



# Constructivist Approach to Teaching of Science

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## Abstract

The word Constructivism is widely used in the context of teaching-learning. It emphasizes how students construct knowledge from their own experiences. It proposes that teachers should try to develop students' natural curiosity and interest to know about the environment around them. Constructivist approach to science teaching helps students to explore and reflect on their own experiences through various activities provided in the classroom to understand the concepts of science. In this article, the emergence of constructivism as a theory of learning, the role of teacher and the students in constructivist science classrooms, and preparation of lesson plans based on constructivist approach using '5E' model for teaching the concepts of science are discussed.

**Keywords:** Constructivist Approach, Teaching - Learning of Science.

## INTRODUCTION

The roots of constructivism may be traced back to the writings of a little-known eighteenth-century philosopher, Giambattista Vico, who believed that a learner knows only the cognitive structure he/she has constructed (Von Glasersfeld, 1989). According to constructivist perspective, learning is an individual process that involves linking new ideas and experiences with what the learner already knows. A fundamental assumption of constructivism is that learners construct knowledge based on their own understanding.

Constructivism has got significant attention in education, teacher preparation, and policy making (MacKinnon and Scarff-Seatter, 1997; Richardson, 1997; Teets and Starnes, 1996). It is an epistemology which suggests an explanation of the nature of knowledge and how human beings learn. It states that individuals construct their own knowledge through the interaction of what they already know and the activities in which they are engaged (Cannella and Reiff, 1994; Richardson, 1997).

### How to Cite this Article:

Yalavarthi Nirmala (2016). Constructivist Approach to Teaching of Science. *The American Journal of Science and Medical Research*, 2(1):246-249. doi:10.17812/ajsmr2016215.

Received: 29 January, 2016; Accepted: 2 March, 2016  
Published online 21 March, 2016

Knowledge is gained through participation instead of imitation or repetition (Kroll and LaBosky, 1996). Learning activities in constructivist classrooms are characterized by active participation, inquiry, problem solving, and collaboration with others. The teacher acts a guide and facilitator who encourages students to question, challenge, and form their own ideas, opinions, and arrive at conclusions.

Constructivism is a synthesis of ideas from philosophy, sociology, psychology and education. In education, constructivism refers to theories of learning. Learning theories state that knowledge is constructed and not gained from an objective world or external reality. In everyday practice, the concept of constructivism is much more difficult to understand and philosophers, psychologists, sociologists, scientists, and educators understand this concept differently. Thus, constructivism is understood best as an academic concept which describes different ways of thinking about learning and knowledge acquisition.

Constructivism as a theory of learning emerged from the works of Piaget, Vygotsky, Ausubel, etc. Social interaction among individuals plays an integral part in how people learn (Rogoff, 1984). Teacher-student and peer interactions are important ingredients of learning from a constructivist perspective. Piaget's (1970) theory of learning is based on cognitive constructivism as it focuses on the cognitive processes that take place within the individual. It emphasises the role of cognitive

processes in meaningful learning. He stated that learning is a developmental cognitive process and proposed that children create knowledge, not receive knowledge from teachers or others and that children construct knowledge based on their experiences and he related this to their physical and cognitive development. Vygotsky (1978) states that all learning take place in a cultural context and involves social interaction. According to him culture and language play a significant role in developing children's thinking. He proposed the concept of 'zone of proximal development' which suggests that children learn with the help of teachers or peers to bridge the gap from what they know and what they can do independently and what they can know and do with the help of others. The role of 'scaffolding' provided in guiding social interaction becomes central to the Vygotskian view. Ausubel states that prior knowledge or existing schemata are of central importance if the learner is to meaningfully acquire new information or concepts and he proposed 'advance organisers'. He proposed that meaningful learning occurs when new information is subsumed by existing cognitive structures (Novak, 1988). He further suggested that effective teaching requires the teacher to choose the relevant information, and to provide the means to help students relate this to the concepts they already have formed i.e., existing schemata (Slavin, 1988). For the student, both of these depend to a large extent on prior knowledge, or existing cognitive Structures.

### **Use of Constructivist Approach in Classroom Teaching - Learning**

Teachers who adopt constructivist approach to teaching of science put forward problems in the class and ask students to explore to solve those problems. Teacher guides the students in inquiry process and encourage new patterns of thinking. Classes can undergo unexpected changes as students are given autonomy to explore on their own.

In constructivist classrooms, teachers take the role of facilitator by encouraging and accepting students' autonomy. Teachers use raw data and primary sources, along with other resource materials, encourage higher-level thinking and inquiry by asking thoughtful, open-ended questions and motivate students to ask questions, engage them in dialogue, both with the teacher and with peers and allow significant wait time to respond. Teachers also encourage discussions in the classroom, allow students' responses to drive lessons and change instructional strategies accordingly, develop reflective thinking among the students and nurture their natural curiosity.

Students come from different backgrounds and they have different ideas and different ways of thinking. If the information provided in the classroom contradicts with their existing ideas, students may try to accommodate both interpretations, rather than change deeply held

beliefs. If teachers can provide in the classroom an atmosphere where students exchange their personal views and test them against the ideas of others, each student can continue to build understanding based on empirical evidence. Hands-on activities and observation of the natural world provide shared experiences for those interpretations. If models, text references, or illustrations are available as resources, students should know that these are the results of others' observations and assumptions. Such references are actually the 'constructions' by others of the existing understanding of the world around us.

