

Imbibing Values through Science Education

Abstract

The purpose of education is to nurture and guide the child for life. The author here is focusing on creating learning experiences for integrating cognitive- affective pedagogy in the classroom for the holistic development of the child. This paper emphasizes the need for an integrated approach of inculcating skills and values through concept analogues, classroom activities and experiments. This will help the teacher and the teacher educators in relating the content areas/ activities with the skills and values and implementing the same during the teaching learning process in the classroom. Value inculcation through Science teaching will help the learner to think independently, to reflect and to critically evaluate their own thoughts which in turn will reflect in their behaviour. Moreover, this will enable students to achieve both academic and human excellence to create a vision for a sustainable global society.

Keywords: Science education, Cognitive, Socio-emotional

Introduction

Education is not about just passing examination and taking a degree and getting a job. It has to have a holistic perspective to emphasize not only on the cognitive domains but also the affective and psychomotor domains. Jiddu Krishnamurti envisioned that education should emphasize the integral cultivation of the mind and the heart, not mere academic intelligence. *Surely a school is a place where one learns about the totality, the wholeness of life. Academic excellence is absolutely necessary, but a school includes much more than that. It is a place where both the teacher and the taught explore not only the outer world, the world of knowledge, but also their own thinking, their behaviour.* Children starting school today will enter careers that do not yet exist, will use technology that hasn't been invented yet. Therefore, the purpose of schools is to prepare children for their life. The role of a teacher is not only to impart knowledge on facts and concepts

of various subjects but also to educate the totality of mind that cultivates your behavior and the whole being.

The concern for value education has been reflected in policy right from 1952-53. In the National Commission of Secondary Education, Mudaliar Commission, focused on character building and personality development of students. The National Policy on Education (1986) emphasized education as a forceful tool for inculcating values at all stages of school education.

The National Curriculum Framework (NCF 2005) echoed the vision of education for peace as a global concern in cultivating values through school education. Values are inbuilt and hidden in the curriculum and cannot be taught in isolation and therefore their development in children cannot be incorporated as a separate subject. It has to be integrated within the subjects during the teaching learning process. Every teacher needs proper planning for integrating values relevant to the content or the activities

performed in the class and needs to make a conscious attempt for an effective integration in the classroom at all stages of education. As per NCF 2005, the Science curriculum is to be validated at cognitive, content, process, historical, environmental and ethical levels, of which ethical validity has to be also emphasized and implemented effectively. Ethical validity requires that the curriculum promote the values of honesty, objectivity, cooperation, freedom from fear and prejudice and develops in the learner a concern for life and preservation of environment. Moreover, imbibing the same must be one of the main aims of science education. The science process skills form the foundation for scientific methods viz; Observation, Communication, Classification, Measurement, Inference, Prediction. The learning Outcome document developed by NCERT in 2017 also talks about holistic development by giving importance to all the three, cognitive, psychomotor and affective domains of education.

Science being a dynamic expanding body of knowledge offers many opportunities for value inculcation; moral, social, intellectual and personal values. In fact, it can provide new insights into human behaviour. This paper is focusing on certain content areas in Science, both at upper primary and secondary level, where selected scientific terms/ concepts were attempted to be correlated with specific values that share meaningful similarity and thereby attempt made to draw an analogy between them. This

paper also emphasises how science process skills are related to different values through an analysis of tasks of performing activities/ experiments at upper primary and secondary level in the classroom. We feel that this will help the teachers in understanding the importance of value inculcation and how to integrate them effectively.

Value Development through Concept Analogues

An analogy is a process of identifying similarities between two concepts. The familiar concept is called the analog and the unfamiliar one the target. Both the analog and the target have features (also called attributes). A concept analogue is a comparison of two ideas which share similar features. Their sharing of similar features can play an important role in value inculcation and will help the students to relate scientific terms with values. This not only fosters the learning process, but also creates an awareness of the importance of values in life and helps in imbibing the same. This can be implemented in the classroom during the teaching learning process; the teacher being the facilitator, can explain the concept and relate it with relevant values simultaneously. Thereby the students will be able to elaborate their thoughts through the cognitive process and construct a relationship between them and assimilate it. Some of the selected concepts at secondary level and the related values are listed in **table 1.1**.

