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Review article

Science activities promoting scientific temper in school students

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Keywords

Nutrition, Soil, Crops, Scientific Attitude, action research Rationality, Scientific-Method, Aversion to Superstition

Abstract

Different scientists, psychologists and researchers have explained scientific tempers and attitudesin a way that removes superstitions, false beliefs and wrong notions which are spread around society and help to cultivate habits of reasoning, observation, experimentation and problem solving. Scientific attitude will lay the foundations of science in young learners.The purpose of this article is to promote science activities for developing scientific temperaments in school students.This paper helps the academicians to choose not only the right activities in classroom teaching but will help the educational planners and the teachers to understand the importance of scientific temperamentamongst the students as well.

Introduction

In current scenario of era of science and technology scienceshould be an integral part of human lives. We can define scienceas: "Science in general is the cumulative and systematic investigation, limited to natural phenomena." Scientific progress is majorly characterized by the accumulation of facts andas well as by the development of scientific methods and scientific attitudes. According to the position paper published by NCERT through the National Focus Group in 2006 on science teaching, scientific concepts must be chosen to give meaning to everyday experiences and many concepts through activities/exercises using readily available materials.

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All educational documents must be obtained such as the NCERT-2006,NCF- 2005; Government of India, 1986; emphasizes the inculcation of different aspects of scientific attitudes in learners as the main objectives of science education in India.Study of various research works brought to light that Scientific temperaments as well as attitude was measurable and was important for national development. Scientific temperamentsimprove and expands the cognitive domains of students enabling them to think in depth.

Chalik, Turan & Cole (2013). The program should help teacher educators to acquire scientific knowledge and to think about it. Price and Lee (2013) Astronomy Citizen science projects promote positive change in the scientific attitudes and epistemological perspectives of the participant. Hyttinen, Toom and Shavelson (2019) Critical and scientific thinking are important 21st skills. Science assists in developing reasoning capabilities, logic, fact, imagination, attention, and hypothetical imaginations. Science believes in reality and does not accept anything without experimental proof. Only those students who choose science or mathematics are able to pursue a scientific career or pursue further scientific education. It is imperative that scientific attitude needs to be inculcated in their minds. The economic prosperity and growth depend on the highly educated, adaptable and well-trained workforce, therefore a negative attitude towards science subjects pose a threat to the same. It is therefore imperative that educators, teachers, parents and the society as such takes all measures to inculcate scientific temperaments in them. Biswal and Pandey (2021) in their research paper aiming to find out scientific temper in secondary students found that there is utmost need of scientific temperament in current scenario in 21stcentury among the youth.

Scientific Attitude/ Temper

The scientific attitude as it appears in the science education literature embodies the adoption of a particular approach to solving problems, to assessing ideas and information or to making decisions. Bindiya Rani (Rani, 2018) brought out that significant relation was not present between scientific attitude and their academic achievements in their school subject(science) among students. However, a similar study by Shivani Yadav (Shivani, 2012) to assess theoretical achievement with respect to scientific attitude found a positive correlation among it. Prejudices of the one making the judgment do not affect the outcome so, this approach evidence is collected and evaluated objectively. No assumption or information is rejected before it is fully evaluated and all available evidences are carefully weighed before making a decision. If the evidence seems to be insufficient then judgment is withheld until enough information is found so as to enable a decision to be made. Any idea, conclusion, judgment or decision is not accepted simply because a certain person asserts it, but it is viewed with scepticism and criticism until its correctness is assessed against the

evidence surrounding it cannot be made. A person who is willing to follow such a procedure and who regularly does so is said by science educators to be motivated by the scientific attitude. (Gauld, 1982). Ability to adapt a mental boldness behind the methods to acquiring reliable and hands-on information and facts is known as scientific temper.

Components of Scientific Attitude.