Students in Constructivist Classrooms learn how to learn and they reflect on how they learn, ask questions, construct their own understanding of knowledge, explore the complex and abstract concepts, interact with peers and provide feedback to one another.

### **Constructivist Model for designing Learning Experiences**

Generally students come to the school with lots of ideas, feelings and skills and this is where their learning should begin. These ideas, feelings and skills are natural in students and are developed as they interact with their peers, teachers and the environment. They construct meaning by making sense of their experiences and make their own ideas into reality. They create their own ideas and explanations about natural phenomenon to make sense of their daily experiences. Constructivists believe that actual learning takes place not only through assimilation but also through accommodation, which occurs when students change their existing ideas in response to new information/ideas/concepts provided to them. Students who acquire an understanding of scientific concepts through constructivist strategies accommodate this knowledge with their own understanding of how the world works. Knowledge is not simply transferred from teacher or textbook to the student. They build their own explanations and ideas.

In the constructivist classroom, the focus is not on meeting objectives or mastering tests, as this does not sufficiently determine how much learning has occurred or track the process of conceptual change. It believes that teaching should be learner-centred and that the teacher facilitates learning rather than transmitting information to children. The teacher observes students' understanding and develops instructional strategies accordingly. Students must actively participate in learning. Learning takes place as a result of shared experiences of students, peers, and the teacher. Sharing their ideas with peers and the teacher allows them to clarify their own thoughts and consider those of their peers.

Lesson plans based on constructivist approach may be prepared by the teachers using the '5E' model for teaching the concepts of science. This model of lesson

plan employs a learning cycle that supports the constructivist approach which includes five phases namely 'Engage', 'Explore', 'Explain', 'Elaborate', and 'Evaluate'. An example of an outline of a '5E' model lesson plan based on constructivist approach is given below:

- Rationale: It should explain why the lesson is important and how it will benefit the students. It should encourage the teacher to be thoughtful and reflective while planning. It should connect new content to other lessons. It should summarize the purpose of learning the lesson.
- Objectives of the lesson
- Materials and Resources needed for teaching the lesson
- Introduction to the lesson: It may include the following: What does the teacher do to help students understand the purpose of the lesson? How will the teacher help them make connections to the previous lesson and the previous experiences? How will the teacher motivate students to engage themselves in the lesson?
- Stating the lesson/topic name
- Presentation: Under this, learning experiences will be designed by the teacher during the five phases of this model as given below.

1. Engage: In this phase, students may be engaged in activities to arouse their thinking and help them to use their prior knowledge. This may include activities such as demonstration, showing a documentary related to the lesson, reading a news item from news papers, etc. Questions may be raised on a particular issue or event to encourage students to know more about a concept by motivating their curiosity to find answer/solution.
2. Explore: During this phase, teacher may provide hands-on activities to students to think, plan, investigate and organize information to explore a concept. This provides a platform for them to share their classroom experiences as a result of which they can socially construct meaning. It is for this reason teacher may design various activities for students to do and learn on their own and thus teacher facilitates their learning.
3. Explain: During the explanation phase, teacher helps students to make sense of their experiences and the questions that come to their mind as a result of those experiences. Teacher may design activities which involve them in analysing their experiences. Teacher may provide reflective activities to clarify and revise their understanding. Teacher introduces scientific terms and explanations of those terms at appropriate time during the classroom activities and discussion. Teacher can discuss in the class regarding their observations when they are engaged in hands-on activities and explain accordingly.

4. Elaborate: Activities provide new opportunities for students to continue to explore the same concept learnt in the previous phases of the learning cycle. They can extend their understanding of the concept in a new setting. Hence teacher may give them an opportunity to elaborate their understanding of the concept and apply it in their daily life experiences. For this, activities may be designed which help them to acquire skills of problem solving, decision-making, inquiry, thinking skills such as comparing, classifying, etc. Teacher may provide alternate activities to inculcate these skills among students by asking them to explore further about the concepts taught.
5. Evaluate: During the 'evaluation' phase, teacher may expect that children demonstrate their understanding of the concepts. They may be assessed throughout the class to know about their learning. Teacher may ask questions to know their understanding of the concepts while they are engaged in the activity and try to link the understanding of various concepts. Teacher allows students to document their learning and reflect on their learning and also encourages students to create new problem-solving environments.

## **CONCLUSION**

Science is one of the core subjects of school curriculum. Usually the information is transmitted to the students in science classrooms by the teachers through the traditional methods used for teaching science. Generally science is considered as a body of knowledge to be acquired. The process aspect of learning science is not given much importance. The traditional methods of teaching science are not effective in developing meaningful learning, critical thinking and problem solving abilities among the students. Hence there is a need to revisit and reform the teaching practices. The students should be viewed as active participants of learning to construct their own knowledge and build the understanding by meaningful learning. Hence, constructivist approach to science teaching may encourage students to question and reflect on their own understanding through active participation in learning process to have meaningful learning. In this approach, emphasis is on the process of learning. Teacher acts as a facilitator of learning and students are active learners of knowledge construction through their own experiences. Hence constructivist approach to science teaching helps the students to understand and reflect on their own experiences through various activities provided in the classroom to understand the concepts of science. It is a challenging task for teachers to practice this approach and teachers need to try a variety of activities emphasizing on the facilitation of knowledge construction and focusing on active participation of students in classroom activities and discussions.

## Competing interests

The authors have declared that no competing interests exist.

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