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A STUDY OF SCIENCE PROCESS SKILLS OF SECONDARY SCHOOL STUDENTS

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1. Science Education

The importance of science all over the world is now well recognized, and it is generally accepted that some knowledge of physical sciences is an important part of a liberal education. What is called 'the scientific age'? Any education intended to fit for graceful and purposeful living will be grievously ill-directed if it takes no account of the intellectual climate of the present day. The main object of education is to prepare a young man for life. In fact, education is supposed to present a picture of the life so that the individual may learn to live successfully. Science, which has so much of importance in life, cannot be denied an important place in the school curriculum. According to (Rai 1990) "The future can only be secured in the hands of a race of people who grasp the significance of changes, which scientific discovery has brought. No State man, Sociologist or Economist can afford to neglect them".

Science education occupies a very eminent place in curriculum both at school and university stages of education in India. Continuous advances in scientific and technological research has led to the growth and greater application of science in contemporary society. Accordingly, science becomes a priority area in education, both at the compulsory education level as well as the level of specialization. Science education is supposed to perform a two-fold task. The prime objective, in individualistic perspective, is the cultivation of a scientific temper, which includes a spirit of enquiry, a disposition to reason logically and dispassionately, a habit of judging beliefs and opinions on available evidence, readiness to reject unfounded theories and principles, the courage to admit facts, howsoever, unsettling or disagreeable they might be, and, finally, recognizing the limits of reasoning power itself. It is

also expected of science education that it would give individuals a firm grasp of the concepts and processes of science and impart to them the ability to use the scientific method of problem solving and the techniques of observation and experimentation in handling problem of comprehension or life. At the societal level, one of the major objectives of science education is to equip individuals to participate in the creation of a society which is free from poverty, hunger, disease and evils such as violence, exploitation, oppression, etc.

Concept of Science Process Skills

In general, process skills refer to the cognitive processes of thinking processes in which the learner is engaged while learning a subject. The exercise of these process skills generates the 'products' of learning a particular subject meaning, definition, explanation of terms, concepts, principles, procedures, laws, theories etc., in the domain of that subject. While these products are specific for each subject forming the knowledge accumulated in that subject, many of the process skills for generating these products are common to several subjects and are acquired and used by the learner according to the situation or topic. Thus, it may be stated that the products of learning a subject are generated through the use of the process skills by the learner such as remembering, questioning, exploring, organizing, classifying data/ information, quantifying, comparing, differentiating, inferring, hypothesizing, generalizing etc. Among these general process skills, there are some skills that are used and exercised more often in particular subject. Those process skills which are more often used and emphasized by learners of science and scientists and which are productive in better learning and problem solving such as observing, classifying, comparing, quantifying, inferring, predicting, hypothesizing, measuring etc. may be called process skills in Science.

In this study the researcher has made an attempt to conduct an experimental study of science process skillsof secondary school students.

The Problem

The present investigation is titled as**: "AStudy of Science Process Skills of Secondary School Students".**

Review of Literature

The investigator has reviewed previous studies which were related to the present study and it is observed that findings of the previous studies were not found significant to the present context of secondary education. In addition to this observation, there were no much

studies found especially science process skills of secondary school level. Hence, the present study is identified and hopes that the findings of the study would help to understand and to develop science process skills amongst students of secondary level.

Objectives of the Study

1. To study the significant difference between Un-aided secondary school Girls and Boys with respect to Science process skill and its components (i.e., observing, comparing, classifying, measuring, experimenting and predicting).
2. To study the significant difference between Aided secondary school Girls and Boys with respect to Science process skill and its components (i.e., observing, comparing, classifying, measuring, experimenting and predicting).
3. To study the significant difference between Government secondary school Girls and Boys with respect to Science process skill and its components (i.e.,observing, comparing, classifying, measuring, experimenting and predicting).

Variables of the Study

In the present study the following variables were considered:

Independent Variable: Science Process Skills

Moderator Variable: Gender (Boys and Girls)

Method of Research

The present study is a type of survey research. IX standard classes of English medium with two divisions were considered for the study.

Hypotheses of the Study

In pursuance of above stated objectives the following hypotheses were formulated.

Hypothesis: There is no significant difference between Un-aided secondary school Girls and Boys with respect to Science process skill and its components (i.e., observing, comparing, classifying, measuring, experimenting and predicting).

Hypothesis: There is no significant difference between Aided secondary school Girls and Boys with respect to Science process skill and its components (i.e., observing, comparing, classifying, measuring, experimenting and predicting).

Hypothesis: There is no significant difference between Government secondary school Girls and Boys with respect to Science process skill and its components (i.e. observing, comparing, classifying, measuring, experimenting and predicting).

Research Tools Used

The following tool was used for collection of data.

1. Science Process Skill Test –Constructed and Developed by the Investigator by using of systematic procedure for the development of test.

