

Methodology of Teaching Science

Objectives

In this lesson, you will learn to

- List and explain the various methods of teaching.
- Comprehend the various merits and demerits of the different methods of teaching.
- Choose an appropriate method of teaching for a particular topic.

Keywords

Methodology

a set or system of methods, principles, and rules for regulating a given discipline.

Methodology of teaching science

Science, taught badly, not only degenerates into superstition, but makes a negative contribution to education. To learn science is to do science. In this context, teaching of science gains significant importance and it needs an appropriate method. So it is important to know about the different methods of teaching science and to be able to choose the appropriate method in a classroom. The methods are namely lecture method, demonstration method, lecture cum demonstration method, laboratory method, heuristic method, assignment method, project method, problem solving method, question and answer method, role playing method, brain storming method and innovative method. It is up to a teacher's discretion to choose the method which is most suitable for a certain topic in a certain class and sometimes a teacher should introduce different methods in a lesson plan to address the learning styles of the students.

Lecture method

Lecture means speech or talk. In a lecture method, the teacher is the speaker most of the time and the students just passive listeners. The teacher prepares the talk on a topic and delivers in the class. Students tend to lose concentration after some time of listening but this can be taken care of by asking questions in between the lecture and often citing interesting examples during the lecture. This method is very economical because a single person can give knowledge to a large number of students at the same time. Also no apparatus or materials is needed. Lecture method is simple, short and fast, thus saving time. This is a very effective method for fact based knowledge and historical explanations and also in certain situations such as introduction of a topic, instructions for some activity, revision of the content, etc. This is a method very useful for higher classes where large amount of knowledge needs to be transferred in a short span of time. Over to the demerits, lecture method is not a psychologically sound method as more emphasis is laid on the content. This method does not provide opportunity for active involvement. It does not give time to the students to grasp the matter as it is delivered very fast. Also lectures cannot be given by everyone and anyone. Only some people are effective speakers.

Demonstration method

Demonstration means to show. In this method, the teacher only shows certain phenomena, concepts or principles to provide concrete experience to the students. It may include the use of specimen, film slides, chemicals, equipments and experiments, etc. Students remain active during the demonstration. Sophisticated and complicated apparatus can be used by the teacher which cannot be handled by the students. As only the teacher is handling the equipment, only less time is consumed. Scientific facts, principles and theories can be effectively proved through this method. Demonstration method is a teacher centered method, the principle of learning by doing is neglected as students do not get a chance to experiment. It is not effective if done in a large classroom. Also the individual differences of the students cannot be taken care of.

Lecture-cum-demonstration methods

Only the lecture method or only the demonstration method is practically not feasible. If a lecture is given in a proper sequence with illustrations or concrete experiences, it is helpful in learning. Any demonstration combined with discussion and questioning is an effective technique. Lecture-cum-demonstration method is thus, a combination of these methods. Also this method has the same merits and demerits as that of the demonstration method.

Laboratory method

There is a talisman in science education which states "I heard and I forgot; I saw and I remembered; I did and I understood." Science is a subject which can be best learned by doing. Laboratory method is one such method which is based on this principle of learning by doing. The teacher acts as a guide and supervisor and gives instructions including required materials and equipments. The students perform the experiment, records observations and draws inferences. The teacher goes to the students, observes what is being done, corrects them if something is wrong. During the process the students learn by doing to gain permanent knowledge. The students are active throughout the class and they are learning on their own by doing. The knowledge gained is permanent. Weakness of each student can be identified and required help can be provided. This method also facilitates training in scientific method i.e., training in performing experiments, observing, recording data, interpreting results and drawing conclusions. The demerits of this method is that it is an expensive method as separate equipments are needed for each student. For this method to be useful, teacher-student ratio has to be low, otherwise the teacher cannot pay attention to each student individually. This method is suitable for some specific type of topics only. It also needs more effort on the part of the teacher as she is expected to prepare the instructions and observe each student.

