Course: Teaching Strategies in Science Education (6437)
Semester: Spring, 2021
ASSIGNMENT No. 2

Q.1 Compare the advantages and limitations of lecture and discussion methods for teaching of science.

Despite the lecture method being so unpopular among professional educational advisers, reformers and intellectuals generally - and almost annual declarations that information technology will render lectures obsolete - many scientists continue to give lectures and students continue voluntarily to attend them. This fact that lectures have survived so much official opprobrium suggests that they are a much more effective teaching method than they are given credit for. Indeed, my experience suggests that properly structured-lectures may be the best teaching method for many subjects and many students, and lectures may be especially well-suited to the transmission of conceptual and systematic knowledge. Lectures are therefore usually the best medium for teaching science up to the point where the student begins to specialize and train as a practicing scientist, at which point a more individualized and skill-orientated 'apprenticeship' becomes necessary. In itself, the greater ease of learning from lectures may indeed account for some of the disdain with which many intellectuals regard lectures – since intellectuals are experts at the cognitively-challenging business of learning by solitary reading. For example, intellectuals may deride clear, comprehensible and enjoyable lectures as ‘spoon-feeding’ students; with the implication that students should be forced to work hard for their basic knowledge in the same way that intellectuals do for their advanced knowledge. Lectures are also criticized as inculcating a ‘passive’ attitude to learning. But we need to be clearer that making learning easier is an admirable objective, assuming that what is being learned is worthwhile (as it is in the sciences). Making learning easier is especially important for the less-naturally-gifted proportion of the population who make up an increasingly large number of higher education students in advanced societies due to the massive recent and continuing expansion of colleges and universities. If knowledge is valuable, then we should embrace effective methods of inculcating knowledge: the easier the better.

What follows are a series of personal impressions based upon 18 years of lecturing in universities and studying educational methods. I see many advantages to lectures, which seem obvious yet are seldom noted or acted-upon. The first is that it is easier for most people to learn conceptual information from spoken communications than from reading. The second is that the real-time, human-presence, social context of a formal lecture makes it easier for most students to focus attention and remember what is said that when students are required to work alone. A third factor which deserves recognition is that the proper unit of educationally-valuable lectures is a course of lectures, not a one-off talk. One-off talks may be entertaining (for the audience) and useful self-advertisement (for the lecturer) – but they do not have much to do with serious education.

In what follows I suggest that lectures are 'spontaneously' easier to learn-from than are written or electronic media, and the reason is probably that they exploit evolved human psychology. In other words, lectures are better suited to ‘human nature’ than solitary study from texts. There is a natural tendency for humans to learn by

hearing and in social situations because this is the medium and context in which human ancestors (hunter-gatherers) did most of their learning. However, learning by solitary reading or from electronic media are a modern cultural artefacts, skills that must themselves be learned; they are not universal and require more effort. While some people manage reach a stage of cognitive development where they can self-educate from impersonal media, many people require a human situation and benefit from being part of a class being lectured by a real person.

One of the most challenging teaching methods, leading discussions can also be one of the most rewarding. Using discussions as a primary teaching method allows you to stimulate critical thinking. As you establish a rapport with your students, you can demonstrate that you appreciate their contributions at the same time that you challenge them to think more deeply and to articulate their ideas more clearly. Frequent questions, whether asked by you or by the students, provide a means of measuring learning and exploring in-depth the key concepts of the course.

Create a comfortable, non-threatening environment. Introduce yourself and explain your interests in the topic on the first day. Encourage questions from the outset. For example, require each student to submit a question about the course during the first day or week. Students can submit these questions via an online discussion forum; this assignment can also serve as a way for you to ensure that they have each figured out how to log on to a discussion forum that you are using throughout the course.

Arrange the chairs in a configuration that will allow students to see and speak with one another. Move the chairs back to their standard configuration after the class session has ended. (In University-managed classrooms, the standard configuration is displayed on a diagram posted near the door.)

Get to know your students and the skills and perspectives they bring to the discussions. Learn your students' names during the first week of class. Consistently use their names when calling on them and when referring to comments they have made in class or in threaded email discussions. Using their names will convince them that you see them each as individuals with something valuable to add, thus creating an environment of mutual trust and interest. This strategy will also encourage the students to refer to one another by name.