Sample of the Study

The study consists of 150 samples of students of secondary schools selected from three types of schools (Government, Aided and Un-aided) by using stratified random sampling technique.

Limitations of the Study

The present study is limited to the following in view of time, practical feasibility of administration of the test and resource available with the investigator.

1. The science process skill consists of six components that are related to cognitive domain.
2. The test of science process skill consists of the multiple choice test items along with images related to the science process skill.
3. The sample of the study includes only English medium IX standard students of school around Gadag city.

Statistical Techniques

In the present study 't' test is used to know the difference between Science process skills and its components in Science of the secondary school students

Data Analyses and Interpretation

Table-1: Results of t-test between Un-aided Secondary School Girls and Boys with Respect to Science Process Skill and its Components

Variable	Groups	Mean	SD	SE	t-value	P-value	Signi.
Science process skill	Girls	49.57	5.75	0.74	2.5604	0.0117	<0.05, S
	Boys	46.77	6.22	0.80			
Observing	Girls	8.33	1.36	0.18	0.4067	0.6850	>0.05, NS
	Boys	8.23	1.33	0.17			
Comparing	Girls	7.95	1.06	0.14	0.7212	0.4722	>0.05, NS
	Boys	7.78	1.44	0.19			
Classifying	Girls	8.22	1.40	0.18	3.1468	0.0021	<0.05, S
	Boys	7.52	1.00	0.13			
Measuring	Girls	8.07	1.18	0.15	3.0517	0.0028	<0.05, S
	Boys	7.43	1.09	0.14			
Experimenting	Girls	8.18	1.41	0.18	1.8755	0.0632	>0.05, NS
	Boys	7.72	1.32	0.17			

Predicting	Girls	8.82	0.98	0.13	3.5441	0.0006	<0.05, S
	Boys	8.08	1.27	0.16			

From the above table we clearly indicated that,

- There is a significant difference between unaided secondary school girls and boys with respect to Science process skill (t=2.5604, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the Science process skill is significantly higher in Girls as compared to Boys of unaided secondary schools.
- There is no significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., observing of girls and boys(t=0.4067, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that, the component of Science processing skill i.e., observing of boys and girls is similar.
- There is no significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., comparing (t=0.7212, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that, component of Science processing skill i.e., comparing of boys and girlsis similar.
- There is a significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., classifying (t=3.1468, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science processing skill i.e., classifying of students is significantly higher in girls as compared to boys of unaided secondary school.
- There is a significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., measuring (t=3.0517, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, component of Science processing skill i.e., the measuring of students is significantly higher in girls as compared to boys of unaided secondary school.
- There is no significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., experimenting of students (t=1.8755, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that, component of Science processing skill i.e., the experimenting is similar in girls and boys and unaided secondary school.

- There is a significant difference between unaided secondary school girls and boys with respect to component of Science process skill i.e., predicting of students (t=3.0517, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science processing skill i.e., predicting of students is significantly higher in girls as compared to boys of unaided secondary school.

Table-2: Results of t-test between Aided Secondary School Girls and Boys with Respect to Science Process Skill and its Components

Variable	Groups	Mean	SD	SE	t-value	P-value	Signi.
Science process skill	Girls	50.60	5.59	1.12	2.8757	0.0061	<0.05, S
	Boys	45.77	5.91	1.26			
Classifying	Girls	8.40	1.26	0.25	2.3609	0.0226	<0.05, S
	Boys	7.64	0.90	0.19			
Measuring	Girls	8.20	1.12	0.22	2.9406	0.0052	<0.05, S
	Boys	7.27	1.03	0.22			
Experimenting	Girls	8.48	1.42	0.28	2.4874	0.0166	<0.05, S
	Boys	7.50	1.26	0.27			
Predicting	Girls	8.76	1.05	0.21	2.7209	0.0092	<0.05, S
	Boys	7.86	1.21	0.26			

From the above table we clearly indicated that,

- There is a significant difference between Aided secondary school Girls and Boys with respect to Science process skill of students (t=2.8757, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the Science process skill of girl students is significantly higher as compared to boys of aided secondary school.
- There is a significant difference between Aided secondary school Girls and Boys with respect to component of Science process skill i.e., classifying of students (t=2.3609, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill i.e., classifying of girlsstudents is significantly higher as compared to boys of aided secondary school.
- There is a significant difference between Aided secondary school Girls and Boys with respect to component of Science process skill i.e., measuring of students (t=2.9406, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill

i.e. observing measuring of girls students is significantly higher as compared to boys of aided secondary school.

- There is a significant difference between Aided secondary school Girls and Boys with respect to component of Science process skill i.e., experimenting of students (t=2.4874, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill i.e. observingexperimenting of girls students is significantly higher as compared to boys of aided secondary school.
- There is a significant difference between Aided secondary school Girls and Boys with respect to component of Science process skill i.e., predicting of students (t=2.7209, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill i.e., observing predicting of girls students is significantly higher as compared to boys of aided secondary school.