Project method

Project may be any purposeful activity like the preparation of a working or static model, a chart or performing an experiment. In this method, a group of students select a problem after discussing with the teacher and formulate the hypothesis. They develop the plan of action, list the needed equipments, and conduct the experiment for testing the hypotheses. Then they note down the observation, collect the data, interpret it and finally they reach the conclusion. This method basically aims to provide the students with the opportunity for extended learning. Moving on to the merits of the project method, this method helps in giving clarity to various concepts of science. The knowledge gained is permanent. The qualities of self confidence, co-operation and leadership are also developed in the students. This method is a psychological method based on learning by doing. Over to the demerits, project method is a very difficult method for teachers as a lot of planning and effort is required. It is also not an economical method as more material and equipments are needed. The method is very time consuming and the syllabus cannot be completed in a systematic and sequential manner.

Problem solving method

Problem solving method provides the students an opportunity to solve problems on their own by following some scientific steps. The lesson starts with a problem and some possible solutions are thought by the students on the basis of their previous knowledge. The problem is first identified, stated and then explained through discussions, self study, practical work, etc. Next is the delimitation of the problem concentrating only on those parts of the problem which are within the reach of the students. Now a hypothesis is formulated for investigation, the hypothesis is tested through experiments and the conclusion is reached finding out the best hypothesis. Through this method, the habit of self learning is developed and the students develop problem solving skills. A scientific attitude is also inculcated in them each time when they follow the steps in solving a problem. Also this method has the same demerits as that of the project method.

Question answer method

Since ancient times, educationalists have realised that teaching is incomplete without questions. It is a major component in lessons to invoke curiosity among the students. The questions need to be framed in a systematic and organised manner and these questions are placed before the students. Co-relating various answers provided by students paves the way for developing new knowledge. It is widely used for purposes like introduction, content presentation, revision, etc. Merits of this method include that the students remain active throughout the class and the response can be used for evaluation. It arouses curiosity and enhances the power of logical thinking, reasoning and expression. The question answer method in itself is not complete and it should be combined with other methods. Also framing and asking proper questions require social skills among teachers.

Brain storming method

In the brain storming method, a problem is given to the students. Everybody gives their views on the problem and discusses it. Points emerging from the discussion are noted on the blackboard. Through the discussion and debate, a solution is found. This method gives a chance to everyone to express their thoughts and contemplate on it. This method is useful in higher classes and encourages students to express themselves and to think independently, logically and critically. It also encourages creativity. This method is suitable for a very few topics. Also it is not suitable for junior classes. The method is again a time-consuming method.

Heuristic method

Let us start by looking at the ninth method. The Heuristic method was given by Prof H.E. Armstrong, a professor of chemistry in London. In the heuristic method, students are given a problem and all the necessary instructions to solve it. All the aspects of the problem are discussed with the students and then they are given the freedom to find the solution. They themselves carry out experiments, make observations and draw conclusions. This method does not intend to be a separate method but it incorporates any method which enables the development of scientific enquiry. Some merits of this method are that the students are actively involved, the spirit of enquiry is developed and the acquired knowledge is permanent. The habit of self study and hard work and a scientific attitude are developed in the students with teachers only for guidance. The students are also bothered with very less homework load. Heuristic method cannot be used at the primary level. Also the expectations are high from the students as they are demanded to discover science on their own. It is time-consuming and the syllabus cannot be covered, if only this method is used. Efforts on the teachers are also high as they have to plan and give proper instructions to the students.

Assignment method

Assignment method can be used for teaching theory as well as practical aspect of the syllabus. In this method, the whole course is divided into various parts according to the topics, as assignments. These assignments are given to the students to be completed within a stipulated time. After completing theory of one topic, the student moves on to the practical aspect. After this they move on to the next topic. In the assignment method, each student works according to his/her capacity. The individual differences are taken care of. Habits of self study, decision making are inculcated in students. There is ample freedom of work as duration of assignment is dependent on the student's capability. This method is also financially viable. In the case of this method, responsibility of a teacher increases manifold as they are required to prepare the assignment, write the instructions, allot the assignments, provide guidelines, ensure the availability of equipments and evaluate the assignments too. But students with lower intelligence may not be able to comprehend the guidelines and the method may not be suitable for all the students. Also this method is not practical in the existing school conditions as the text books in this format are not available.