Understanding your students' skills and perspectives can help you to develop specific ways of challenging each of them to think critically and express ideas clearly.

Clarify the rules and expectations for discussions at the outset. Define what you think of as a successful discussion (for example, one that includes participation by all group members, stays on topic, and explores issues in depth and from a variety of perspectives.) Make it clear that good discussions rarely happen without effort. Distribute or post on the board a list of rules and expectations that will promote successful discussions. For example, to discourage students from monopolizing the discussion or interrupting one another, indicate

whether it will be necessary for students to raise their hands and be called on before speaking; this decision will depend on your preference and on the size of the class.

You might also consider opening the discussion on the first day of class with small-group discussions about effective discussions and how to achieve them. Then, reconvene the class as a whole to formulate together the guidelines for discussion that the class will follow the rest of the semester. Less experienced students will require more guidance with this task. For all groups, however, having the students take a role in formulating the rules will mean that they will be more invested in following them.

Communicate to students the importance of discussion to their success in the course as a whole. If you use discussions on a regular basis, assign grades for student participation. Inform students of the specific criteria that you will use. For example, will you evaluate the frequency and quality of their contributions, as well as how effectively they each respond to others' comments? Will you include in each participation grade the student's performance on informal writing, online discussions, minor group projects, or other work? If you grade class participation, give students preliminary grades and brief written evaluations as early as 3-4 weeks into the semester and at midterm so that they will know where they stand. Your written evaluation can be designed to encourage the quiet students to talk more often and the verbose students to hold their comments to give others a chance to participate).

No matter how often you use discussions in your course, you can underscore their importance by ensuring that you discuss material that later appears on exams and by integrating students' contributions (with attribution) into subsequent lectures, discussions, and assignments.

Plan and prepare the discussion. Develop clear goals and a specific plan for each session. Compose specific questions that will move the discussion forward, illuminate major points, and prompt students to offer evidence for their assertions and to consider other points of view (see Asking Questions to Improve Learning).

Accommodate different learning preferences. Expect that your students will bring into the course different learning preferences. For example, while some may be active learners who prefer to solve problems in order to learn concepts, others are reflective learners who prefer to master concepts through uninterrupted reflection. Recognize your own learning preferences and make efforts to extend your approach beyond those preferences. In other words, do not assume that you can teach something in the same way that you learned it and get the same results with all of your students. You can be most effective if you combine teaching methods to reach as many students as possible: for example, combine verbal and visual explanations, explain concepts using both a "big-picture" and a detail-oriented approach, and give students opportunities for active learning and reflection. (For more information about the learning preferences referenced here, see Professor Richard Felder's Web site.)

Provide a structure. Write an outline or list of guiding questions on the board before you begin the discussion. Each session should have a clear beginning, middle, and end. Respond to student contributions in ways that move the discussion forward and keep it focused on the topic at hand.

Throughout the Discussion

At appropriate points in the session, summarize the major ideas and write them on the board. If you do not do this, students will have a hard time picking out the most important ideas from the discussion and understanding their significance. Writing on the board is particularly helpful for students who are visual learners.

Combine discussions with other methods. Plan to use brief lectures to introduce complex topics or to clarify the larger concepts that the current set of readings investigates (see Teaching with Lectures). Beginning on the first day, use frequent small-group work: divide the class into groups of 2-4 students, then give each group a focused assignment, with specific objectives and roles that they should each take on in order to complete the assignment. Assign students brief writing assignments, such as writing a set of questions or a brief reflective piece that will serve as the basis for in-class discussions. Consider supplementing class discussions with threaded, online discussions that you monitor. Small-group discussions, writing assignments, and online discussions can be effective methods for encouraging participation by students who are uncomfortable speaking in large groups and for enabling students to learn from one another.

Integrate student responses into the discussion without making the discussion merely a student-teacher interaction. Ask students to respond directly to one another's ideas. The use of small-group discussions will allow students to become better acquainted and thus facilitate their communication with one another.

Use verbal and non-verbal cues to encourage participation. Especially near the beginning of the semester, call on all students to answer questions, not just those who consistently raise their hands. Make eye contact and move around the room to engage the attention of all the students and to communicate that you expect each of them to participate.

