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A Conceptual Framework For Science Teaching

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ABSTRACT-

Science teaching is an indispensible subject to our life. Its contributions for this Earth are countless. It helps in building a logical mindset as well as invents and discovers the new facts. If science follows by all in everyday life, the superstitions and conventional thought will disappear. Therefore, it is a great responsibility of a teacher to provide qualitative science teaching. For this, a teacher must have knowledge on its approaches, process, techniques, methodology and many other aspects. Realizing its importance, the researcher here made a little effort to throw light on framework of science teaching. This article would elaborate the different aspects related to science teaching. Along with this, a framework will also be suggested.

Key words- Science, Framework, Qualitative, Process.

INTRODUCTION

Science is a core subject of general education in India. **Lederman defines** the nature of science as "the values and assumption inherent to science". Science teaching aims at producing scientific attitude in students and encourages them to choose a science-based career. For the development of a nation, there is an urgent need to encourage the students to move towards scientific careers.

In teaching-learning system, the existence of a curriculum and its framework is a necessity. The inclusion of science in the school curriculum was the same as those for the inclusion of other subjects but it had given a core place in the curriculum because of some special values provided by science. All the school subjects have taught to provide a liberal education to its pupils so that they might play their part in society as intellectual citizens.

The inclusion of any subject in the school curriculum based on certain philosophical and psychological footings of educational thinkers and curriculum framers. Moreover, the curriculum satisfied the intellectual, utilitarian, vocational, cultural, moral and aesthetic values. Aside from these values, the teaching of science had been imparting training in 'scientific method' and 'scientific attitude' that were much transferable to other situations in life.

Two decades ago, research by **Gilbert, Osborne and Fensham** (1982) showed that children are not passive learners and the way they make sense of their experiences led to

this intuitive knowledge being called 'children's science' (p. 623). During the last few decades, the conceptual framework of physics has undergone a drastic change and this should reflect in the high school curriculum. Similarly, in chemistry, the stress has given on memorization of facts, formulae, processes, and compounds should give place to an emphasis on the unifying concept in the subjects. It is necessary to highlight the application of chemistry in industry and daily life and its growing importance in our developing economy. Again, the present content of the school course in biology is traditional. Earth sciences should introduce in the secondary school, geology and geography should teach as an integrated subject. There are also many areas in chemistry, physics, and biology where certain topics can naturally relate.

SUGGESTIONS ON CONCEPTUAL FRAMEWORK FOR SCIENCE TEACHING

The education system mostly set around with three main aspects, these are input, process, and output. Input refers to syllabus, curriculum, textbooks, and content. Process refers to techniques, methodology, and strategies. Output refers to the learning outcome and behavioral changes of the learners. All these three aspects are highly significant and correlated with each other. But in India, only input and output aspects are considered important. The process aspect is being ignored during curriculum planning. A notion still exists in our country is that those who want to learn, they can learn at any condition. This type of notion does not apply to all types of learners. There are individual differences and no one can deny this fact. Moreover, the same technique is not fruitful for all subjects. There are few subjects like science, mathematics, etc. that need special techniques and methods of teaching. The style of teaching in these subjects is completely different from other literature or humanities subjects like social studies, English, Hindi, etc. Therefore, the process aspect is of utmost importance to apply the innovative techniques and strategies in science.

1. The first and foremost aspect which may change the scenario of science teaching is approaches of science teaching. In the field of teaching, many approaches have been developed and applied in classroom such as the Herbartian approach or five steps approach, Gloverian approach, the evaluation approach, Morrison approach, project approach, 5 E's approach, and RCEM (Regional College of Education Mysore)approach. Among these approaches, 5 E's approach is considered important for science teaching. However, in school education, the teachers follow hardly any approach. It was revealed that most of the teachers used the Herbartian approach, which is not suitable for all subjects. For Science, Geography, and Mathematics, the subject teachers need to use 5 E's approach. The 5 E's approach includes the 5 E's which means engage, explore, explain, elaborate, and evaluate. The concept can better understand by the following diagram
2.

