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Constructivism in Science Classroom

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Abstract

Constructivism is a learning philosophy. This is a paradigm to see the classroom practices. In contrast to behaviorism, constructivism believes knowledge can be constructed in individuals' minds; it cannot be transferred from the teachers to the learners' heads. Under this philosophy, many methods and strategies are used that help in the construction of knowledge and facilitate learning. Constructivism assumes that knowledge is individually constructed and socially constructed by the learner based on their interpretation of experiences in the world. Constructivism activates many cognitive processes in learners such as selection, organization, and integration of information in the existing body of knowledge (Senapaty and Pradhan, 2004). This paper presents the concept of constructivism and how it evolved. In this paper, a brief description has also been focused on the policy perspective of constructivism. After that, the researcher will discuss the 7Es model of constructivism and how it will be implemented in the classroom.

Keywords: Constructivism, science teaching, secondary school, 7 E model.

INTRODUCTION

In the dynamic landscape of science education, the pedagogical framework known as constructivism has emerged as a cornerstone for fostering meaningful learning experiences within the classroom. Rooted in the foundational works of Piaget (1970) and Vygotsky (1978), constructivism posits that knowledge is actively built by the learner through the assimilation of new information into existing cognitive structures. This paradigm shift has particularly gained traction in science education, where the process of scientific inquiry aligns seamlessly with the constructivist philosophy.

The constructivist approach emphasizes the active engagement of students in the scientific method, encouraging them to question, explore, and construct their understanding of scientific concepts. The integration of constructivist principles in the science classroom is not merely a

pedagogical choice but a transformative pedagogical shift that resonates with the very essence of scientific inquiry (Driver et al., 1994). As we delve into the intricacies of applying constructivism in the science classroom, it becomes imperative to explore its theoretical underpinnings, examine its impact on student learning outcomes, and discern practical strategies for implementation.

This paper aims to unravel the significance of constructivism within the context of science education, navigating the intricate interplay between theory and application. By elucidating the theoretical foundations and examining empirical evidence, we seek to illuminate the potential of constructivism in fostering a generation of scientifically literate individuals. As we embark on this exploration, it is essential to know the notion of constructivism.

CONSTRUCTIVISM

In the pursuit of fostering a profound and enduring comprehension of scientific concepts, the pedagogical landscape has witnessed a paradigm shift towards constructivism—a theoretical framework that accentuates the active engagement of learners in constructing their knowledge. According to Piaget, 1973 "Learning is not the product of teaching. Learning is the product of the activity of learners". This is a crucial component of constructivism. This is a philosophy of pedagogy that gives more chances to students for learning by doing. It gives more scope to work with objects and construct knowledge in their own way; in a nutshell, we can say that constructivism gives scope to the learner for the construction of knowledge by integrating previous knowledge in novel circumstances. Constructivism assumes that knowledge is individually and socially constructed by the learner based on their interpretation of experiences in the world (Senapaty and Pradhan, 2004). In this approach, students apply their experience and construct subjective knowledge. This knowledge is subjective but true. Constructivist learning activates many cognitive processes in learners such as the selection of information, organization of information in a specific order, and integration of information in the existing body of knowledge (Senapaty and Pradhan, 2004). This notion is concerned with cognitive constructivism, on the other hand when social interaction helps in the construction of knowledge then called social constructivism (Woolfolk, 2003).

In the constructivist approach, many ways are used to apply it on the ground level, such as problem-solving, brainstorming, observation, the Jig-saw method, and Cooperative learning (Pathak and Mahure, 2022). Through these methods, the teacher can implement the constructivist

approach in the classroom and make students more active. When learners are involved in learning, then their academic achievement gets better.

Within the realm of science education, the application of constructivist principles holds significant promise for cultivating a generation of scientifically literate individuals. This paper embarks on a comprehensive exploration of constructivism in the science classroom, delving into its theoretical underpinnings, practical implications, and the transformative impact it holds on students' scientific reasoning and problem-solving skills.

