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Abstract: Constructivism sees learning as a dynamic and social process in which learners actively construct meaning from their experiences in connection with their prior understandings and the social setting. In the context of science teaching, learning process, it is observed that students conceptualize science as making sense of the world around them and as a mean of discovering theories, laws, and principles associated with reality. The constructivist epistemology asserts that the only tools available to knower are the senses. It is only through seeing, hearing, touching, smelling and tasting that an individual interacts with the environment. The individual builds a picture of the world from the message from these senses only. Therefore, constructivism asserts that knowledge resides in students and that knowledge cannot be transferred without any transformation from the head of a teacher to the heads of students. Students try to make sense of what is taught by trying to fit it with their previous experiences. Teacher seeks students’ point of view in order to understand the formation of their concepts, not to validate their learning as in a traditional classroom. Constructivist classroom places a child in the centre position of the classroom. Idea initiated by student are accepted and encouraged. Students’ opinions are valued. The National Curriculum Framework-2005 brought out by the NCERT emphasizing constructivist approach in classroom states ‘’ Teachers should also nurture their classroom spaces as places where children can ask questions freely ‘’.

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes.

Constructivist teaching is based on recent research about the human brain and what is known about how learning occurs. Caine and Caine (1991) suggest that brain-compatible teaching is based on 12 principles:

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1. "The brain is a parallel processor". It simultaneously processes many different types of information, including thoughts, emotions, and cultural knowledge. Effective teaching employs a variety of learning strategies.

2. "Learning engages the entire physiology". Teachers can't address just the intellect.

3. "The search for meaning is innate". Effective teaching recognizes that meaning is personal and unique, and that students' understandings are based on their own unique experiences.

4. "The search for meaning occurs through 'patterning'". Effective teaching connects isolated ideas and information with global concepts and themes.

5. "Emotions are critical to patterning". Learning is influenced by emotions, feelings, and attitudes.

6. "The brain processes parts and wholes simultaneously". People have difficulty learning when either parts or wholes are overlooked.

7. "Learning involves both focused attention and peripheral perception". Learning is influenced by the environment, culture, and climate.

8. "Learning always involves conscious and unconscious processes". Students need time to process 'how' as well as 'what' they've learned.

9. "We have at least two different types of memory: a spatial memory system and a set of systems for rote learning". Teaching that heavily emphasizes rote learning does not promote spatial, experienced learning and can inhibit understanding.

10. "We understand and remember best when facts and skills are embedded in natural, spatial memory". Experiential learning is most effective.

11. "Learning is enhanced by challenge and inhibited by threat". The classroom climate should be challenging but not threatening to students.

12. "Each brain is unique". Teaching must be multifaceted to allow students to express preferences.

Constructivism (learning theory)

Constructivism is a theory of knowledge (epistemology) which argues that humans generate knowledge and meaning from their experiences. Constructivism is not a specific pedagogy,
although it is often confused with constructionism, an educational theory developed by Seymour Papert. Piaget’s theory of costructivist learning has had wide ranging impact on learning theories and teaching methods in education and is an underlying theme of many education reform movements. Research support for conductivist teaching techniques has been mixed, with some research supporting these techniques and other research contradicting those results.

Formalization of the theory of constructivism is generally attributed to Jean Piaget, who articulated mechanisms by which knowledge is internalized by learners. He suggested that through processes of accommodation and assimilation, individuals’ construct new knowledge from their experiences. When individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework. In contrast, when individuals’ experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to the theory, accommodation is the process of reframing one’s mental representation of the external world to fit new experiences. It is important to note that constructivism is not a particular pedagogy. In fact, constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or following the instructions for building a model airplane. In both cases, the theory of constructivism suggests that learners construct knowledge out of their experiences. However, constructivism is often associated with pedagogic approaches that promote active learning, or learning by doing.

Implications for Curriculum and Practice

Teaching for Construction of Knowledge

In the constructivist perspective, learning is a process of the construction of knowledge. Learners actively construct their own knowledge by connecting new ideas to existing ideas on the basis of materials / activities presented to them (experience). For example, using a text or a set of pictures / visuals on a transport system coupled with discussions will allow young learners to be facilitated to construct the idea of a transport system. However, there is a social aspect in the construction process in the sense that knowledge needed for a complex task can reside in a group situation. In this context, collaborative learning provides room for negotiation of meaning, sharing of multiple views and changing the internal representation of the external reality.
Construction indicates that each learner individually and socially constructs meaning as he/she learns. Constructing meaning is learning. The constructivist perspective provides strategies for promoting learning by all.

