M Ed
Science Education

CONSTRUCTIVISTIC LEARNING APPROACH IN SCIENCE

Dr. Satyajit Kar

Assistant Professor in Physics
Ramakrishna Mission Sikshanamandira
Belur Math, Howrah.

"Imagination is more important than knowledge."

"Knowledge is limited. Imagination encircles the world"

--Albert Einstein

What is constructivism?

Constructivism is basically based on a theory of observation and scientific study. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences.

Constructivism is a student-centered approach that places responsibility on students to take charge of their learning experiences.

Teachers create activities and assignments that foster the creation of knowledge by different learning situations.

Students are challenged to produce reality based products such as portfolios and papers.

The constructivist educational philosophy operates on four major assumptions:

Four Major Assumptions

1. Knowledge depends on past constructions. We know the world through our mental framework and we transform and interpret new information through this framework.

2. Constructions come through systems of assimilation and accommodation into our existing mental framework.
3. Learning is an organic process of invention, not mechanical.
4. Meaningful learning occurs through reflection and generating a new knowledge or concepts upon existing framework of knowledge or understanding.

In the classroom

•The constructivist view of learning can point towards a number of different teaching practices.

•In the most general sense, it usually means encouraging students to use active techniques to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing.

Our past experiences about learning

1. Learning as response strengthening

2. Learning as knowledge acquisition

3. Learning as knowledge construction

Learning as response strengthening

- According to the first view, learning occurs when learner strengthens or weakens an association between a stimulus and a response.
- This first view developed in the first half of 20th century .
- The role of learner is to passively receive rewards and punishments.
- The instructional designer role is to create environments where the learner repeatedly is cued to give a simple response, which is immediately followed by a feedback.

Learning as knowledge acquisition

- Learning occurs when a learner places new information in long-term memory.
- This view developed in 1950s, 1960s and 1970s and was based largely on the study of human learning in artificial laboratory settings.
- The role of the learner is to passively acquire information, and the teacher's job is to present information, such as in textbooks and lectures.

- According to this view, information is a commodity that can be transmitted directly from teacher to learner.

- The instructional designer's role is to create environments in which the learner is exposed to large amount of information through textbooks, lectures and computer based multimedia programmes.

Learning as knowledge construction

- Learning occurs when a leaner actively constructs a knowledge representation in working memory.
- This view emerged in 1980s and 1990s and was based on largely on the study of human learning in increasingly realistic settings.

- According to this view, the learner is a sense maker, whereas the teacher is a cognitive guide who provides guidance and modeling on authentic academic tasks.
- The instructional designer's role is to create environments in which the learner interacts meaningfully with academic material.

How constructivism is different from traditional ideas about teaching and learning?

Traditional Classroom	Constructivist classroom
Curriculum begins with the parts of the whole.	Curriculum emphasizes big concepts, beginning with the whole and expanding to include the parts
Emphasizes basic skills Strict adherence to fixed curriculum is highly valued	Pursuit of student questions and interests is valued
Materials are primarily textbooks and workbooks	Materials include primary sources of material and manipulative materials
Learning is based on repetition.	Learning is interactive, building on what the student already knows
Teacher's role is directive, rooted in authority	Teacher's role is interactive, rooted in negotiation
Assessment is through testing correct answers	Assessment includes student works, observations, and points of view, as well as tests. Process is as important as product
Knowledge is seen as inert	Knowledge is seen as dynamic, ever changing with our experiences
Students work primarily alone	Students work primarily in groups

Constructivist Pedagogy

- Learning should take place in authentic and real-world environments
- Learning should involve social negotiation and mediation
- Content and Skills should be made relevant to the learner
- Content and skills should be related to the learner's prior knowledge

- Students should be assessed formatively, serving to inform future learning experiences.
- Students should be encouraged to become self-regulatory, self-mediated, and self-aware
- Teachers serve primarily as guides and facilitators of learning, not instructors
- Teachers should provide for and encourage multiple perspectives and representations of content

In a constructivist classroom, learning is

- **Constructive**
- **Active**
- **Reflective**
- **Collaborative**
- **Inquiry based**
- **Evolving**

The Constructivist Classroom

- Students autonomy and initiative are accepted and encouraged
- The teacher asks open-ended questions and allows wait time for responses.
- Higher-level thinking is encouraged.
- Students are engaged in dialogue with the teacher and with each other.
- Students are engaged in experiences that challenge hypotheses and encourage discussion.
- The class uses raw data, primary sources, manipulative, physical, and interactive materials.

What the constructivist teacher has to do in his classroom?

S-/ he may:

- prompt students to formulate their own questions (inquiry)
- allow multiple interpretations and expressions of learning (multiple intelligences)
- encourage group work and the use of peers as resources (collaborative learning)

Benefits of constructivism

- Children learn more, and enjoy learning more when they are actively involved, rather than passive listeners.
- Education works best when it concentrates on thinking and understanding, rather than on rote memorization. Constructivism concentrates on learning how to think and understand
- Constructivist learning is transferable. In constructivist classrooms, students create organizing principles that they can take with them to other learning settings.

- Constructivism gives students ownership of what they learn, since learning is based on students' questions and explorations. Engaging the creative instincts develops students' abilities to express knowledge through a variety of ways. The students are also more likely to retain and transfer the new knowledge to real life.
- Students in constructivist classrooms learn to question things and to apply their natural curiosity to the world.
- Constructivism promotes social and communication skills by creating a classroom environment that emphasizes collaboration and exchange of ideas.
-

Interpretation Construction:

Students construct interpretations of observations and construct arguments for the validity of their interpretations

Multiple Interpretations:

Students gain cognitive flexibility by being exposed to multiple interpretations

Multiple Manifestations:

Students gain transferability by seeing multiple manifestations of the same interpretations

EXAMPLE FROM SCIENCE

- students study astronomy and science in general by using observations of telescopic plates and a computer simulation of the sky to construct and test interpretations of astronomical phenomena. Students examine and make measurements on photographic plates from observatory telescopes and computer simulations of the sky (**Observation**), then relate these analyses to reference materials (**Contextualization**) containing what is know about astronomical objects (i.e., stars, planets, etc.).

- The teacher initially talks through how he would analyze and interpret examples of such astronomical data (**Cognitive Apprenticeship**) then the students form groups to work on some data (**Collaboration**), while the teacher coaches and advises them as they proceed.

- The students develop their own hypotheses and test them against the astronomical data (**Interpretation Construction**). Students defend their hypotheses using their analyses and reference materials both within and between the groups, and such argumentation together with background readings exposes them to various ways to interpret the data (**Multiple Interpretations**).

- As they proceed through the course, the students see how basic principles of astronomy, physics and chemistry can be used to make sense of different sets of astronomical data (**Multiple Manifestations**).

SCIENCE

Learning Situation

- Learners read a text on mammals and view a video on the life of mammals in different locales. Such events or activities consist of mammals moving in groups on land or in water, grazing, attacking a prey, giving birth, flocking together at the time of danger and related events.
- Learners make note of the key events or behaviour or activities of mammals.
- They relate their analysis to the text.
- Teacher illustrates how he/she would analyse and interpret such information using the example of mammals.
- Learners form groups to work on the task while the teacher suggests/guides them as they proceed.
- Learners analyse and generate evidence to verify their hypothesis related to mammals living on land or water, etc.
- They provide explanations and defend their ideas or hypotheses using their analyses and text both within and between groups.
- Evidence and arguments along with the text expose them to various ways of finding answers or interpreting data.
- By going back and forth through the process and relating each contextual background on various events and the behaviour of mammals, the learners notice that the general principles embedded in what they are doing become manifested.