As we embark on this journey, it is imperative to recognize the foundational contributions of luminaries such as Jean Piaget and Lev Vygotsky, whose theories serve as cornerstones for understanding the cognitive processes involved in the construction of scientific knowledge. Furthermore, contemporary scholars have extended and refined these theories, emphasizing the dynamic interplay between the learner, the sociocultural context, and the subject matter (Driver et al., 1994; Osborne & Wittrock, 1983).

As we delve into the intricate tapestry of constructivism in the science classroom, it becomes evident that this pedagogical approach not only aligns with the nature of scientific inquiry but also empowers students to actively participate in the construction of their scientific knowledge. In doing so, we endeavor to shed light on the transformative potential that lies within the conscientious application of constructivist principles, ultimately paving the way for a more robust and resilient foundation in scientific understanding.

HISTORY OF CONSTRUCTIVISM

Constructivism comes into existence due to the disapprobation of traditional Western theories of knowledge. Objectivist notions believe in objective truth, while the constructivist notion believes truth is not absolute; knowledge does not exist outside the brain or mind of learners but is constructed by them by incorporating previous experience in the new phenomena(Crotty, 1998, p.42). When we see the base of constructivism, the Socratic method of questioning is Rooted. The Socratic dialectic method is very fruitful in the constructivist classroom. Through this method, the teacher assesses their students' outcomes and plans and executes new teaching experiences in a constructivist setup, but it has become an emerging philosophy of the 21st century (Singh and Yaduvanshi, 2015). Jean Piaget and Lev Vygotsky are eminent advocates of constructivist learning.

Firstly, Jean Piaget gave his concept rooted in cognitive psychology and epistemology and said

that every person individually constructs knowledge according to their cognitive development. In cognitive constructivism, learners actively engage in learning and construct knowledge based on their past experiences through assimilation, accommodation, equilibrium, and adaptation of new information. In this process, the learner develops their understanding of the concept, but after some time, Vygotsky argued that the social environment plays a significant role in learning processes. When learners interact with their environment and society, they construct knowledge. Learners interact with peers, and the more knowledgeable person then they find scaffolding and construct the knowledge in their own way by developing an understanding of the given concepts. At the same time, radical constructivism says there is no objective knowledge. Every piece of knowledge exists in learners' minds, and they construct the knowledge according to their individual differences. In radical constructivism, two basic principles exist. First, knowledge is not passively received by sense organs. However, it is actively constructed by the learner through understanding the topic or concepts, and second, the function of cognition is organizing the events experienced by the learner rather than the discovery of truth and facts (Walshe, 2020). But Novak added the emotion of the learner in the process of construction of knowledge and gave the name Humanism constructivism (Dubey, 2021).

We can say that constructivism believes in the process domain of science rather than just transferring the product of science in the form of fact or concept. This process-oriented approach is essential to achieve the objectives of science, such as the development of scientific temperament, scientific attitude, rational thinking, and logical thinking. Considering all these objectives, different commissions and committees recommend the practice of activity-centred learning.

POLICY PERSPECTIVE

The objective of science teaching is process-oriented like the development of scientific temperament, and scientific attitudes (NCF, 2005). To attain these objectives must be necessary to adopt process-oriented teaching in the classroom. Kothari Commission (1964) recommended that science should be taught through an activity-based teaching method; after that, the National Curriculum Framework (2005) recommended the adaptation of the constructivist approach in science teaching through which students find more space for learning by doing. This approach allows the learner to construct their knowledge according to themselves, and learning shifts from subject-centered and teacher-centered to learner-centered. In this continuum, the National Policy

on Education (2020) also recommends the adaptation of activity-centered pedagogical practices in science teaching, such as discovery learning, inquiry learning, guided inquiry, discussion method, and project method, through which learners participate in learning as active participants instead of passive listeners.