Q.2 Discuss steps of recitation method. Also provide examples for its effectiveness for science teaching.

Recitation is a direct, teacher-centered approach in which the teacher asks specific short answer questions with a specific answer in mind. Incorrect answers are usually corrected by the teacher or by the class. A teacher may use probing questions in order to help the class come to the correct answer. The repetition of question and answer helps information retention. It is best used for the memorization of facts--base level knowledge.

Uses:

Assessing student comprehension of a lecture or demonstration.

Reviewing factual material for an upcoming test.

Methods:

When using recitation as a strategy, the teacher should have all of the questions planned out ahead of time.

The teacher should obtain the attention of the entire class, and address the question to the entire class before asking a specific student to respond.

Call on volunteers as well as non-volunteers

Encourage students to speak to the whole class when responding

Jeopardy game is a good way to incorporate technology into recitation strategy.

Have students call on one another by having them pass an object around the room.

Be sensitive to students' willingness to speak publicly, and never put a student on the spot.

A recitation class is a small class that complements a large lecture by focusing on the critical points from the lesson in a smaller setting. Students are guided by a teacher's assistant as they evaluate lecture content with their peers, asking questions and wrestling with their ideas as they develop a deeper understanding of the material.

A recitation class is going to be the foundation you need to complete your studies and finish with a proper understanding of the concepts you were taught. When you go into college, you will have a variety of class types that your curriculum is taught through. These range from labs and lectures to seminars and recitations. A recitation class is a little different from the other courses you will have. This class can be incredibly beneficial to your learning; however, it can be a little challenging to make the most of it. The recitation class is designed to serve as a supplement to this format, providing students an opportunity to learn from each other as a teacher's assistant (TA) guides the group's discussions and thought processes in an effort to ensure deeper learning takes place. A recitation class is a complement class to a lecture. It is designed to focus on complex points of the associated lecture that either have complicated material (i.e., math or science) or a large-sized class where messages can get lost. It's important to remember that the lecture aims to teach many students; however, not every student's academic needs are adequately addressed, so a recitation class focuses on this and fills in any gaps. Depending on the subject, each recitation class may be structured a little differently. A recitation class that is a complement to a mathematics or engineering lecture will often utilize this section by performing derivations, solving problems, and ensuring that students have a proper understanding of methods and applications. Scientific classes (ie. biology, chemistry and physics) use their recitation class to clarify anything that was not fully understood during the lecture or was not able to be adequately covered due to time constraints. When it comes to English/language courses, recitation classes will iron out any issues with pronunciation, prose, multiple meanings while promoting a deeper understanding of the material. Overall, a recitation class allows a student to clarify anything that they were unsure about as well as ask questions about particular concepts and review the material.

A recitation class can vary a little depending on the course and what the professor has outlined and instructed the TA/instructor to do.

It is usually about interactive learning with other students and personalizing interactions with the professor or TA, so academic needs are met. 4

The smaller group allows students to develop their confidence to ask questions and fully participate in discussions, without the stress of a large audience, ensuring the student can grasp concepts and accomplish their goals fully.

A Recitation Class Usually Consists of the Following Elements:

- Group work
- Opportunities to ask questions
- Clarification of points from the lecture
- Written or discussed examples of concepts from the lecture
- Discussion of lecture or material from the course
- Quizzes/Worksheets
- Review of homework, quizzes, and assignments
- Preparation for exams

Q.3 Develop a lesson plan for teaching physics to 9th grade students using guided discovery learning cycle.

ACCELERATION

Class: 9

Subject: Physics

Book: Punjab Textbook Board

Teacher Name:

ACCELERATION

When does a body possess acceleration?

In many cases the velocity of a body changes due to a change either in its magnitude or direction or both. The change in the velocity of a body causes acceleration in it.

Acceleration is defined as the rate of change of velocity of a body.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{Acceleration} = \frac{\text{final velocity - initial velocity}}{\text{time taken}}$$

$$a = \frac{v_f - v_i}{t} \quad \ldots \ldots \ldots (2.3)$$

Taking acceleration as a, initial velocity as V_i, final velocity as v_f and t is the time interval. SI unit of acceleration is metre per second per second (ms^{-2}).

