

# SCIENCE TEACHING THROUGH 5E LEARNING CONCEPT

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## ABSTRACT

Present education system is been criticized due to overemphasis on use of conventional method for imparting instructions in science in classroom, Here science is considered only as a body of knowledge and product end is given more importance than the process aspect of science ( NCF 2005). In conventional classrooms there is undue emphasis on memorization which is mistaken for learning. There is an urgent need to shift our teaching practices and evaluation from memorization of content and recall in examination hours to development of foundation skills of learning and independent thinking. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. A key component of constructivist thinking is that it views learning as a process in which the learner actively constructs or builds new ideas or concepts based upon current and past knowledge through his/her own experience. The role of teacher is to act as a facilitator for providing opportunities and environment for activity based learning in science classrooms. In order to make students active variety of learning can be employed by teachers based on constructivist approach. 5E learning concepts encourages learners to explore, experience, and discover various subjects and as a result it can be considered an effective method for teaching. Different phases of the 5E learning concept include (Engage, Explore, Explain, Elaborate and Evaluate). Present article focused on the 5E learning concept related to the effectiveness in science subject, teaching-learning strategies for science classroom.

## Introduction

Science is a systematic study and knowledge of natural and physical phenomena. In this era, scientific education is much emphasized in all societies the world over. The main goal of science education is to prepare the right type of environment for the individual, to allow learners grow physically, mentally and spiritually in order that learner can develop harmoniously within time together fellow human beings. According to NCF-2005 teacher should act as a facilitator and not as a transformer of contents where they can think, realize, analyze and develop their own way of learning which something beyond the textbook. Science is a dynamic, expanding body of knowledge, covering ever-new domains of experience. In a progressive forward-looking society, science can play a truly liberating role, helping people escape from the vicious cycle of poverty, ignorance and superstition. In other words, society directly or indirectly depends on products and services that are developed with the help of science and technology. Innovations in science and technology have changed the way we live, move, communication, work and play. Meanwhile, news headlines on global warming, environmental protection, cloning or genetically engineered food all deal with science-based issues that directly affect our lives (International Council for Science (ICSU), Paris (2011)). The major aim of science teaching is to promote the understanding of the concept being taught with a view to applying the knowledge of such understanding to real life situations. In spite of the much focus on teaching strategies in science, students' performance in science subjects continued to record a persistent and depressing downward trend. Studies show that students are unable to successfully integrate or contrast memorized facts and formulate with real-life applications outside the science classroom. Practical knowledge and school knowledge are becoming mutually exclusive; many students see little connection between what they learn in the science classroom with real life. Moreover, the traditional teaching method in which of teacher as information-giver to passive students appears outdated. They emphasize the learning of answers more than the exploration of questions, memory at the expense of critical thought, bits and pieces of information instead of understanding in context. In addition, they fail to encourage students to work together, to share ideas and information with each other, or to use modern instruments to extend their intellectual

capabilities. One solution for this problem is to prepare students to become good adaptive learners. That is, students should be able to apply what they learn in school to the various situations in real-life. Obviously, the traditional teacher-as- in formation giver, textbook guided classroom has failed to bring about the desired outcome of Producing thinking students. An alternative is to change the focus of the classroom from teacher-centered to student-centered using a constructivist approach. With the emphasis on the learner, we see that learning is an active process occurring within and influenced by the learner as much as by the instructor and the school. From this perspective, learning outcomes do not depend on what the teacher presents. Rather, they are an interactive result of what information is in countered and how the student processes it based on perceived notions and existing personal knowledge.