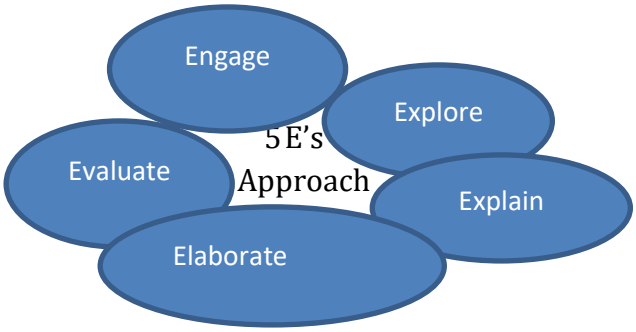

Figure 1– Process of 5 E's Approach

This approach is based on the constructivism theory where the emphasis is laid on the construction of new ideas on the top of older ideas. In this approach, students need to be active and they must be engaged in classroom learning so that they can explore new ideas. Moreover, they have to explain and elaborate on the new ideas and information in front of the teachers. Accordingly, teachers evaluate their performance. Therefore, in this whole process, task of the teacher is to engage the learners, show them the right path, encourage them for their right move, and inspire them for achieving the target. In short, for science teaching, the science teachers should follow 5 E's approach rather than the Herbartian approach.

3. Another important aspect which can change the mind-set of the learners towards science is the style of teaching. There are few designs or style of teaching which are mostly applied in classroom teaching. These are forward design, central design, and backward design. The forward design gives importance to the input aspect, the central design gives importance to the process aspect and backward design gives importance to the output aspect. Among these designs, the central design is quite useful for science teaching as it derives the input and output aspect from classroom methodologies.
4.

Figure 2.- Central Design

5. The model of teaching is a plan or a pattern that is used while framing the curriculum and developing other instructional\ teaching-learning materials. It

guides the planers to plan the curriculum or the course. This is the blueprint for a teacher to implement his \ her plan effectively in the class and to evaluate the strengths and weaknesses of the learners. In teaching, different types of models have used such as the information processing model, behavioral model, personal model, and social model. Under the information processing model Gagne's information processing model, the expository teaching model, and inquiry teaching model are considered important. Likewise, the behavioral model has also categorized into three categories, these are direct instruction model, mastery learning, and programmed instruction model. The personal model has also divided as non- directive teaching model, developing positive self- concepts and project model. Alike, the social model has also categorized as a model of group teaching and cooperative learning as well as a simulation model.

Among these models, the important and useful model for science education is the scientific inquiry teaching model. This model is used to study principles, phenomena, and characteristics of scientific knowledge. This model first analyses the problems deeply, collect the relevant and valid information from different sources, determine hypothesise, and finally testing hypothesise by using different techniques and evaluate the result. Its whole process has described as below-

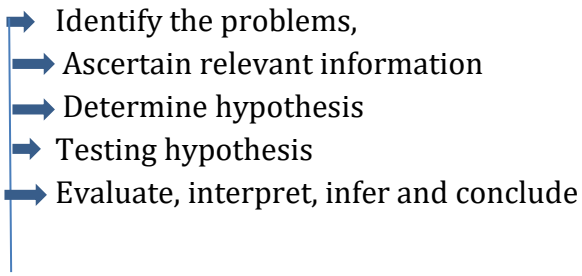

Figure 3- Scientific Inquiry Teaching Model

6. Another important aspect that needs to study well is the instructional objective. Instructional objective deals with the learning behavior of the learners. It aims at ensuring whether students learn the content or not and to what extent, that content effects their behavior. It is known as learning objectives or behavioral objectives as its main concern is to observe the behavioral changes of the learners. For this, instructional objectives need to be well developed so that these will provide a specific idea about the content. Many factors may influence while writing instructional objectives like the needs of the learners, demand of the society, and nature of the subject matter.