Topic:	How do you find the acceleration of a moving object using velocity and time as well as force and mass?
Content:	Calculating acceleration using two different formulas. 1st. acceleration = change in speed divided by the time. 2nd acceleration = force divided by the mass. Key Vocabulary Words are: force, Newton's first law, inertia, newton, net force, acceleration, deceleration, Newton's second law.
Goals:	Student should know the difference between Newton's first law and second law. Student should know how to calculate the veloscity of an object by distance divided by the time. Student should know how to calculate acceleration by using velocity and time. Student should know how to calculate acceleration by using force and mass. Student should know how to convert distances from the metric system to the English system. Student should know how to use apparatus (car, track, timer, and photogate) to calculate acceleration problems. Student should know how to create a graph from a data table and interpret the results.

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Objectives:	Student will be able to calculate acceleration using force and mass. Student will be able to calculate acceleration using veloscity and time. Student will be able to set up apparatus to conduct experiments on acceleration. Student will be able to convert kilometers to miles and vice versa. Student will be able to convert meters per hour to meters per second. Student will be able to graph data gathered during the experiment. Student will be able to create a data table. Student will be able to analyze and interpret data. Student will be able to calculate the net force on an object. Students will be able to use the acceleration formula to solve for time or final velocity. Student will be able to use the acceleration formula to solve for force and mass.
Materials:	SMART Board Technology, Laptop, CPO apparatus (timer, photogate, track, cars, weights), scientist notebook, graphing paper.
Introduction:	Students will start the unit by reading the text in class along with the students. The text will be put on the SMART Board so that it can be dissected using the SQ3R strategy. Students will break down material into three categories (survey, question, read, recall, review).
Development:	Students will work out problems on the SMART Board in front of the class with the help of the teacher to show and learn now to do problems. The problems will come from the math skill builder CD. Students will work in their assigned groups to complete laboratory experiments utilizing the first and second laws of physics and the formulas that pertain to those laws.
Practice:	Students will try to do problems on the SMART Board with help form the instructor. The instructor will go over areas of difficulty with the students asking them to not only write the answer to the problem but to write out how they arrived at that answer so that I may see where their difficiencies lie. Student will look at laboratory problems and make flow chart about how they will conduct the experiment on poster board to help them visualize what they will be doing the day before they so an experiment.
Accommodations:	I will give students calculators to use to help them solve math problems. I will use SQ3R to help those students who have trouble reading an getting out the core information. I will also have the students make index cards with the questions they create from SQ3R on one side and the answer on the other. They will use them as flash cards to help them retain the information in the reading.

Checking For Understanding:	They will have to do a hands on laboratory experiment that will entail that they use the proper formula to solve the problem given. They will be given a quiz on whether they understand the math formulas solving for various situations via. (final velocity, acceleration, mass, force, and time). They will be given an examination where they will be asked to answer vocabulary related questions and solve math equations for the Newton's first and second laws.
Closure:	The goal of student assessment is not merely to measure student performance but to improve it.
Evaluation:	This will be looked at afer each part of the lesson.
Teacher Reflections:	This will be completed at the end of the project

Q.4 Elaborate the different characteristics of educational technologies that may help in teaching of science.

Modern age is the age of science and technology. The world of today is very dynamic. The life of man in the primitive age was altogether different from his life in this sputnik age.

There have been tremendous changes in the life style of human beings which may be attributed to the contribution of science and technology, science has extended the frontiers of our knowledge in various ways and directions. Science is considered to be a blessing to mankind.

Nothing better has happened than the advent of science in man's life. The contribution of science and technology has been experienced in almost all the spheres of human life including education.

Before understanding the meaning of educational technology it is essential to know the meaning of technology. The word technology has been taken from the Greek word (techniques) which means an art and which is related with skill and dexterity.

The term 'technology' implies the application of science to art. The concept of technology has developed during the last few years. It is a new area in the discipline of education. Educational technology is comprised of two words education and technology. When we apply the science of learning and communication to teaching we evolve a technology. There are three major factors that emphasize the linking of education with technology.

(i) Explosion of population.

(ii) Explosion of new knowledge.

(iii) Explosion of scientific and technological development.