In the present scenario, people are faced with a rapidly changing world. To cope up with emerging challenges and for bringing up the standards of living, education of science and technology has become a matter of great concern internationally. There is no doubt that effective science education can serve as a mean for solving existing as well as upcoming global problems. These different imperatives have to be kept in mind in shaping science education in order to be meaningful in school. Teaching and learning of science should be aimed at bringing holistic and maximum development of students. But at present, it seems to be very difficult to achieve comprehensive scientific literacy because most of the educational system in the undeveloped and developing countries is still following the conventional lecture method of teaching in which the teacher dominates the entire classroom activity. In such an approach the interaction is basically a one way streak from teacher to students (Gillies and Khan, 2008). Today it is essential to organize the classroom environment in a student centered way facilitating all round development of the students. In traditional learning environment students memorize information which does not develop their critical thinking. To overcome such types of problems it is required and strongly recommended to use student centered approaches. Recently, one of the approaches that closely influence the organization of learning environment is the constructivist approach (Oguz, 2008). Constructivism is defined as a set of beliefs about knowledge that begins with the assumption that reality exists but cannot be known as a set of truth (Tobin et al, 1994). Constructivists believes that objective knowledge cannot exist, rather all of us are involved in constructing our own words, part of which we take as being shared by others. Constructivist believes in truth but not in a truth that has been constructed by somebody. It maintains that individuals create or construct their own new understandings or knowledge through the interaction of what they already know and believe and the ideas, events, and activities with which they come in contact. Knowledge is acquired through involvement with content instead of imitation or repetition. Constructivism is not accepting what you are told but your prior knowledge about what you are taught and your perceptions about it. The new idea is not imposed on the learner. The learner is actively re-structuring his past and present experiences. Students' active involvement is emphasized in constructivism; the knowledge is then rooted into their memory. Von Glasersfeld (1993) argues that constructivism is a way of knowing that recognizes the real world as a source of knowledge.

In order to make students active variety of learning cycle model 5E based on constructivist approach. 5E instructional model ( Bybee and Landes, 1990) can be used to design a science lesson, and is based upon cognitive psychology, constructivist –learning theory, and best practices in science teaching. The cycle consists of cognitive stages of learning that comprise engage, explore, explain, elaborate and evaluate. Bybee (1997) declares that using this approach, students redefine, recognize, elaborate, and change their initial concepts through self- reflection and interaction with their peers and their environment. Learners interpret objects and phenomena, and internalize those interpretations in terms of their current conceptual understanding. Science teachers and curriculum developers may integrate or apply the model at several levels. The model can be the organizing pattern of a sequence of daily lessons, individual units, or yearly plans.

### **Origin of 5E model of constructivism**

It is instructive to highlight that the 5Es is itself a derivative of a more general learning model. The 5Es progression constitutes a learning cycle that Bybee, Taylor, Gardner, Van, Powell, and Colleagues (2006) frame relative to an earlier three step learning cycle involving exploration, invention, and discovery (Karplus and Their, 1967). The 5Es evolves and adds steps that leverage research-based principles from cognitive science concerning the roles of prior learning and metacognition. In this way, the 5Es is itself, one aspect of broader and ongoing lines of research. The 5Es is shorthand for a five-step inquiry process involving engagement, exploration,

explanation, elaboration, and evaluation ( Bybee, Taylor, Gardner, Van, Powell et al., 2006 ). In brief , illustrative introductory experiences enlist students interests and prior experience to build connections to learning objectives (engagement step), inquiry activities investigate relevant phenomena ( explore step ), concepts are then explicated, including opportunities to demonstrate conceptual understanding ( explanation step), complementary experiences then challenge and deepen understandings ( elaboration step ), lastly, formal, summative assessments evaluate students understanding (evaluation step),. The 5Es provide opportunities to construct then refine ideas about the conceptual and material tools of science, both during and after direct experiences with relevant phenomena. In this way, each 5Es step builds one on another, framing a progression. Majority of researches have employed 5E learning cycle model and it was found that there was positive effect of 5E learning cycle on student's achievement in science. Constructivist approach and 5E learning cycle has been employed for teaching various subjects ( chemistry, physics, biology, maths and social science etc.) and various levels primary, secondary, higher secondary and college level). Despite of this it follows the main principles of effective teaching in science which are as follows;

- Dealing with students existing ideas and conceptions.
- Encouraging students to apply new concepts or skills into different contexts.
- Encouraging students' participation in lessons.
- Encouraging students' inquiry.
- Encouraging co-operative learning among students, and
- Offering continuous assessment and providing corrective feedback.

In the present article 5E model has been selected mainly because of its complete and well defined steps.

### **Different steps of 5E learning concept**

The different steps of 5E learning concept which can be employed to sequence science lessons are as follows;

#### **Engage**

In this step students mentally focus on an objects, problem, situation or event. Demonstration of an event or questions can also be used to engage students. Connections are facilitated by teacher between what students know and can do. The activities of this step make connections to past experiences and explore students' misconceptions; they should serve to mitigate cognitive disequilibrium. A demonstration of an event, showing a picture or making a discussion, the subject of course is not told to students, Basis of work for upcoming activities is organized. Students derive some questions and try to find answers to them. For teachers, this step provides opportunities for determining their students' misconceptions. This step can be used to create disequilibrium in students mind.