Table 1.1: Concepts and the related values

S. No.	Concepts (Analogue)	Values (target)
1	Solar System; Different phases of the moon; Circulation of blood	Discipline, systematic, regularity and punctuality
2	Circulatory system; Excretory system	Blood/ organ donation, empathy, concern for others
4	Periodic Table	Co-existing, social adjustment
5	Bee keeping	Sharing, division of labour, cooperation and leadership
7	Filtration	We get pure water by filtration, removal of negative thoughts, purity of mind leads to healthy living.
8	Conservation	Conservation of natural resources

S. No.	Concepts (Analogue)	Values (target)
9	Radiation	Spreading positive energy and own potentialities all around which in turn can inspire and help others
10	Intercropping	Living together, socialization, collaborative work.
11	Nucleus of a cell	Nucleus of a cell is acting as a leader, controls and regulates the system
12	Diversity in living organisms	Concern and appreciation for other forms of life, interdependency
13	Natural resources	Environmental sensitivity, protecting and conserving the environment
14	State of matter, covalent bonding	Coordination, sharing
15	Symbiosis	Mutual regard, concern, sharing

Teaching learning of Science gives several opportunities for classroom activities like individual/ group presentations, discussions, use of teaching learning materials, experimental demonstrations and other curricular and co-curricular activities. These activities play an important role not only in developing Science process skills but also inculcate different values among the students. All this has to be pre planned and purposefully incorporated in the lesson of the relevant content areas so that the class is more interactive and participatory. Effective implementation of group activities and practicing self-reflections can develop many personal qualities and creates opportunity for imbibing values (**Fig. 1**).

Group activities: discussions, presentations, experimental activities, etc.

- Awareness
- Sharing views
- Tolerance
- Self Confidence

Reflections: Self assessment of the classroom activities, based on rubrics

- Space for thinking back on their own experiences
- Self improvement
- Change in ones attitude
- More productive

Fig 1: Values associated with group activities

Incorporating Skills and Values through Experiments

Experimental learning in Science can also be an effective platform to implement integrated cognitive-affective pedagogy in the classroom. Science process skills viz. *Observation, communication, classification, measurement and inference* can be related with the different values during the teaching learning process.

Example I: Acids, bases and salts

An example to integrate skills and values during classroom transactions can be through the concept of acids, bases and salts from NCERT Class VII Science text book. We will discuss how it may be done here. The key idea is that the adopted strategy must enable the teacher to create a learning situation in the classroom where the student incorporates the process skills and values associated with it, while performing the activity.

Classroom Transaction

Think of different substances like lemon, tamarind, salt, sugar, vinegar, which we use in our day to day life.

- Make a list of the items with their corresponding taste.
- Share the items noted and the experience of taste for all the students and analyses with the whole class.

Students try to explore why the tastes are different and what makes them different in nature. Teacher explains that the substances that are sour in taste contain acids and those that are bitter and feel soapy on touching contain bases.

To find out whether a substance is like an acid or base, without tasting let us perform an activity. The students are divided into two groups and each provided with two different items for testing (lemon juice/ detergent or soap solution)

Activity 1: To test / identify the given solution as acid/ base.

Materials Required: Lemon juice, detergent solution, water, plastic cup/ tumbler/ test tube, red and blue litmus paper, dropper.

- Mix some water with lemon juice/ detergent or soap solution in a test tube.
- Put a drop of the above solution on a strip of the red litmus and blue litmus paper with the help of a dropper.
- Is there any change in colour?

The teacher may facilitate the students in testing other items like vinegar, tamarind, curd, grape juice, lime water, ant sting, window cleaner, soap, etc; as an extended activity and classify them as an acid or a base in a table. The teacher may now initiate a discussion in the classroom on the difference in the colour observed and also on the intensity of colour change.

S. No.	Test Solution	Effect on Red litmus paper	Effect on Blue litmus paper	Inference
1.	Lemon juice	Remains red	Turns red	Acid
2.	Soap solution	Turns blue	Remains blue	Base
3.

Skills: Observation, communication, classification, inference.

Values: *Patience, concern, respect, empathy, integrity, self confidence.*

Skill and Value Integration

Observation of colour change while testing different items during the activity is one of the Science process skills. Skill of observation requires one or more senses and needs patience and the habit of waiting. This practice of making students wait for different kinds of observation is the best practice to develop the value of patience. Patience being an important life skill (emotional skill) helps the students in managing stress, emotions and resisting peer pressure. The concept of patience is the ability to endure different circumstances, and as a value it reflects the state of one's body and mind.

Discussions based on the observations made by the students will create a situation that would aid the development of the skill of communication. By expressing their

ideas, listening and responding to others, accepting feedback, etc. students would understand how to hold discussions. Moreover, the teacher himself/ herself can set an example as an effective communicator not only through speaking and writing, but also by exhibiting qualities like friendliness, respect, confidence, empathy, etc; and also being an active listener. Thereby students will be able to imbibe the value of caring and respect through discussions and group work. Respectful listening will not only make them understand the words, but also to understand the emotions behind. Hence the skill of communication plays an important role in developing values like respect, concern and empathy, important moral aspects of character.