There are more than twenty components of scientific attitude, however based on various literature reviews and definitions, major components of scientific attitude can be identified as Rationality, Open Mindedness, Confidence in Scientific measures, Curiosity and Aversion to Superstition. Rationality measures the ability of students to reason and apply logic to solve problems and identification of cause-and-effect relationship. Open-mindedness deals with the ability to revise the existing opinions and conclusions with a desire to learn new things and ideas. Confidence in Scientific Method involves acceptance of observable, empirical and measurable evidence for the reasoning principles. Curiosity defines the desire for completeness of knowledge, understanding new situations, searching answers to why's and how's, and aversion to Superstition implies rejection of superstitious beliefs and acceptance of only scientific facts and explanations.

Reviews of related literature

The main aim to write the article is to promote scientific activities in development in school students. Inferences of the related literatures studied are mentioned for last one decade have been considered to support the aim of the paper.

Arun Vishnu (Vishnu, 2021) in his review paper on scientific attitude, Subhashish Kundu (Kundu, 2018) in his study on students in West Bengal, Dr Chakradhara Singh (Chakradhara, 2017) in his study on students in Tripura, Revati, Dr KP Meera (Revati N, 2017) in their study in Keralahighlight thatscientific attitude of an average level exists amongst the students of secondary level schools with no significant difference between boys and girls since science was one of their subjects in syllabi.

Meanwhile Nisha K (Nisha, 2022) in her survey to assess the level of scientific attitude among school students showed that there was a high level of scientific attitude among them developed due to learning of science in school days. On the contrary, studies by Y Varaprasada Reddy, Dr P Harinath (Varaprasada Reddy, 2014) and Dr. G. Kalaiarasan (Dr.G.Kalairasan) showed that there

was a significant difference between boys and girls.Ramesh C Patel (Patel, n.d.) in his study concluded that the mean scientific attitude of girls was more than that of boys.

Revati N and Dr KP Meera (Revati N, 2017), brought out that there was no significant difference in scientific attitude based on type of management or locality. The finding wassimilar to G. Kalaiarasan (Dr.G.Kalairasan) , Varaprasada Reddy and Dr. P Harinath (Y Varaprasada Reddy, 2014) but not in sync as the later mentioned that management had significant influence on the scientific attitude.

Ramesh C Patel (Patel, n.d.) in his study highlighted that and mean scientific attitude of urban students was more than that of rural students which is similar to Gayatri C Choukade (Choukade, 2014) based on her study on Marathi medium students in Maharashtra.

Mohd Abid Siddiqui & Moheeta Khan (Moheeta, 2018) in a study aimed at finding the impact of Scientific Attitude and Teaching Effectiveness on Physics Achievement of students found that effective teaching is related to student's physics achievement and development of scientific attitude however scientific attitude is weakly associated with physics achievement.

A Studies by Ramesh C Patel (Patel, n.d.) and Bettaswamy H B & Sharath Kumar (R, 2022) showed that there was a significant relationship between scientific attitude and achievements in science activities of students. However, a similar study by Shivani Yadav (Shivani, 2012) brought out that significant relation was present between scientific attitude and their academic achievements among students. This verdict is in synchronised with the findings of Jyoti Victoria (Victoria, 2022), Ksheerasagar & Kavyakishore (Ksheersagar, 2013); Narmadha & Chamundeswari (Narmadha, 2013).

The stream of study also plays a significant role in determining the developed attitude of higher secondary students towards science. It has been observed that science students have more favourable attitude towards sciencethan non-science students. Swati Gupta (Swati, 2015) in her research paper based on this brought out that there is a significant difference between the attitudes with reference to stream of study. The mean scores of secondary school students of science streams were higher indicating that sciencestudents of higher secondary level possess higher attitude towards science than their counterparts of non-science streams. Very few studies pertaining to students of upper primary were available however in a study of the relationship between attitude towards science and academic achievementof Upper Primary School Students by

Mohammad Faaz & Zebun Nisa Khan (Faaz, 2017) a significant positive correlation was found between attitude towards science and academic achievements. No significant difference was found between academic achievement of male and female students.