Educational Technology is concerned with the development, application, and evaluation of system, techniques and aids to improve the process of human learning. It could be conceived as a science of techniques, methods and media by which educational goals could be realized. Generally the term "Technology" denotes the systematic application of the knowledge of science to practical tasks in industry. Hence, "Educational Technology" may be roughly defined as the systematic application of the knowledge of sciences to practical

tasks in Education. It is not primarily concerned with the task of prescribing the goal although it does help in specifying the goals and translating them in behavioral terms.

It is a communication process resulting from the adaptation of the scientific method to the behavioral science of teaching/learning. Educational

Technology widely accepted as the application of system approach in the systematic design of a learning system to bring about improvement in teaching-learning evaluation process.

It is not an end in itself but a means to accomplish some educational and instructional objectives already determined and clearly defined. It tries to make the whole teaching-learning process more and more meaningful for both the teachers and the learners. It modifies teacher's method of teaching and learner's behavior for their own betterment and for the betterment of the mankind. It is not the same thing as instruction or education or learning but an aggressive invention which includes in itself everything that helps in shaping personality.

Earlier the Concept of Educational Technology was used as a synonym to audio-visual aids like pictures, charts, maps, and models meant for direct teaching-learning. With the advent of physical science and electronic revolution there came an era of hardware and software like projectors, tape- recorders, radio and T.V. etc.

Then came the age of mass media which led to massive communication revolution for instructional purposes with the advent of programmed instruction and programmed learning, a new dimension of educational technology came into existence it has individualized the process of education and introduced a system of self-learning in the form of self- instructional material and teaching machine. The concept of programmed learning added another dimensions to the meaning of educational technology when some new devices and approaches such as. In other words we can see one aspect of Educational Technology related to the use of specific techniques such as 'educational television, radio, programmed learning and other audio-visual aids. In another aspect, Education Technology is seen as the application of scientific and other organized knowledge to the practical problems of education.

In the particular context of the developing countries, the emphasis is on the application of techniques and knowledge with a view to mobilizing and optimizing the available human as well as technological resources.

Educational technology is seen both as a means as well as service to effect and facilitate better and more productive learning systems. It may be defined as a separate field in the theory of education dealing with the development and application of the use of educational resources.

Educational Technology should not be confused with teaching or instruction or education or learning or engineering but it should be taken as a sum total of all such aspects which go a long way in shaping the personality of the learner in a meaningful context.

It is neither technology in education nor technology of education but both and all pervasive which pervades the whole teaching-learning process to make it meaningful for the teacher who teaches and the learner who learns and modifies his behavior for his own betterment and the betterment of mankind.

Characteristics of Educational Technology

Characteristics of Educational Technology are as follows:

1. It is based on scientific and technological advancements.

2. It is more a practical discipline and less a theoretical one.

3. It is a fast growing modern discipline.

4. It makes use of the research findings of psychology, sociology, engineering, sciences and social psychology etc., and applies the same to the field of education.

5. It brings pupils, teachers and technical means together in an effective way.

6. It is the science of techniques and methods. It locates the problems in the field of education, remedies them and ultimately aims at improving the education system.

7. It is bound to improve the teacher, the learner and the teaching learning process.

Nature of Educational Technology

1. The basis of educational technology is science.

2. Educational Technology studies the effect of science and technology upon education. In other words, science and technology are used under educational technology. Hence, it is the practical aspect of science.

3. Educational Technology is a continuous dynamic, progressive and effect-producing method.

4. New conceptions are possible only due to educational technology such as programmed learning, micro-teaching, simulated teaching, interaction analysis, video-tape, tape-recorder, projector and computer, etc.

5. Educational Technology accepts schools as a system. In this system, the school-building, furniture and teachers act as input while various methods, techniques, strategies and the teaching and examination with the help of audio-visual aids function in the form of a process. Lastly, the output is in of form of ability of the pupils.

6. Audio-visual aids cannot be termed as educational technology. It is because its concern is only with the process-aspect of educational technology and not with the input and output aspects. But if these A.V. aids are used to achieve educational objectives, then it can be put in the category of Educational technology.

7. Programmed Instruction is also different from Educational Technology. Its main cause is that the student learns himself during the programmed instructions. It does not allow interaction between pupil and teacher.
Hence, it can be used only for limited objectives and limited subject-matter. Therefore, programmed instruction is merely a part of educational technology.

