengula, Mumba & Mbewe (2012) studied about the conceptual understanding and performance of preservice teachers on science process skills. They found that teachers had limited conceptual understanding but higher performance on SPS. Aydogdu, Erkol & Erten (2014) in their study investigated the science process skills of elementary school teachers and found that elementary school teachers' integrated process skills was not sufficient. Aydogdu (2015) investigated science process skills of science teachers and revealed that integrated process skills of science teachers were not satisfactory. Gultepe (2016) studied about the views of science teachers' on science process skills and found most of the teachers commenting that these skills can be developed through laboratory activities and that examination based teaching is an obstacle in this regard.

Objectives of the Study:

The main objective of the present study is to analyse the class-VI science textbook approved by Government of Assam with respect to science process skills. The specific objectives of the study are-

1. To analyse the activities given in the textbook with respect to science process skills.
2. To analyse the exercises of the textbook with respect to science process skills.
3. To analyse the suggested projects of the textbook with respect to science process skills.
4. To study the science teachers' views regarding inclusion of science process skills in the class-VI science textbook.
5. To suggest some measures for proper inclusion of science process skills to improve the textbook.

4. Delimitation of the Study:

The study has been delimited in the following dimensions:

1. The data are collected only from the science teachers of the upper primary schools under Barbaruah Block of Dibrugarh district, Assam.
2. The data are collected only from the science teachers who have D.El.Ed. (Diploma in Elementary Education) or B.Ed. (Bachelor of Education) degree.

Though the study has been delimited in different dimensions, the findings of the study would not be bounded to these limits and would be extended in all dimensions.

Definition of Key Terms:

Science process skills: The skills necessary for science learning and scientific discovery. These skills help the pupils to be more responsible and active in their own learning. They help the students to think scientifically.

Basic process skills: The preliminary process skills of science.

Integrated process skills: The higher order process skills of science.

Methodology:

6.1 Method:

Considering the objective of the study, descriptive survey method is considered to be appropriate for the present study. The study demands the survey of the views of the teachers regarding inclusion of process skills in the science textbook. Content Analysis is used to analyse the inclusion of process skills in the activities, exercises and suggested projects of the science textbook of class-VI approved by Government of Assam.

6.2 Population:

Since the class-VI science textbook holds the chief position in the study so it is the population of the study. The population of the teachers in the present study comprises of all the science teachers of the upper primary schools under Barbaruah Block of Dibrugarh District, Assam. There are 23 upper primary schools having 28 Science teachers under Barbaruah Block of Dibrugarh District, Assam.

6.3 Sample:

The population (textbook) is the sample. Considering the objectives and the nature of the data to be collected, purposive sampling technique has been adopted for sampling the teachers. All the science teachers, having B.Ed or D.El.Ed, of upper primary schools under Barbaruah Block of Dibrugarh District, Asssam, have been selected as a sample of teachers for the present study. The number of teachers is 12.

6.4 Tools and Techniques:

Content analysis of the class-VI science textbook: Since the main objective of the present study is to analyse the class-VI science textbook with respect to science process skills hence the textbook assume the central place in the investigation. The analysis of the textbook includes the chapter wise analysis of activities, exercises and suggested projects with respect to science process skills. The 16 chapters included in the textbook are: Food: Where Does It Come from; Components of Food; Fibre to Fabric; Sorting Materials into Groups; Separation of Substances; Changes Around Us; Getting to Know Plants; Body Movements; The Living Organisms and Their Surroundings; Motion and Measurement of Distances; Light, Shadows and Reflections; Electricity and Circuits; Fun with Magnets; Water; Air Around Us; Garbage in, Garbage out.

Questionnaire for the science teachers: The questionnaire, prepared by the investigator, was meant for the science teachers of the upper primary schools under Barbaruah Block of Dibrugarh District, Assam. It was used to elicit information regarding the inclusion of science process skills in the activities, exercises and suggested projects of the class-VI science textbook. The questionnaire consists of both open-ended and close-ended questions.

7. Results and Findings:

All the 99 activities spread over 16 chapters of the textbook were analysed with respect to science process skills. Here are some examples to show how process skills are involved in the activities-

1. In activity no. 5 of chapter 1 of the textbook 'Observation' is involved. In this activity, the students have to perform the whole activity from dipping the seeds in water to observe sprouting of the seeds. If the activity is properly carried out, the 'Observation' skill of the students will be developed.
2. The process of 'Observation' is involved in the activity no. 3 of chapter 3. From this activity students will be able to know that Yarn is made up of Fibres as they will scratch the cotton yarn and obtain thin strands of fibres.
3. In activity no. 3 of chapter 4, 'Classification' is involved. Here, the students are asked to classify different materials such as paper, cardboard, wood, copper wire, aluminium sheet, chalk into two groups- materials with cluster and without cluster.
4. In activity no. 11 of chapter 7 'Observation' is involved. In this activity, students are asked to cut the ovary of the flowers in two different ways as directed and observe the bead like structures i.e. ovules.
5. 'Measurement' is involved in activity no. 4 of Chapter 10 as students would measure the length of a curved line as directed in the activity.