While writing instructional objectives, the three main domains have given consideration and accordingly, the objectives have written, these domains are- cognitive, affective, and psychomotor. Cognitive domain deals with cognition, affective domain deals with emotion, and the psychomotor domain

deals with action. All these domains are related to the behavioral aspect. Therefore, these domains should get importance while framing the curriculum or writing instructional objectives. The following aspect should give importance while framing instructional objectives for science teaching-

Cognitive domain- In this domain**,** the scientific terminology, trends and sequences of the content, natural phenomena, different theories and structure of science, generalization of facts and principles of science, correlation and interdependence of different branches of science etc. should be prioritized.

Affective domain – In this domain, the curriculum framer should frame objective in such way so that it gives opportunity to the learners to ready towards science teaching, perceive content, and active participate in classroom learning.

Psychomotor domain- This domain should be directed in such way so that students can observe the laws and facts of science. Moreover, the objectives of each content should promote scientific attitude, inductive and deductive thinking in students. For this the curriculum framers should design the content materials in such manner so that all domains get into its area.

7. **Pupil –Teacher Ratio (PTR)** – The pupil-teacher ratio is the average number of pupils per teacher at a specific level of education in a given school year. The effectiveness of teaching is largely depending upon the size of the class. The adverse pupil teacher ratio has hampered the quality education in the state. An overcrowded class always creates chaos and it cannot provide good feedback to the teachers. The Right to Education Act revealed that nearly 70 per cent schools of Assam do not have satisfactory pupil-teacher ratio. The Right to Education Act suggested that the ratio should be 30:1 for lower primary and 35:1 for upper primary. Likewise, Rashtriya Madhyamik Shiksha Abhiyan suggested that the pupil- teacher ratio for high school should be 30:1. The RMSA report 2018 revealed that the pupil teacher ratio of government\ provincialized high school was 34.11: 1 and private school was 20.91:1.

8. **Syllabus –**
   Another important aspect which is responsible for the slow progress of students in science is the syllabus. The out dated and overloaded syllabus always creates boredom in learners. Therefore, the curriculum constructor should consider the following aspects while developing the syllabus for the subject science-
   - The syllabus should be activity-based. There should provision for learners to get engage in the content through activity.

- There should be provision for negotiating the content with learners. This will help the teachers to look into the interest and needs of the learners.
- Science teachers should evolve with the learners during course. The two way communication always stimulates active learning. The more conversation, discussion, and engagement of the teachers and students will give both concrete and abstract ideas on the content.
- Reflecting the process of learning while deciding the syllabus. Every subject has a different process and it should keep in mind while developing a syllabus.

The above aspects can be presented through the following diagram-

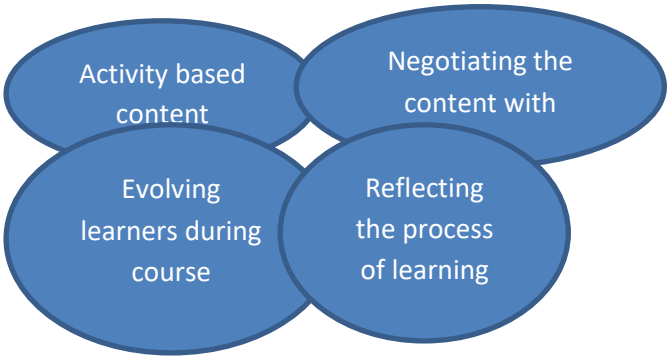

Figure 5- Design of syllabus

The syllabus will more beneficial if the sequence of the syllabus may be arranged based on the difficulty level of the learners. The syllabus should be prepared in such a way so that students with different intelligent quotient (I.Q.) to be included.

9. Methodology

The success of teaching depends on the styles, techniques, and strategies that a teacher has used during his\ her class. The best approach will provide the best feedback to the teacher. Each subject has different methods that need to be used in class. If a teacher is unaware of this, it will ruin the classroom atmosphere. Therefore, a teacher before entering must decide which method he \ she will use to teach the learners. On the other hand, if the desired outcome will not produce, the teacher then changes his \ her style or method of teaching. The important methods which a science teacher should adopt in a science class are given below-

- Learner-centred methods should adopt in science class. The learner-centred methods are demonstration method, discussion method, brainstorming technique, etc.
- The focus should give on the active engagement of the students in interaction and communication. In this regard, the teachers should

adopt strategies so that they can motivate the learners to take an active part in classroom learning.