WHY IS CONSTRUCTIVISM IMPORTANT IN THE CLASSROOM

Constructivism is an umbrella term that comprises the many methods of learning, but at the root of all methods is the construction of knowledge by the learner. This approach is student-centered. This constructivism focuses on how knowledge is constructed in the classroom and how to implement the learning process in the classroom (Butler and Griffin, 2010). This is the paradigm shift in the field of teaching and learning. In behaviorism, the child assumes as an empty vessel that the teacher pours through their knowledge, and the child is a passive learner. In constructivism, a child assumes a vital body that has daily life experiences and interacts with other social groups; therefore, they find the scope for constructing knowledge according to their experiences (Yadav, 2016). Like this, the role of the teacher is also shifted from a Sage or a body of knowledge to a facilitator of children (Singh and Yaduvanshi, 2015). Teachers correct the misconception in knowledge constructed by learners. This step is essential because, due to misconceptions of the learners, they deviate from the construction of true knowledge; in this way, the teacher acts as the facilitator or guide. Based on all these arguments, NCF- 2005 advocates a shift in the classroom towards constructivism, and after that, NEP-2020 also vehemently advocates the adoption of the constructivist approach in the classroom; for these, it recommends virtual labs hands-on activity, inquiry-based and discovery-based learning. These characteristic features are carried out by methods of the constructivist approach; therefore, it is a very useful approach for teaching and learning science in the classroom.

MODELS OF CONSTRUCTIVISM

7E model of constructivism

Elicit- In this stage, the teacher checks the priory knowledge of the students and seeks the previous information of learners about the concept that they want to be taught in the classroom and illuminates interest and motivation in the students through some questions, story, etc.

Engage- In this stage, the teacher presents a problem and instructional task before the students, seeks their attention, and engages in it. The teacher should stabilize the connection between the

prior knowledge of students and the problem he presents before the student; this way, he can engage the student in the concept, process, and skill that will be learned by students.

Explore- In this phase, students are provided with time and space to carry out the experiments or interact with the environment. In this stage, students try to find equilibrium by accommodating and assimilating in the disequilibrium generated by the engagement stage. In this stage, the teacher observes students, helps them, and keeps them away from misconceptions in students. This stage is crucial because, based on the experiences gained in this stage, further discussion takes place.

Explain-In this stage, students or teachers provide a scientific explanation of the event, considering the experiences developed by the students. In this stage, students work with other classmates and teachers to accept and reject their proposed hypothesis (Mirçik and Saka, 2015). The teacher tries to focus students' attention on a specific aspect of the exploration stage.

Elaborate- In this stage, students try to improve their knowledge of concepts and skills and apply them to another context and scenario.

Evaluate- In this stage, students evaluate themselves and try to find the answers to different questions based on the previous stages of the learning. The teacher also evaluates the students in every aspect of the learning. The teacher evaluates the process as well as the product of a student.

Extend- The teacher presents a new context before the students and develops a deeper understanding among the students. The teacher presents the new situation and asks about the new examples and daily life examples, etc.

HOW TO IMPLEMENT IT IN CLASSROOM

Topic- Diversity in Animals, Class- 9th Elicit

Teacher- How many animals do you see in your daily life? Write on paper.

Students- write the names of different animals.

Teacher- Take some examples of different animals and ask for their characteristics.

Students- tell the characters of animals.

Teacher- Can you categorize all animals into different groups?

Students- Face difficulty during the categorization of animals into different groups.

Engage

Teacher- The teacher gives many examples of the animals and is asked to categorize them into

different groups.

Students- categorize them into different groups according to their external characters.

Teacher- What differences are observed in animals that you see in daily life?

Students tell different external characteristics of animals

Teacher- tells the definition of classification and name of the phylum. Gives lots of examples of animals, and shows the pictures in PPT.

Students- They carefully listen to the definition and watch all the animals shown by the teacher.

Explore

Teacher- He assigns a phylum to each group and asks students to categorize all animals according to their phylum.

Students- read and write characters of all phyla and categorize animals according to their phylum.

Explain

Teacher- will ask each group to explain what they observe and what character they identify during the categorization of animals.

Students- carefully listen to each other observations and characters of phylum and attempt to redefine their understanding.

Teacher- Asks questions specific to the character of the phylum

Students- Give proper and suitable justification for the categorization of animals.

Teacher- The teacher will clarify the characters of all phyla and give examples from animals categorized by students.

Elaborate

Teacher- Asks for some new examples of animals with their phylum and the reason for categorization in the specific phylum.

Students- They will give examples of many animals that they encountered in daily life and categories according to their specific phylum and give proper justification.

Evaluate

Teacher- Checks the worksheet of students.

Students- evaluate themself during classroom activities and group discussions.

Teacher- Initiates the group discussion and asks for another example of animals.

Teacher- Can give the name of the animal and ask to identify the phylum and type of that

animal.

Expand or Extend

Teacher- Presents some exceptional cases of animals and their larval stages before the students.

Students- They are curious to know the exceptional cases and larval stages of animals.

Teacher- He can ask about larval stages, which are seen by students in daily life, such as the Caterpillar larva of a butterfly.

Students- Identify some larval stages. Ex- Caterpillar larva of butterfly, Tadpole larva of frog.

Teacher- He can initiate discussion through questions like, how does diversity help in nutrient management on the earth?

Or

Why is diversity necessary on the earth?

Students- They will give many responses according to their understanding and experience.

Teacher- Helps students where they face difficulty and conclude the class.

CONCLUSION

In the modern era, science is a very necessary element of the curriculum at all stages of the school because it promotes critical, rational, and logical thinking in learners. Today, science is taught as a product of knowledge, while science should be taught as a process of knowledge. In the present scenario, constructivism is a very befitting approach for the teaching and learning of science in the classroom because it considers the student as a constructor or creator and discoverer of the knowledge; therefore, an urgent need to reform the pedagogical practices in the light of NEP-2020. It is also recommended that students be the discoverers of knowledge and advocate the different types of pedagogical practices such as the discovery method, inquiry-based method, and discussion-based learning; in this continuum, it also suggests the flexible method for the evaluation, which also supports the child's wellness and evaluates every aspect of the child, not only paper-pencil test basis these all things are found in constructivism. It shifts the learners' and teachers' roles towards a more democratic environment. Among the different available models of constructivism, the 7e model of constructivism is the most appropriate model for developing process skills in a child. A typical lesson plan based on the 7 Es framed by the author is an attempt to frame the learning strategy for the class 9th standard science classroom, which may prove helpful in realizing the goal of constructivism, i.e., helping the students to learn science in the classroom and outside of the classroom.

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INTRODUCTION

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POLICY PERSPECTIVE

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5

MODELS OF CONSTRUCTIVISM

7E model of constructivism

Elicit- In this stage, the teacher checks the priory knowledge of the students and seeks the previous information of learners about the concept that they want to be taught in the classroom and illuminates interest and motivation in the students through some questions, story, etc.

Engage- In this stage, the teacher presents a problem and instructional task before the students, seeks their attention, and engages in it. The teacher should stabilize the connection between the

prior knowledge of students and the problem he presents before the student; this way, he can engage the student in the concept, process, and skill that will be learned by students.

Explore- In this phase, students are provided with time and space to carry out the experiments or interact with the environment. In this stage, students try to find equilibrium by accommodating and assimilating in the disequilibrium generated by the engagement stage. In this stage, the teacher observes students, helps them, and keeps them away from misconceptions in students. This stage is crucial because, based on the experiences gained in this stage, further discussion takes place.

Explain-In this stage, students or teachers provide a scientific explanation of the event, considering the experiences developed by the students. In this stage, students work with other classmates and teachers to accept and reject their proposed hypothesis (Mirçik and Saka, 2015). The teacher tries to focus students' attention on a specific aspect of the exploration stage.

Elaborate- In this stage, students try to improve their knowledge of concepts and skills and apply them to another context and scenario.

Evaluate- In this stage, students evaluate themselves and try to find the answers to different questions based on the previous stages of the learning. The teacher also evaluates the students in every aspect of the learning. The teacher evaluates the process as well as the product of a student.

Extend- The teacher presents a new context before the students and develops a deeper understanding among the students. The teacher presents the new situation and asks about the new examples and daily life examples, etc.

HOW TO IMPLEMENT IT IN CLASSROOM

Topic- Diversity in Animals, Class- 9th Elicit

Teacher- How many animals do you see in your daily life? Write on paper.

Students- write the names of different animals.

Teacher- Take some examples of different animals and ask for their characteristics.

Students- tell the characters of animals.

Teacher- Can you categorize all animals into different groups?

Students- Face difficulty during the categorization of animals into different groups.

Engage

Teacher- The teacher gives many examples of the animals and is asked to categorize them into

different groups.

Students- categorize them into different groups according to their external characters.

Teacher- What differences are observed in animals that you see in daily life?

Students tell different external characteristics of animals

Teacher- tells the definition of classification and name of the phylum. Gives lots of examples of animals, and shows the pictures in PPT.

Students- They carefully listen to the definition and watch all the animals shown by the teacher.

Explore

Teacher- He assigns a phylum to each group and asks students to categorize all animals according to their phylum.

Students- read and write characters of all phyla and categorize animals according to their phylum.

Explain

Teacher- will ask each group to explain what they observe and what character they identify during the categorization of animals.

Students- carefully listen to each other observations and characters of phylum and attempt to redefine their understanding.

Teacher- Asks questions specific to the character of the phylum

Students- Give proper and suitable justification for the categorization of animals.

Teacher- The teacher will clarify the characters of all phyla and give examples from animals categorized by students.

Elaborate

Teacher- Asks for some new examples of animals with their phylum and the reason for categorization in the specific phylum.

Students- They will give examples of many animals that they encountered in daily life and categories according to their specific phylum and give proper justification.

Evaluate

Teacher- Checks the worksheet of students.

Students- evaluate themself during classroom activities and group discussions.

Teacher- Initiates the group discussion and asks for another example of animals.

Teacher- Can give the name of the animal and ask to identify the phylum and type of that

animal.

Expand or Extend

Teacher- Presents some exceptional cases of animals and their larval stages before the students.

Students- They are curious to know the exceptional cases and larval stages of animals.

Teacher- He can ask about larval stages, which are seen by students in daily life, such as the Caterpillar larva of a butterfly.

Students- Identify some larval stages. Ex- Caterpillar larva of butterfly, Tadpole larva of frog.

Teacher- He can initiate discussion through questions like, how does diversity help in nutrient management on the earth?

Or

Why is diversity necessary on the earth?

Students- They will give many responses according to their understanding and experience.

Teacher- Helps students where they face difficulty and conclude the class.

CONCLUSION

In the modern era, science is a very necessary element of the curriculum at all stages of the school because it promotes critical, rational, and logical thinking in learners. Today, science is taught as a product of knowledge, while science should be taught as a process of knowledge. In the present scenario, constructivism is a very befitting approach for the teaching and learning of science in the classroom because it considers the student as a constructor or creator and discoverer of the knowledge; therefore, an urgent need to reform the pedagogical practices in the light of NEP-2020. It is also recommended that students be the discoverers of knowledge and advocate the different types of pedagogical practices such as the discovery method, inquiry-based method, and discussion-based learning; in this continuum, it also suggests the flexible method for the evaluation, which also supports the child's wellness and evaluates every aspect of the child, not only paper-pencil test basis these all things are found in constructivism. It shifts the learners' and teachers' roles towards a more democratic environment. Among the different available models of constructivism, the 7e model of constructivism is the most appropriate model for developing process skills in a child. A typical lesson plan based on the 7 Es framed by the author is an attempt to frame the learning strategy for the class 9th standard science classroom, which may prove helpful in realizing the goal of constructivism, i.e., helping the students to learn science in the classroom and outside of the classroom.

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