All the 121 exercises given in the 16 chapters of the textbook were analysed with respect to science process skills. A few examples are given to show how process skills are involved in these exercises:

1. In exercise no. 3 of chapter 1 'Relationship' is involved. Because students would match the two columns seeing the relationship of the variables of the two columns (Column A: milk, curd, *paneer*, ghee; Spinach, cauliflower, carrot; lions and tigers; herbivores. Column B: Eat other animals; eat plants and animals; are vegetables; are all animal products.)
2. In exercise no. 6 of chapter 4 'Observation' is involved as students are required to check whether the objects that float in water also float in oil.
3. 'Classification' is involved in exercise no. 2 of chapter 11. Here, the students are asked to classify the given objects (Air, water, a piece of rock, a sheet of aluminium, a mirror, a wooden board, a sheet of polythene, a CD, smoke, fog, sun, etc.) into groups viz. opaque, transparent or translucent, luminous or non-luminous.

There are a total of 46 suggested projects in the 16 chapters of the textbook. All these suggested projects were analysed to study whether these projects involved the science process

skills. A few examples are given to show how process skills are involved in the suggested projects:

1. In the suggested project No. 1 of chapter 2 'Communication' is involved as students are asked to prepare a diet chart representing balance diet.
2. 'Observation' is involved in suggested project no. 1 of chapter 7. In this project, the students are required to collect leaves, put these under a press and then paste on a paper to know about different kinds of leave.
3. 'Observation' is involved in the suggested project no. 4 of chapter 13 as students are directed to make a doll with magnets in hands to observe what objects are attracted by it when brought near its hands.

The questionnaires were distributed to 12 teachers and the same numbers of filled-in questionnaires were received by the investigator. The following analysis is based on the suggestions given by those 12 teachers.

i. Most of the teachers reported that the science process skill 'Observation' is involved in most of the activities, exercises and projects given in the textbook. They also reported that there are ample scopes for inclusion of other science process skills such as classification, measurement etc in the chapters.
ii. Most of the teachers mentioned that science process skills were mostly involved in the activities and suggested projects. However, there are very less numbers of science process skills involved in the exercises. They suggested to provide the exercises such that these involve more science process skills.
iii. Some of the teachers opined that there was scope to include science process skills in some of the activities, exercises and suggested projects, e.g. in the activity no. 1 of chapter 1 which is about food items eaten during the day. They suggested that the activities, exercises and suggested projects should be given in such a way that science process skills could be involved.
iv. 75% of the teachers also suggested that in the future edition of the textbook it should be taken into account to provide the activities, exercises and suggested projects adequately so that these could involve the process skills properly.

The process skills are found in different activities, exercises and suggested projects in different numbers. This is shown by the Table- 1.

Table – 1
Process skills involved in different activities, exercises and suggested projects

Process Skill	No. of process skill present out of total activities 99	No. of process skill present out of total exercises 121	No. of process skill present out of total suggested projects 46	% of process skill present in the total of 266 activities, exercises and suggested projects

Observation	88	6	27	45.49%
Measurement	6	-	2	3.01%
Classification	11	3	2	6.01%
Quantification	5	-	1	2.26%
Inferring	1	-	1	0.75%
Prediction	-	-	-	0%
Relationship	1	6	-	2.63%
Communication	-	-	3	1.12%
Interpreting Data	-	-	-	0%
Controlling Variable	-	-	-	0%
Operationalization	-	-	-	0%
Hypothesizing	-	-	-	0%
Experimenting	-	-	-	0%

Percentages of different science process skills involved in the activities, exercises and suggested projects of the textbook are shown in Fig. 1.