Science Activities Designing Which Help in Promoting Scientific Temper

1: Crop Production and Management

Activity 1- Soil Test

Sita's uncle who is very fond of kitchen

gardening is sad because he had continuously added manure and irrigated his kitchen garden properly. Still the plants are not very healthy and strong. Chinky guided her uncle as to what he should do.

Can you guess what was the advice Sita's gave to her uncle?

Which figure is best representing the situation Fig-1/2/3. ….

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Activity 2- Nutrition in Plants

As the rose plant was not providing any flowers,Jaya's mother had pruned all the branches of the rose plant with not even a single leaf. She thought that the plant would dry up as there would be no photosynthesis. However, after a few days Jaya saw new leaves sprouting.

Can you help Jaya to understand how the plant survived.

Which figure is best representing the situation Fig-1/2/3. -------

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Activity 3- Shadow

Priya observed a dark patch following her whenever she moves under the sun. In the Science class her science teacher had explained to all students how shadows are formed. However, she is puzzled as to why the shadow is always black/ grey in colour. Can you explain it to her**?**

Which figure is best representing the situation Fig-1/2/3….

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[Figures related to above mentioned activities to choose the right answers]

Figure 1

Figure 2

Figure 3

(Pictures-curtsy - https://images.app.goo.gl/3beqbyXFW1GTYp5K7, https://link.springer.com/article/10.1007/s00468-020-01977-w, https://encrypted-tbn3.gstatic.com/images?q=tbn: ANd9GcRfWOO2PwIyVCdhzJot-qMQIfhPgiPS2e9cUwLuIDQvAqBKJex3,

These above types of many more activities improve scientific temperament in a way of life that involves using the scientific method and questioning, observing, testing, theorizing, analysing, and communicating demands for the scientific method and the scientific methods. Involving scientific teaching aids, laboratory, library facilities, participation in learning activities make the students curious and creative.

Check your progress

Activity 1- Soil Test

- This leads to salt toxicity. Too much of any nutrient can affect the uptake of other nutrients by plants resulting in deficiencies.
- To correct this problem her uncle must get a soil test done.

- Soil test helps to assess the pH, alkalinity and salt concentration in the soil. Fruits and vegetables require a pH of 6.0 – 7.0
- The problem seems to be excess composted manure. Compost manure is higher in phosphorous and Calcium.

Figure is best representing the situation Fig-1/2/3. Ans-Fig-1.

Activity 2- Nutrition in Plants

Leaves prepare food and store it in the stem and roots. The rose plant survived on the food stored in plant stem and root till the leaves started sprouting. It happens with all the plants.

Figure is best representing the situation Fig-1/2/3. Ans-Fig-2

Activity 3 - Shadow

A shadow is formed when a light from a light source is obstructed by some object. The object absorbs all light from the light emitting

source. As a result, a shadow is produced which is black in colour.

Figure is best representing the situation Fig-1/2/3. Ans-Fig-3.