Role playing method

Role playing method is based on the imitation of a role. This method is very helpful in bringing out changes in the personalities of students including developing their social skills. It can be used for various purposes. It can also be used to teach some simple topics to younger children, e.g., solar system, balanced diet. No time is given to practice the role as they are given in the class itself. The topics to be taught are divided into topics and an outline to the play is prepared by the teacher. The roles are allotted to the students. After giving a briefing on how to play the roles, the roles are enacted. The teacher observes the role playing and reviews it. Later on, a discussion is held between the students and the teacher to summarize the learning. This method gives proper chance for expression of feelings and is very useful for primary classes. This method is very interesting and enjoyed a lot by the students. The demerits of this method includes that it is suitable mainly for junior classes and often creates an artificial atmosphere in the class. Also this method cannot be used to teach all the topics.

Innovative method

The last and final method is namely innovative methods. This methods include taking the students for field trip, organising science exhibitions which provides concrete experiences as well as enhances the creativity of the students and also using two or more methods clubbed together to cater the different learning styles of the students in a class. For example, project-cum-laboratory method can be used to develop different process skills and science skills in the students. This method is useful in a diverse class with different learning styles. It helps to develop process skills and creativity. This method can be customised to classrooms and lessons, making it very effective.

Previous Year Questions

1. Geeta is preparing a lesson-plan' for teaching the topic on 'Human eye' to Class VIII students. Inclusion of which of the following activities in the lesson-plan is likely to be most effective in helping the *students understand related concepts better?
 - a. Preparing a good home assignment
 - b. Dictating notes to students in the classroom
 - c. Using student activities and interactive classroom questioning
 - d. Demonstration using model of human eye
1. Practical work in Science may be given due emphasis in order to
 - a. improve the percentage of marks obtained by the students
 - b. help the students develop the habit of maintaining written records
 - c. keep proper check on punctuality and regularity of students
 - d. help the students verify the theoretical concepts
1. **Hands-on activities and projects form an integral part of learning of Science. These learning experiences primarily aim at**
 - a. assessing the students on practical skills
 - b. keeping the students engaged all the time
 - c. maintaining discipline in the laboratory
 - d. providing opportunity to students for extended learning
2. **The following steps (not in the proper sequence) are generally recommended to be followed in scientific method :**

(A) Testing of hypothesis (B) Formulation of hypothesis (C) Identification of problem (D) Collection of data (E) Drawing of conclusion Which one of the following is the correct sequence of, the above steps to be followed for this purpose?

- a. (C), (A), (D), (B), (E)
- b. (C), (B), (D) (A), (E)
- c. (D), (C), (B), (A), (E)
- d. (B), (C), (A), (D), (E)

3. **Science is considered to be questioning, exploring, doing and investigating. Which of the following activities, carried out by Dipika in teaching of Science, is, best suited to satisfy these criteria?**

- a. Unit test on microorganisms
- b. A group discussion on Common diseases.
- c. A "debate on environmental issues
- d. Project work on nature of sound

4. **Which of the following strategies are most appropriate for a teacher to teach the topic 'Save Energy'?**

- A. Ask students to write slogans on saving energy
 - B. Write at least five ways to save energy
 - C. Make a model/project to depict energy saving
 - D. Encourage students to save energy in various ways in their lives
- a. A, C and D
 - b. B, C and D
 - c. A, B and C
 - d. A, B and D

1. One of the main limitations of the Project method of teaching Science is that

- a. the students have to perform excessive mental and physical work
- b. it is a psychological method
- c. knowledge is not acquired in a sequential manner
- d. integration of concepts in various subjects can be achieved

1. Project method in teaching of science is suited most to

- a. promote understanding of basic concepts in Science
- b. enhance numerical abilities of students
- c. strengthen reasoning skill of students
- d. promote scientific method of working

1. Somia usually takes her Class VII students on a field trip. Which of the following could be the objective(s)? A. It provides concrete experiences to students. B. She can give them assignments and projects for formative assessment. C. It enhances process skills of students. D. It saves her teaching time.