Classification is done by the students based on the observations and the discussions in the classroom. The colour changes obtained on the litmus paper while testing different items will help the students in reasoning, sorting and classifying the solutions into the two groups, acids and bases. Classification

is done based on certain reasons which students really see and feel by which they trust and believe in the scientific concept or fact. Hence grouping, sorting, classifying materials based on evident scientific reasons develop the value of trust, honesty and integrity, an important moral character.

Inference, drawing conclusions is based on the learning experience gained by the students by which students accept the ideas and make logical connections. Students thereby go through the process of establishing something in exact, the quality of being determined, which in turn develops the value of self confidence and self determination, an important performance character.

Example II: Meristematic tissues

An investigatory activity for transacting the concept of meristem from NCERT Class IX Science text book has been discussed here with an integrative approach of cognitive-affective pedagogy.

Classroom Transaction

Teacher asks the students about vegetative propagation and discusses various examples

like potato, carrot, onion, etc; with the questions how do they grow? Which type of cells/ tissues in the plant grows in the same way? Teacher divides the class into six groups and asks each group to bring a few onion bulbs and perform the activity by involving them.

Activity 2: To study the role of root meristem.

Materials Required: onion bulb, turmeric powder, two beakers/ glass jars, water, glass tumbler.

- Take three glass jars, 1, 2 & 3 and fill them with water till the rim.
- Add a pinch of turmeric powder (1gm) in jar 3
- Place one onion bulb in each jar, with the root portion slightly touching the water
- Observe and measure the length of the roots of the bulbs for a few days.
- On day five, cut the root tips of the onion in the second jar by 1 cm. Now observe the root growth in both the jars for the next two days.

Ask the students to observe the growth in length in all the three jars for about a week, record and tabulate the same (Fig. 2, a, b, c)



a



b



c

Fig 2: Onion Root tips; a, control in water, b (day 4) & c (day 9), control and experimental group

Table: 1.2

S. No.	COGNITIVE DOMAIN (questions for discussion)	AFFECTIVE DOMAIN	
		SKILLS	VALUES (performance and moral characters)
1	What is the rate of growth of the root tips in the different jars?	Observation	Patience
2	Speaking about and discussing the difference between observation in jar 1, 2 & 3? What was observed when the bulbs were grown in turmeric solution? Discussion on the factors necessary for root growth.	Communication	Concern, Respect, Empathy
3	Measure and tabulate the root growth in the control and the experimental group.	Measurement	Integrity
4	Compare the growth of root tips in the control and the experimental group. What will happen if the water is not changed daily?	Classification	Justice
6	What are the conditions to be provided/ needed for the experimental set up and why? What can you conclude from the experiment as per the observations done? Discuss the effectiveness and application of the activity.	Inference	Work ethics, Self responsibility, Self confidence
8	What is the reason behind the depression of root growth in the turmeric solution? How does the root respond to other solutions?	Prediction	Creativity

The teacher here has upgraded the activity to higher cognitive levels to create inquisitiveness and interest among the students by asking them to find the difference in growth of the roots when the onion bulbs are kept in water (control group) and in turmeric solution (experimental group) and measure the length of the root for a week and record the observations by measuring the length of the roots Fig. 2 b. The above is not only a low cost activity which can be performed in the classroom by the students, but also has significant inferences. The experiment reveals that turmeric inhibits/ depresses cell division in onion root meristem cell. In addition, it can implicate anti-cancer activity by reducing the percentage of cell division. We can say this because growth is slower. Through other experiments we see in the solutions of turmeric the presence of a phenolic compound, curcumin. The above experiment is an example to demonstrate the integration of cognitive-affective pedagogy in the classroom for skills and values. A routine and regular practice of the same

in the classroom can bring out remarkable changes in the mindset of children through the inculcation of skills and values.

Conclusion

Values and skills can be inculcated through concept analogues, experimental learning and other activities through Science Education during the teaching learning process. This approach will help the teachers in maintaining discipline in the classroom as rather than imposition it is the concept of self-discipline among the children that will be developed. This approach of cognitive-affective integrative pedagogy and a planned regular practice of the same will strengthen the student teacher relationship. This is necessary to build up a stress free learning atmosphere in the classroom. Hence, there is a strong relationship between scientific process skills, individual values and beliefs and personal development. The skills, values and beliefs we embrace affect our behavior

and, furthermore, the way we act impacts on our personal development and socio-economic performance of the society we live in.

Therefore, there is a strong need for an integrated approach of inculcating values and skills in the classroom by the teachers and teacher educators. This will help the

learner to think independently, to reflect on and to critically evaluate their own thoughts. Through classroom activities the students will gain experiences to internalize the values which will in turn reflect in their behaviour and actions. Moreover, this will facilitate the students to achieve both academic and human excellence to create a vision for a sustainable global society.

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