The teacher’s own role in children’s cognition could be enhanced if they assume a more active role in relation to the process of knowledge construction in which children are engaged. A child constructs her/his knowledge while engaged in the process of learning. Allowing children to ask questions that require them to relate what they are learning in school to things happening outside, encouraging children to answer in their own words and from their own experiences, rather than simply memorizing and getting answers right in just one way – all these are small but important steps in helping children develop their understanding. ‘Intelligent guessing’ must be encouraged as a valid pedagogic tool. Quite often children have an idea arising from their everyday experiences, or because of their exposure to the media, but they are not quite ready to articulate it in ways that a teacher might appreciate. It is in this ‘zone’ between what you know and what you almost know that new knowledge is constructed. Such knowledge often takes the form of skills, which are cultivated outside the school, at home or in the community. All such forms of knowledge and skills must be respected. A sensitive and informed teacher is aware of this and is able to engage children through well-chosen tasks and questions, so that they are able to realize their developmental potential.

Active engagement involves enquiry, exploration, questioning, debates, application and reflection, leading to theory building and the creation of ideas/positions. Schools must provide opportunities to question, enquire debate, reflect, and arrive at concepts or create new ideas. An element of challenge is critical for the process of active engagement and learning various concepts, skills and positions through the process. What is challenging for a particular age group becomes easy and uninteresting for the other age group, and may be remote and uninteresting at another stage.

So often, in the name of ‘objectivity’, teachers sacrifice flexibility and creativity. Very often teachers, in government as well as private schools, insist that all children must give identical answers to questions. Such arguments make a travesty of the meaning of learning and only serve to convince children and parents that schools are irrationally rigid. We must ask ourselves why
we only ask children to *give* answers to questions. Even the ability to make a set of questions for given answers is a valid test of learning.

Learning takes place through interactions with the environment around, nature, things and people, both through actions and through language. The physical activity of moving, exploring and doing things, on one’s own with one’s peers or in the company of adults, and using language – to read, to express or ask, to listen and to interact – are the key processes through which learning occurs. The context in which learning takes place is thus of direct cognitive significance.

Much of our school learning is still individual based (although not individualized). The teacher is seen as transmitting ‘knowledge’, which is usually confused with information, to children, and organizing experiences in order to help children learn. But interaction with teachers, with peers, as well as those who are older and younger can open up many more rich learning possibilities. Learning in the company of others is a process of interacting with each other and also through the learning task at hand. This kind of learning is enriched when schools enroll children from different socio-economic backgrounds.

In the early primary school years, a beginning has been made in the area of group work. Projects and activities that can be carried out by groups need to become a feature of learning to the middle and high school also. There are ways in which such group learning can be assessed and evaluated. Schools could also consider giving mixed age groups of children projects to do together. In such mixed groups, there is much that children can learn from each other, such as team work and social values. In the company of others, one has opportunities of participating in larger tasks where one may find a niche to contribute to, thus achieving something above one’s own potential, and one may be able to try out what one does not fully know. Group learning tasks, taking responsibility, and contributing to a task at hand are all important facets of not only acquiring knowledge but also in the learning of arts and crafts. In a multi-grade class situation, such vertical grouping, which cuts across different grades, and which allows a single activity to be used across different age groups, could provide a pedagogically feasible and sound curriculum plan.
Teaching learning process is not only an arrangement of teaching strategies but setting of situations and environment in which learning process is recognized and supported. For this situation to be created for science teaching learning, a constructivist classroom has certain characteristics which are as follows :

(i) A constructivist classroom is Child Centered. NCF2005 establishes the need to recognize the child as a natural learner, and knowledge as the outcome of the child’s own activity. Students’ experiences, their voices and their active participation are valued. Focus is given to what students are learning rather than what the teacher is teaching.

(ii) Students’ prior knowledge is acknowledged and valued. During teaching learning process students construct meanings that fit with their experiences and expectations. This can lead them to construct meanings different from what was intended by a teacher. As a result students experience a cognitive conflict. In other words, students distinguish between scientific explanation and their “real world” explanations.

(ii) Students and teachers are interactive in a constructivist classroom. An interaction between teacher and students creates an environment within which emerging ideas can grow. Collaborative teaching, group discussion, group work and assignment and project work are some of the essential elements of an interactive classroom. Students interact with their peers as well as teacher.

(iv) ‘Others’ are important in constructivist classroom. Learning is restructuring the knowledge that students already have. Students learn science by observing those phenomenon and events and performing experiments and activities and interacting with others. As others are part of students’ experiential world, those are important for constructing their knowledge. Interaction with others constraint their thinking; hence they make adaptation in their thinking to make new meaning of the world. Others are part of their experiential world.