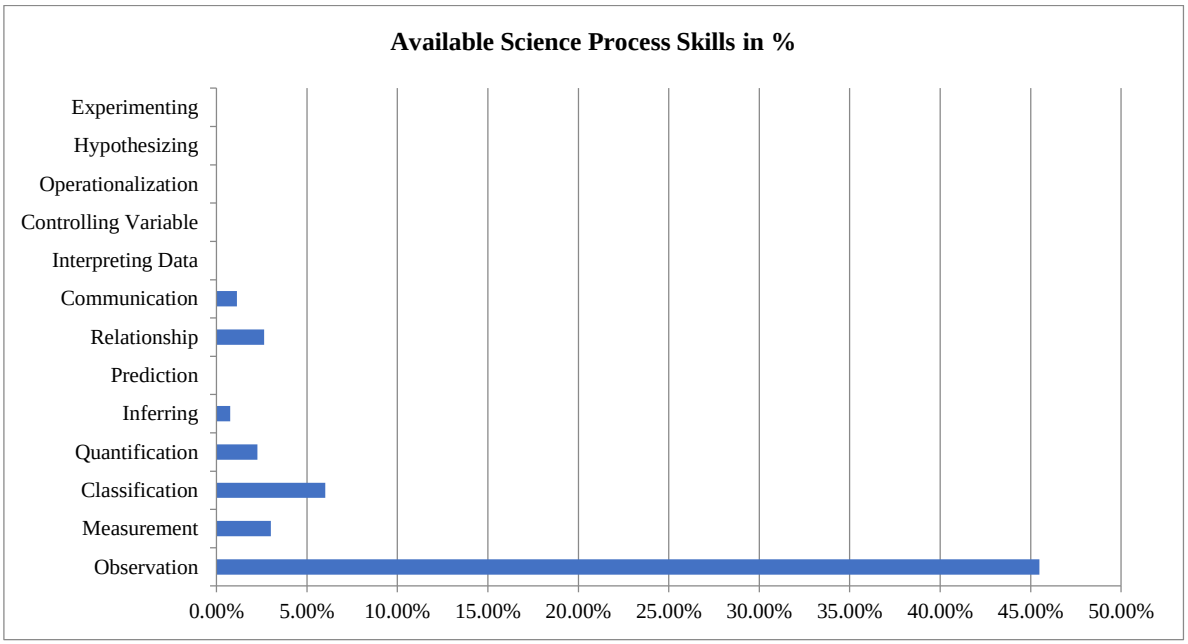

Fig. 1: Percentages of Science Process Skills involved in different Activities, Exercises and Suggested Projects

From Table-1 and Fig.1, it is clear that activities, exercises and suggested projects involve only the basic process skills. No integrated process skills are found in any activity, exercise or suggested project. Basic process skills observation, measurement, classification, quantification, inferring, prediction, relationship, communication are found in 45.49%, 3.01%, 6.01%, 2.26%, 0.75%, 0%, 2.63%, 1.12% respectively.

Science process skills are mostly involved in the activities. The number of science process skills involved in exercises is very less. There is involvement of basic process skills only.

Integrated process skills are not found in any of the activities, exercises and suggested projects. Some of the activities or suggested projects are given in such a way that no process skill is involved in them. But there was scope to present the activity to involve process skills.

Discussion:

The researcher in the present study found that in the class-VI science textbook approved by government of Assam only the basic science process skills are involved in the activities, exercises and suggested projects; no integrated science process skills are involved in the textbook. This finding is similar to the findings of Zeitoun & Hajo (2015) , Yumusak (2016). However the result is not tallied with that of the studies carried out by Aydin (2013) .

The investigator of this study found that process skill of observation was mostly involved in the activities, exercises and suggested projects of the textbook. This is also supported by the results of Aziz & Zain (2010), Antrakusuma, Masykuri & Ulfa (2017), Alayasrah & Yahyaa (2017).

In this study it is tried to investigate the process skills involved in the class-VI textbook of science which revealed that only the basic process skills are emphasised.

Conclusion:

The science process skills form the foundation for learning science in true sense. Science process skills help in developing effective thinking (Ozgelen, 2012). From the primary stage onwards, the science process skills should be involved in the science curriculum. It is needed to develop process skill based curriculum activities and present with a proper structure (Yeany, Yap & Padilla, 1986). These science process skills can be involved in the activities, exercises and suggested projects of the science textbooks. If the process skills are involved properly in the textbook, then the true learning of science and development of scientific temper would be possible.

From the content analysis of class-VI science textbook approved by Government of Assam it is seen that only basic process skills are involved but no integrated process skills are found in the activities, exercises and suggested projects. And only one or two basic process skills are emphasised, other basic process skills are not emphasized. There was scope to involve more process skills by providing the activities, exercises and suggested projects adequately.

On the basis of the content analysis and the suggestions provided by the science teachers, following suggestions for proper inclusion of science process skills in the class-VI science textbook are made: It should be tried to involve integrated process skills in the activities, exercises and suggested projects; steps should be taken to involve the process skills properly in the activities, exercises and suggested projects of the textbook in the future edition.

It is hoped that the findings of the present study will prove useful in taking steps for reformation of the textbook to make the students learn science in true sense from the elementary stage. It is also hoped that these will provide a guideline for further research on any specific issues relating to science process skills.

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