8. Engineering Technology is not the educational technology because the engineering technology has manufactured radio, tape- recorder, video-tape and T.V., etc., which are used in teaching as audio-visual aids, but still engineering technology is different from educational technology. In education, it is accepted as hardware approach only.

9. Educational Technology cannot solve each and every problem of education. It can be used successfully in teaching and instructional system only.

10. Some people assume that educational technology will replace the teacher which will make the teacher unemployed one day. It is their mistake. Educational technology can never replace the teacher. It is because of three aspects of educational technology.

These are 1. Input, 2. Process and 3. Output. Input is the teacher's job and therefore, educational technology cannot snatch the place of a teacher.

In spite of this, educational technology develops cognitive domain only and not the affective domain. Affective domain can only be developed when an interaction between teachers and pupils takes place. Hence, educational technology cannot replace the teacher.

In Educational Technology, both hardware and software mechanisms are involved.

Garrison (1989), opines "technology will be viewed here as having both a process (software) and a product (hardware) component, where process is the creative application of knowledge of purposeful activities. A subset of hardware is media, where media are the devices used to distribute information."

In Educational Technology, hardware covers TV, Computer, Overhead projector, Tape Recorder, Teaching machines etc. Software includes audio/video cassettes, Filmstrips, micro films, slides etc.

Educational Technology is comprehensive. It is associated with all aspects of educative process-methods, teaching strategies, learning materials, handling of various equipment etc.

The following 4 M's are the major components of Educational Technology:-

(i) Methods, (ii) Materials, (iii) Media, (iv) Manpower.

(i) Methods:

It is concerned with the devices such as Programmed Learning Team Teaching, Micro Teaching, and Personalized System of Instruction in Teaching Learning situations.

(ii) Materials:

Instructional materials such as Programmed Text book the material of this type may be handwritten or printed.

(iii) Media:

The media used here are audio, or visual or audiovisual. A few examples are radio, tape recorder, charts, films, educational television etc.

(iv) Man Power:

Man power controls educational technology in every way. Educational Technology without man is zero.

Q.5 Discuss different approaches to individualized science teaching. Suggest any of the approach for hearing impaired learners.

The term teaching method refers to the general principles, pedagogy and management strategies used for classroom instruction. Your choice of teaching method depends on what fits you your educational philosophy,

classroom demographic, subject area(s) and school mission statement. Teaching theories can be organized into four categories based on two major parameters: a teacher-centered approach versus a student-centered approach, and high-tech material use versus low-tech material use. While teachers are still an authority figure in a student-centered teaching model, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of material, and to measure student learning through both formal and informal forms of assessment, like group projects, student portfolios, and class participation. In the student-centered classroom, teaching and assessment are connected because student learning is continuously measured during teacher instruction.

Advancements in technology have propelled the education sector in the last few decades. As the name suggests, the high tech approach to learning utilizes different technology to aid students in their classroom learning. Many educators use computers and tablets in the classroom, and others may use the internet to assign homework. The internet is also beneficial in a classroom setting as it provides unlimited resources. Teachers may also use the internet in order to connect their students with people from around the world.

While technology undoubtedly has changed education, many educators opt to use a more traditional, low tech approach to learning. Some learning styles require a physical presence and interaction between the educator and the student. Additionally, some research has shown that low-tech classrooms may boost learning. Ultimately, tailoring the learning experience to different types of learners is incredibly important, and sometimes students work better with a low-tech approach.

Here are some examples of low technology usage in different teaching methodologies:

- Kinesthetic learners have a need for movement when learning. Teachers should allow students to move around, speak with hands and gestures.
- Expeditionary learning involves "learning by doing" and participating in a hands-on experience. Students may participate in fieldwork, learning expeditions, projects or case studies to be able to apply knowledge learned in the classroom to the real world, rather than learning through the virtual world.
- Many types of vocational or practical training cannot be learned virtually, whether it be a laboratory experiment or woodworking.
- As the primary teaching strategy under the teacher-centered approach, direct instruction utilizes passive learning, or the idea that students can learn what they need to through listening and watching very precise instruction. Teachers and professors act as the sole supplier of knowledge, and under the direct instruction model, teachers often utilize systematic, scripted lesson plans. Direct instruction programs include exactly what the teacher should say, and activities that students should complete, for every minute of the lesson.