Example of other suggested activities which can be recommended in the classrooms

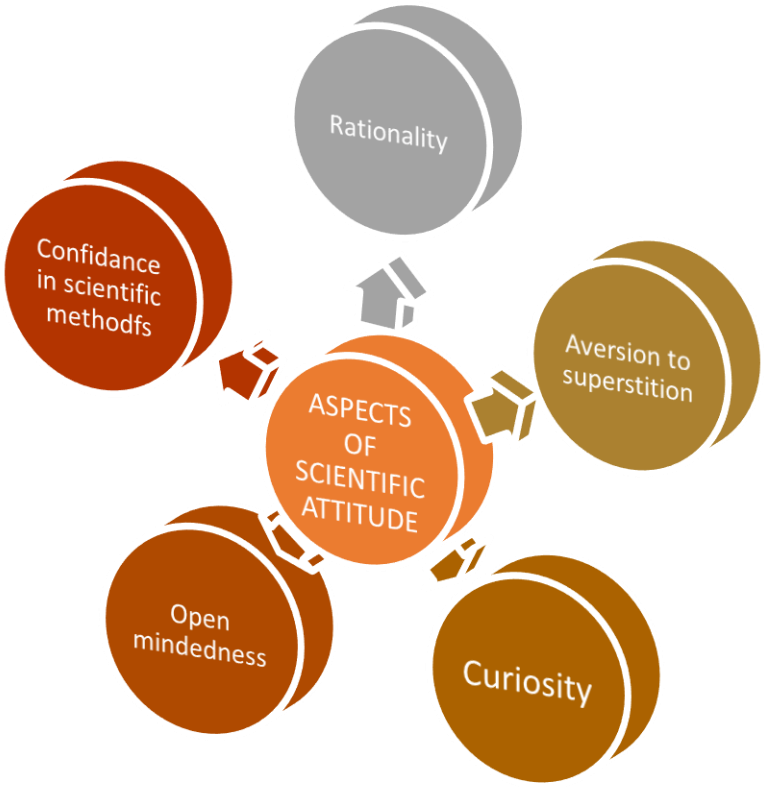
1. Why wearing many layers of cotton clothes keeps us warmer in winters than one thick sweater? Describe it by bringing original samples of cloths which have 1-3 layers. Explain them the concept of insulation formation in layers with hand-on / pictorial experiences.
2. Meghana was asked by her teacher to make two mixtures of chalk and salt in water separately. Now his teacher asked him if he could separate the sugar and chalk from the solution. Meghana is worried and concern. Can you help him to find the chalk or sugar? Is that possible to separate them.
3. After reading the Principle of Reflection in the Chapter of Light and the Chapter of Sound, Emmye thought of an alternative to the scare crow. She was happy that this idea would not harm the environment or the birds. 1. Can you guess what materials could be used to satisfy the "better than waste" principle? 2. Do you want to make it for your balcony and garden?

Plan of action

Action research for obtaining the findings on science activities promoting scientific temper in School Students is to be conducted by the teachers in classroom of primary to secondary classes.Activities can be designed from their science subject from class five to tenth books.Pick the

class sixth activity for class eighth students. This will enhance the interest of students initially for developing their scientific temperament. It is suggested that a class of thirtystudents can be divided in three groups of ten students which helps for better observations and measurement of efforts applied to develop the scientific attitudes. It should be hand on experience or action-oriented sessions for students. Teachers can design their own short and rapid science activities or small events, minimum 3-5 as per their time duration of class to conduct them in regular time table. It also suggested that teacher can declare from their own side the whole week or so like in name called‘learn logics’ during their regular classes for students well in advance. Prior information works effectively on outcomes.Activitiesconduction is important continuously for 7 to 12 days in regular class rooms. This strategy ininteresting manner and correct way can develop Rationality, Open-mindedness, Confidence in Scientific Methods, Curiosity and Aversion to Superstition. Innovative techniques on science workbooks may be chosen for making classes activity based. On the basis of these session cognitive, affective and psychomotor domain become active and enhance learning takes place as per the learning theories. More sessions of these activities’programs, use of audio visual/ smart teaching etc. are able to develop scientific attitude.

Picture-1 Aspects of scientific attitude



Conclusion-

activity-based classes enhance the capacity of learning in students so biology, chemistry, physics and science teachers to plan their lessons on these activities. Most of the research work

concentrated on higher secondary students. Hence there is a need to carry out further works on scientific attitude of students of different educational levels, viz., primary to college levels. There are a large number of variables associated with development of scientific attitude. However, correlation between genders, medium of teaching, type of school management and their location seemed to be the most preferred ones amongst the researchers. Effect of other variables like medium of instruction, qualification of parents, parent's occupation, teacher's qualification, availability of educational infrastructure in schools/ home, etc. may be explored.

Conflicts of interest statement-

We the authors of this paper do not have any conflict of interest to disclose.

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