(v) Negotiation is compulsory for constructivist teaching. Negotiation is an important element for constructivist classroom. It brings teacher and learner on a common platform. Out of negotiation comes a sense of ownership in students for the work they are doing. Therefore they become committed to learning. Active involvement of students in their own learning as well as in other actions such as doing activities and at the same time maintaining discipline is a vital reality of constructivist classroom.

(vi) Process Approach is emphasized in constructivist classroom. Process approach in science is method and techniques of learning science. A context is created within which students are able to explore new ideas and experiences. Students are provided opportunities to perform and participate in various activities and experiments. Thus, from a constructivist perspective,
science is not a search for truth. It is a process that assists us to make sense of our world. It is an active, social process of making sense of experiences, as opposed to what we now call “school science”. From a constructivist perspective, learning science becomes more like the science that scientists do. (vii) Management of the classroom is democratic. Democratic environment of the classroom facilitate constructive learning. Such environment emphasizes shared responsibility in learning and decision making. Students are directly involved in all the activities of the classroom. Relationship among students and teachers is also democratic and responsive. It stimulates interest in the subject matter and develops a sense of self-achievement in students. Teacher’s focus is on students learning rather than on her own performance. (viii) Students learn from whole to part in a constructivist classroom. Teacher presents the curriculum holistically in a constructivist classroom, not in parts. She organizes the instructional materials in conceptual clusters, or themes. Instructions in the classroom are provided inter-relating many contents area at once. Emphasis is given on primary facts rather than on a set of disconnected discrete facts. (ix) Power in a constructivist classroom is shared. Empowering students to learn themselves is basic in constructivist philosophy. Teacher makes every effort to develop skills and abilities to become an autonomous learner. Emphasis is given on students thinking rather than on their answers and memorization of facts. Students and teachers work together with concrete objects to investigate the concept of science themselves. It helps them to think critically and gain confidences in problem solving abilities. Learning takes place naturally. It provides students the power to construct their knowledge. Contrary to the popular belief a constructivist classroom is highly organized. In such a classroom control comes from involving the students in responsibilities and not from imposing strict rules. The teacher focuses only on students learning. (x) Assessment is interwoven with teaching learning process. In a constructivist classroom of science, assessment of students learning is done in the context of daily teaching. NCF2005 suggests that maintaining a daily diary based on observation helps in continuous and comprehensive evaluation. Assessment is not considered as separate and patchwork, but interwoven in teaching learning process of a constructivist classroom. It is done in totality of learning experiences. Science teacher in a constructivist classroom embraces “alternative assessment” strategies also, in order to truly understand what students are thinking and to identify the steps they have taken to construct meaning out of their learning experiences. Alternative assessment complements the constructivist approach to teaching by providing
ongoing assessment of learning and more accurate measure of students’ actual understanding. Displays of attainment and progress by assessment enhance understanding of concepts of science, which can become jumping off points for further enrichment of the students’ learning.

Recent Curriculum Reform in India and Constructivism- In the National Curriculum Framework 2005 formulated by NCERT for the reform of school education in India, the constructivist approach and its implications for practice have been brought out in detail in which the key principles given are: In the constructivist perspective, learning is a process of construction of knowledge. Learners actively construct their own knowledge by connecting new ideas to existing ideas on the basis of materials/activities presented to them (experience). The structuring and restructuring of ideas are essential features as the learners’ progress in learning. The engagement of learners, through relevant activities, can further facilitate in the construction of mental images of the relationships (cause-effect) and collaborative learning provides room for negotiation of meaning, sharing multiple views and changing the internal representative of external reality.

Conclusion: From a constructivist perspective, science is not the search for truth. It is a process that assists us to make sense of our world. Using a constructivist perspective, teaching science becomes more like the science that scientists do. Indeed, actively engaging students in science is the goal of most science education reform. Also science knowledge as accepted today in scientific communities in principle is tentative in nature and open for revision. It is an enjoyable activity and role of the teacher is very challenging. Thus constructivism is a learning theory based on scientific observation and research and explains how people learn. Just as teachers have to learn how to teach from a constructivist point of view, students must also learn how to be effective learner. Educating students to be effective learners is an important priority in establishing environments conducive to effective learning of science. According to NCF 2005, in the constructivists’ perspective, learning is a process of construction of knowledge. Learners actively construct their own knowledge by connecting new ideas to existing ideas on the basis of materials/activities presented to them. The curriculum must be such which enable children to find their voices, nurture their curiosity- to do things, to ask questions and to pursue investigations, sharing and integrating their experiences with school knowledge rather than their ability to reproduce textual knowledge. Constructivist epistemology assumes that learners
construct their own knowledge on the basis of interaction with their environment. Constructivism focuses on knowledge construction, and not on knowledge reproduction. Views of the external world differ of each others because of our unique set of experiences.

References:


