Pedagogical Approaches in Science Teaching

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INTRODUCTION

Learning is dependent on the pedagogical approaches, the teachers use in the classroom. A variety of pedagogical approaches are common in schools, but some strategies are more effective and appropriate than others. The effectiveness of the pedagogical approaches often depends on,

(i) The subject matter to be taught

(ii) Understanding of the diverse needs of the learners

(iii) Class room conditions and the conditions of the surrounding context.

In general, the best teachers believe in the capacity of their students and they carefully utilize a vast range of pedagogical approaches to ensure that the process of learning occurs effectively.

Pedagogy and its Forms

Pedagogy refers to the interactions between teachers, students, learning tasks (the content to be mastered) and learning environment.

This broad term ‘pedagogy’ explains how teachers and students relate together with the instructional approaches implemented in the classroom.

Pedagogical approaches are often placed on a spectrum from teacher-centred pedagogy to learner-centred pedagogy.

Though these two approaches seem to be contradictory, they can often complement one another in the attainment of the desired educational goals - for example, a teacher-centred approach may be useful to introduce a new theme, while a learner-centred approach may be necessary to allow students to explore these ideas and develop a deeper understanding.

Teacher-Centred Pedagogy

‘Teacher-centred’ pedagogy positions the teacher at the centre of the learning process and typically relies on methods such as whole-class lecture, rote memorization and chorus answers.

This approach is often criticized, especially when students complete only lower-order tasks and are afraid of the teacher.

However, teacher-centred pedagogy can be effective when teachers frequently ask students to explain and elaborate the key ideas, rather than merely lecture.

Learner-Centred Pedagogy

This pedagogical approach has many associated terms (e.g., constructivist, student-centred, participatory, active), suggesting that learners should play an active role in the learning process.

The students use prior knowledge and new experiences to create new knowledge. The teacher facilitates this process, but also creates and structures the conditions for learning.

Learning-Centred Pedagogy

"Learning-centred pedagogy" is a relatively new term that acknowledges and includes both learner-centred and teacher-centred pedagogical approaches, but the teachers must consider the surrounding context such as the total number of students in the class, the physical environment, the availability of teaching and learning materials, etc.

This pedagogical approach also suggests that the teachers should be flexible and carefully employ their pedagogical approaches based upon the school environment.

Basic Principles of Pedagogical Approaches

(i) Explanation follows Experience

(ii) Importance of Prior Experiences

(iii) Importance of Student Involvement

(iv) Conceptual Development

(v) Importance of Student Discussion and Questioning by Teachers

Explanation follows Experience

Many teachers explain scientific ideas first to their students then illustrate the ideas with practical aspects and experiences.

This works well on the reverse principle that theory (or explanation) should follow the experience. In other words, understanding will be developed better from concrete activity than from verbal explanation.

If students are to understand concepts, they need a concrete base upon which they can build their understanding.

It is important for teachers to provide a structure for students to carry out investigations and more effective learning will come from students' own experiences rather than from what the teacher tells them.

Importance of Prior Experiences

Students come to learning situation with a variety of previous experiences.

Their minds are not similar to empty vessels but they have a whole range of different ideas and misconceptions.

A teacher must identify these ideas, since learning and knowledge need to be built on existing ideas and challenging misconceptions as appropriate.

Importance of Student Involvement

Learning is enhanced if students are actively involved.

These pedagogical approaches are directed at increasing involvement of the students.

Students need be interested and engaged if they are to learn.

Relevant activities, discussion and events that spark curiosity can foster this interest.

Conceptual Development

To be intellectually rigorous is an important issue in learning (knowledge resources).

Rigor is not measured by the amount of scientific facts that are memorized, but rather by the depth and richness of conceptual understanding (understanding and development of newer concepts).

The best measure of learning is not what students remember, but rather how the students apply their understanding to new situations (application of concepts).