Table-3: Results of t-test between Government Secondary School Girls and Boys with Respect to Science Process Skill and its Components

Variable	Groups	Mean	SD	SE	t-value	P-value	Signi.
Science process skill	Girls	48.83	5.83	0.99	1.0347	0.3043	0.05, NS
	Boys	47.34	6.40	1.04			
Classifying	Girls	8.09	1.50	0.25	2.1123	0.0382	<0.05, S
	Boys	7.45	1.06	0.17			
Predicting	Girls	8.86	0.94	0.16	2.4167	0.0182	<0.05, S
	Boys	8.21	1.30	0.21			

From the above table we clearly indicated that,

- There is no significant difference between Government secondary school Girls and Boys with respect to Science process skill of students (t=1.0347, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that, the Science process skill of Government secondary school girls and boys is similar.
- There is a significant difference between Government secondary school Girls and Boys with respect to component of Science process skill i.e., classifying of students (t=2.1123, p<0.05) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill

i.e., classifying of girl students is significantly higher as compared to boys and Government secondary school.

- There is a significant difference between Government secondary school Girls and Boys with respect to component of Science process skill i.e., predicting of students ($t=2.4167$, $p<0.05$) at 0.05 level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted. It means that, the component of Science process skill i.e., predicting of girl students is significantly higher as compared to boys and Government secondary school.

Major Findings of the Study

Findings of the present study is as follows:

- The Science process skill is significantly higher in Girls as compared to Boys of unaided secondary schools.
- The component of Science processing skill i.e., observing of boys and girls is similar.
- The component of Science processing skill i.e., comparing of boys and girls is similar.
- The component of Science processing skill i.e., classifying of students is significantly higher in girls as compared to boys of unaided secondary school.
- The component of Science processing skill i.e., the measuring of students is significantly higher in girls as compared to boys of unaided secondary school.
- The component of Science processing skill i.e., the experimenting is similar in girls and boys and unaided secondary school.
- The component of Science processing skill i.e., predicting of students is significantly higher in girls and boys and unaided secondary school
- The Science process skill of girl students is significantly higher as compared to boys of aided secondary school.
- The component of Science process skill i.e., classifying of girls students is significantly higher as compared to boys of aided secondary school.
- The component of Science process skill i.e. observing measuring of girls students is significantly higher as compared to boys of aided secondary school.
- The component of Science process skill i.e. observingexperimenting of girls students is significantly higher as compared to boys of aided secondary school.
- The component of Science process skill i.e., observing predicting of girls students is significantly higher as compared to boys of aided secondary school.

- The Science process skill of Government secondary school girls and boys is similar.
- The component of Science process skill i.e., classifying of girl students is significantly higher as compared to boys and Government secondary school.
- The component of Science process skill i.e., predicting of girl students is significantly higher as compared to boys and Government secondary school.

Implications of the Study

The results of the present study have very significant value in the field of science education and potential value in furthering our understanding of learning behaviour in science. Hence, the present study has a number of implications, which if properly appreciated can go a long way in appraising the position relating to various components of the educational process in science education and provide the much needed basis for its vitalization and improvement. The implications are briefly discussed as follows:

- Science teachers should contribute to narrowing the gap between class room science and its application to daily life by emphasizing the contributions that laboratory activities could make in raising the learners' various intellectual and procedural skill that are likely to be useful in their future careers.
- Through constant motivation and encouragement during the teaching-learning activities in science the students can re-conceptualize their perceptions about science learning and they will be more involved in the activities.
- Innovative and creative instructional styles may aid in facilitating a fun filled and enjoyable science environment.
- Need for relating curriculum development efforts to basic assumptions underlying science teaching and learning has to be realized by curriculum developers in general and teachers in particular.
- The present study hints at a possible hierarchy of the processes from concrete science process skills of observing, comparing, classifying, measuring, experimenting and predicting. The development of proper skills under each of these science processes at proper sequence can give a proper frame work for the development of a stimulating and dynamic science curriculum.
- The level of expected achievement in terms of knowledge and intellectuals skills concerned to the cognitive domain is referred to as the standard here. The present study demands re-specifications of science process from the point of view of

- The development of proper skills:The first responsibility of the parents and teachers should be to know the areas where the students lackadjustment and try to give better conditions for proper adjustment in every sphere.

Conclusion

Processes of science are the basic steps for the development of useful skills, right kind of interests, attitudes and values and in making teaching –learning process more dynamic, stimulating and meaningful. Since High school level is a period in which students will start thinking about their subject preferences and their future career, this study is of much use to suggest ways and means to develop the critical thinking skills and interest in science among the high school students in respect of various science processes. Science process skills help in fostering their academic performance.

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