- Content related activities should conduct in the class that involves negotiating content.

10. **Skills** –

In a class, knowledge over the subject is not enough for a teacher to control the learners. He\ she must be aware of the use of skills. Skills are those forces which will make a class effective. Therefore, science teachers should use the following skill and develop those skills among learners while imparting science to them-

Experimental Skill

- Impart the learners to handle the apparatus and instruments during the experiment.
- Arranging apparatus for an experiment
- Preserving chemicals, specimens, apparatus, etc. for an experiment.

Construction Skill

- Encouraging the learners to make hand-made apparatus. This will develop their construction and creative skill.
- Repairing of certain instruments will give them an idea about their different parts, their connections, and their utility in daily life.

Drawing Skill

- The teacher while explaining should draw the biological specimens on the blackboard\ whiteboard. This task should also give to the pupils so that their drawing skills will enhance.
- Encourage the pupils to draw the sketches of a certain experiment. This will develop more interest among learners towards science and they may be inclined to take science as a career.

Observation skill

- Observing the activities of the learners like patiently listening to the teacher, note down the important points, clearing the doubts by asking questions to their teachers, etc.
- Observing the interaction process of the class. There are different types of interactions that can see in the class. These are- pupils –pupil interaction, pupil-teacher interaction, and pupil- whole class interaction, and teacher-pupil group interaction.

Critical thinking skill

- Asking questions to the learners to develop their critical thinking.
- Provide home assignments and projects on the science-based topic.
- Reflect and think about the project that the teachers asked the students to do. Interpret the findings of the project and its relevance to a real-life situation.
- Identify and recognize how science can be used in a real-life situation context.
- Enabling learners to make a connection between science and the real world. This way the students can transfer this skill to new contexts.

11. **Assessment –** Assessment is a process where the level of performance of the learners is identified. In this regard, a school can use different assessments to assess classroom learning. The objective of the assessment is to get feedback from the students by conducting tests, quiz, or discussion. This is the easiest process for a teacher to know his\ her level of teaching and at the same time record the classroom performance of the students. Hence, the teacher should assess the pupils' performance through the following ways-
    - Formative assessment is an important tool to assess the learning outcome of the learners. It can organize in terms of class test, surprising test, quiz, and weekly test. This kind of assessment helps the teacher to know the progress of the learners.
    - Self- assessment is another way of assessment. Here, the learners themselves can assess their progress in learning. This is the best way to drive self-verification and self-enhancement. The teacher can use this assessment by giving some tasks to the learners and engage them in the assessment process. This will develop the capacity for self –reflection and self- evaluation
    - The teacher should assess the performance of the learners by identifying areas of improvement. This will also motivate the pupils to work on their weaknesses.
    - Assessment should process-oriented. It should reflect the learning outcome by adopting methodologies and skills of teaching.

12. **Evaluation –**

    The evaluation aims at finding out the degree to which goals of teaching are achieved. Evaluation gives importance to the product or behavioral outcome of the learners. The school and the teacher must know evaluation and how does it differ from the assessment. The school and the science teacher should keep in mind while evaluating the performance of the pupils in science –
    - Find out the specific weaknesses, either on an individual or at class level, and also to find out the particular strengths.

- Maintain the systematic record of the pupil's progress in theoretical studies, practical work, and the various co-curricular activities which form an integral part of education progress.
- Maintenance of students' diary, anecdotal record, and cumulative record.
- Making a judgment about a finished product or process.

Conclusion -

At high school stage, laboratory work is being ignored. Old school philosophy on science teaching now has to change. Many researches have been conducted on science teaching, but the fact which needs to be noticed is to implement the research findings while designing the curriculum. Now it's time to close the gap of theoretical and practical teaching by extending the hours of practical work/ laboratory work. Therefore, a science based framework should develop for different stages of education and should be inclusive in nature. Hence, through this paper, the researcher made a humble attempt to present a qualitative framework for science teaching.

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