- a. Only D

- b. B and C
- c. A,B and C
- d. Only A

2. Which one of the following is most suited to the development of scientific skills in students ?

- a. Conducting Science quiz
- b. Organizing a field visit
- c. Conducting Science Olympiads
- d. Performing laboratory work

3. Science Exhibitions is to

a. **grade students on practical skills.**

- 1. provide opportunity to students to compete with others.
- 2. provide opportunity to students to showcase their creative ideas
- 3. provide opportunity to students to enhance their academic performance.

1. Vandana is interested to focus more on acquisition of process skills of science by students of Class VIII. Which of the following combination of methods should she prefer to teach the topic on 'Micro-organisms' ?

- a. Assignment-cum-questioning method
- b. Project-cum-laboratory method
- c. Home assignment-cum-science quiz method
- d. Home assignment-cum-questioning method

1. A Science teacher is interested to focus more on acquisition of process skills by the learners. Which of the following combination of methods of teaching should be preferred by her to achieve the objectives ?

- a. Assignment-cum-questioning method
- b. Lecture-cum-discussion method
- c. Project-cum-laboratory method
- d. Lecture-cum-demonstration method

1. The technique of role-play is considered to be an effective strategy in 'teaching of Science because

- a. it ensures better understanding of one's role in real life
- b. it ensures active participation of students in the process of learning
- c. it is likely to promote social skills of students
- d. it ensures breaking of monotony in the process of learning

Previous Year Additional Questions

1. While investigating 'how water affects the germination of seeds', a teacher asked the students to soak bean seeds on a bed of cotton wool for a few days and observe the changes. What is the guideline that she forgot to mention? To place

- a. many seeds on wet cotton

- b. a few seeds on wet cotton
 - c. many seeds on dry cotton
 - d. a few seeds on dry cotton
2. Describing the relationship between the distance travelled by a ball that is rolled on the inclined plane and the angle of the plane by constructing a graph is an example of
- a. Hypothesizing
 - b. Predicting
 - c. Interpreting
 - d. Communicating

CFU Questions

Fill in the blanks questions

1. Science, taught badly, degenerates into -----
2. ----- method is a very effective method for fact based knowledge and historical explanations.
3. In ----- method, sophisticated and complicated apparatus which cannot be handled by the students can be used by the teacher.
4. The demerits of ----- method is that it is an expensive method as separate equipments are needed for each students.
5. In a ----- method, the teacher is the speaker most of the time and the students just passive listeners.

True or False questions

1. The project method is very time consuming and the syllabus cannot be completed in a systematic and sequential manner.
2. Problem solving method provides the students an opportunity to solve problems on their own by following some scientific steps.
3. The assignment method is suitable for all the students.
4. The role play method very helpful in bringing out changes in the personalities of students including developing their social skills.
5. Innovative method helps to develop process skills and creativity

Summary

- To cater to a wide variety of learning styles and the demand of process skills in a classroom, different methodology of teaching is important in science.
- The methods are namely lecture method, demonstration method, lecture cum demonstration method, laboratory method, heuristic method, assignment method, project method, problem solving method, question and answer method, role playing method, brain storming method and innovative method.

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Answers

Previous Year Questions

1. b. supervise students and provide guidance wherever required.
2. d. demonstration using model of human eye.
3. d. help the students verify the theoretical concepts.
4. d. providing opportunity to students for extended learning
5. b. (C), (B), (D) (A), (E)
6. d. Project work on nature of sound
7. b. B, C and D
8. c. knowledge is not acquired in a sequential manner
9. d. promote scientific method of working
10. c. A,B and C
11. b. Organizing a field visit
12. c. provide opportunity to students to showcase their creative ideas
13. b. Project-cum-laboratory method
14. c. Project-cum-laboratory method
15. c. it is likely to promote social skills of students

Previous Year Additional Questions

1. b
2. c

Check For Understanding

1. Fill in the blanks.

1. Superstitions
2. Lecture
3. Demonstration
4. Laboratory 5.lecture

2. Write True or False.

- a. True
- b. True
- c. False
- d. True
- e. True