#### **Explore**

The aim of exploration activities is to establish experiences that teachers and students can use later to formally introduce and discuss concepts, processes or skills. During the activity, the students have time, in which they can explore events, or situations. As a result of their mental and physical involvement in the activity, the students establish relationships, observe patterns, identify variables, and question events. The teacher's role in the exploration step is that of facilitator or coach. The teacher initiates the activity and gives the students time and opportunity to investigate objects, materials, and situations based on each students own ideas of the phenomena. If called upon, the teacher may coach or guide students as they begin reconstructing their explanations. Use of tangible materials and concrete experiences is essential.

#### **Explain**

Teacher provides opportunity to learners to explain the causes of their opinions. Explain new information and concepts about subject. A connection is established with learners' previous knowledge. Teacher explains the concept formally and removes misconceptions to ensure students are learning new concepts. They help learners to correct and complete missing information. Teacher repeats, summarizes, and re-reads subject

information for learners. He listens to the findings and information made by learners. Assistance is provided to learners in summarizing their findings. He tells the students what they have explored if their understanding is incomplete. Teacher explains new information and concepts about the subject. Wait for learners to explain the causes of their opinions. Helps learners to correct and complete missing information.

### **Elaborate**

Teacher ensures learners transfer their learning to new situation via proper practices (deciding, finding solution, producing etc.). He encourages learners to develop their knowledge and skills in new situations. Direction is provided to learners to question their knowledge of new situation and to share this with classmates. It is the duty of the teacher to make sure that assigned homework and activities relate to learners real lives. He plans to connect present knowledge to prior experiences by keeping in mind the next concept related to the present one. He encourages learners to make their own decisions. He plans out questions which can be used to encourage discovery of the concepts importance. Activities if planned, allow students to apply concepts in contexts, and build on or extend understanding and skill.

### **Evaluate**

In this step teacher evaluates learners gained knowledge and skills. He gives opportunities to learners for self-evaluation and evaluation by their peers. He tests that learning outcomes are proper or not. He plans for different hands on evaluation techniques which children can do to demonstrate the basic science process skills. Pictures can be used to evaluate children to know how well they can think through problems. For this step teacher can plan out types of questions that will helps children to reflect on what they have.

### **Conclusion**

Every nation craves for science and technological advancement which can be achieved through the medium of education. In modern era, science education is the key component of curriculum. So, in order to gain students interest in science it is necessary for the teachers to adopt new approaches in science teaching. Teacher should provide opportunity to students for learning by exploring and reaching themselves to knowledge. They should be motivated to find the solution of the problem on their own. It is the duty of the teacher to assist the students in finding their mistakes which are causing hindrance in achieving the solution. Teachers should be careful about choosing teaching activities for different steps of the 5E model. It should be remembered that these materials should be according to the level of the learners so that they can be able to construct knowledge by them. In education system use of constructivist approach 5E model should be included in their teaching practice. Students should be asked to prepare course plans according to the steps of these models and apply them in their teaching wherever required. These plans should be evaluated by the authorities. This will provide pre-service teachers to learn about these models so that they can employ it in various other subjects.

### **Implications**

In the light of the findings of the present article the following implications could be offered:

1. Since its abstractive nature learning science is difficult. Prospective teachers should be given opportunities to apply their understandings about 5E learning cycle model based on constructivist approach in school students. Universities and schools should work together to create more fully developed constructivist teachers.
2. Teachers should use instructional techniques that promote students' understanding such as: 5E learning cycle based instruction since traditional instruction is less effective than 5E learning cycle based instruction. The role of the teacher is facilitate safe, guided or open inquiry experiences and questioning so students

uncover their misconceptions about the concept. And also, in universities, teacher education programs especially methods of science courses should include some topics related to 5E learning cycle approach.

3. Teachers should create disequilibrium with students' existing conceptions, so that, they will have to rethink and try to reconstruct understanding.

4. Teachers should be trained about the usage and importance of 5E learning cycle based on constructivist approach and they must plan the instructional activities accordingly. Curriculum programs should be based on the constructivist perspective.

5. Teachers should be aware of students' attitudes towards science as a school subject. They must know that attitudes affect the students' achievement and should seek to improve students' attitudes.

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