Importance of Student Discussion and Questioning by Teachers

In traditional lessons, the main vehicle of teaching is teacher explanation (whole-class lecture).

In inquiry learning, the teacher uses questions to help developing the understanding.

Questions and questioning become very important skills for an effective teacher.

As students discuss ideas in small groups or as a class, they can test and refine their understandings. This does not mean that teacher explanation is not important. Bothe should go hand in hand for maximum impact and effect.

Since, ideas need to be related to evidences and views need to be justified.

Pedagogical Approaches in Science Teaching

"Eight 'Es' of Science Teaching

1. Expectation
2. Engagement
3. Exploration
4. Explanation
5. Elaboration
6. Experience
7. Enjoyment
8. Evaluation

Eight ‘Es’ of Science Teaching

(i) Expectation

- The teachers are the guiding lights as they help students achieve the expected learning objective and the teachers should also deliver the lesson plan with great energy and enthusiasm.
- All the students should aim at the same learning expectations to excel and develop creative thinking toward individual constructivism.

(ii) Engagement

- In an academic discipline, engagement is usually called the "anticipatory set."
- The main purpose of this stage is to make sure that students' minds are ready for instruction.
- The students must be ready to learn before teachers tap them into the learning process.

Eight ‘Es’ of Science Teaching

(iii) Exploration

- This is an investigative imagination process.
- Teachers must allow students to explore the things they are going to be working with in the lesson. The students should explore both prior and new knowledge and thereby discover new ideas.
- This stage will be more productive if the teachers provide physical samples (fossils, plants, lab experiments, specimens, etc.,) so that the students can see and handle things for themselves.
- Exploration leads the students to discover new ideas and arouses curiosity, which prepares them to receive and understand the concepts in the lesson plan.

(iv) Explanation

- Following the exploration process is the instructional phase, the core concept of teaching and learning science.
- Educators refer to this stage as guided practice for which a number of instructional models can be used.
- This process is best performed when teachers encourage students to ask questions to clarify their misperception and misconceptions.
- Also, the students should be encouraged to question the answers rather than looking for the answers.

(v) Elaboration

- In this stage, the teachers help the students to differentiate, explain, compare, contrast, and combine ideas.
- Depending on the objectives of the lesson plan, the teachers provide additional information and would be constantly checking for their understanding.
- The teachers need to provide means and opportunities for the students to demonstrate their understanding.
- Besides, the students also need to have some kind of experimental experiences.

Eight ‘Es’ of Science Teaching

(vi) Experience

- Science could be learned from experimental experiences, not always from the book.
- If permitted, teachers should encourage the students to conduct simple experiments with the surrounding context as much as possible.
- The teachers should design a lesson plan to be taught outside the classroom, like paying a visit to the local zoo.
- The students need to have experiences that are rich, meaningful and cognitively constructive.
- Most importantly, the teachers must evaluate the learning outcome with constructive applications.
- Direct experiences, such as visiting museum, going on a field trip, collecting leaves in the school yard, planting seeds and observing germination process are the true experiences for the students to think critically about teaching and learning science.

(vii) Enjoyment

- Once the students find that science learning is fun, enjoyable and playful, then the level of excitement and enjoyment will take them to the next thought process that will engage students deeply and actively in the learning process.
- Enjoyment, in most cases can produce intrinsic as well as extrinsic learning motivations.
- In other words, students learn science because of self-desire or of rewards which they receive from the teachers that are highly and academically valuable to motivate them to do more.

(viii) Evaluation

- The scientific activity should end up with evaluation. Teachers need to do a final check for understanding as part of the closure of the lesson.
- In most cases, evaluation is a test that measures the student learning. The problem is that most teachers test students on retention of information rather than on creation of new knowledge.
- The ultimate goal of science education is the construction of new knowledge.
- Therefore, the teachers should evaluate students on their mastery of the subject knowledge that would be the objective of the lesson plan.

Thank you