South Valley University

College of Education

Science Teaching Methods

Third year

Prof . Dr. Rifaat M. Bahgaat

Teaching process

Objectives

-.Identify the three major roles performed by teacher

-Identify the teaching skills necessary for effective teaching

-define teaching.

-explain the importance of effective planning Describe the seven sequential steps of the planning process.

-*E*xplain cycle nature of the planning process.

- Identify various generic teaching skill

Roles of teacher

1-Instructional expert

The person who plans, guides ,and evaluates learning .as an instructional expert you must make decision related to what to teach ,what teaching material to use ,the best method to teach, the selected content ,and how to evaluate the intended learning .

these decisions will based on a number of factors , including goals, your knowledge of the subject ,your knowledge of learning theory , motivation ,the abilities of your students ,your own personality , , needs , and your overall teaching goals.

Students will expect you as an instructional expert , to have all the answers ,not only to questions about your subject but to multitude of subjects .

2-Manager

The second important job of a teacher to order and structure the learning environment . this role included all the actions required to

maintain order in classroom. such as laying down rules and learning activities. procedure of

Teacher must manage classroom environment , therefore teacher are environmental engineers who organize the classroom space to fit their goals and to maximize learning. Seating must be arranged ;poster hung ; extra books installed .

Classroom management also involves modeling a positive attitude toward curriculum , toward school and learning in general.

Finally management also involves clerical works . There are papers to be read and graded , tests to be scored , marks to be entered ,notes and letters to be written and so forth

3-Counselor

You should be sensitive observer of human behavior you must be prepared to respond when behavior problems get in the way of student learning and development .Remember that teacher work with people :students ,parents ,administrators ,and colleagues. You posses good human relation skills and be prepared to communicate and work with this faction on day to day basis. These interaction will benefit from a deep understanding of people and their behaviors .

Finally you need a understanding of yourself – your own motivation ,hops ,, and desires all of which will effect your ability to relate to others.

A definition of teaching

Teaching can be defined as the action of a person imparting skills, knowledge , or giving instruction ; or the job of a person who teach .teaching is an attempt to assist student in acquiring or changing some skill, knowledge ,attitude or appreciation .

A broad definition of teaching might be : the action of someone who is trying to assist others to reach their fullest potential in all aspects of development physical, social, emotional , and cognitive.

What skills might one need in order to accomplish teaching task ?

Specific teaching skills

1-Area of the curriculum

At the elementary level: elementary teachers are required to teach all area of the curriculum .

At the secondary level: secondary teachers usually teach in only one or two curriculum area .subject matter instruction will usually be deeper at secondary school.

2- Teaching reading.

At the elementary level: elementary teachers are responsible for teaching basic reading skills , they need extensive training in teaching reading skills.

At the secondary level: reading instruction has been neglected.

3-Developmental differences between elementary and secondary students.

At the secondary level :

=physical change: can lead to an exaggerated concern about appearance and size .

= socially: adolescent try to achieve independence from the family and often influenced by peer group and involved in extra activities.

=emotionally : there is a search for identity that can result in moodiness , experimentation with drug ,and alcohol in extreme cases.

= at this stage thinking become more complex, a value system is developed and refined ,and competences for life goals are mastered .thus adolescent students need teachers who can model and help them acquire complex physical, social, emotional and cognitive skills . What is needed is a combination subject matter expert , counselor, social psychologist , mental health worker and youth group worker

At the elementary level:

Students are still quite dependent and need teachers who can display and provide affection and act as surrogate parent .As a result of these developmental differences ,vastly different skills are needed to work with elementary and secondary students

Generic teaching skills

Generic teaching skills are essential for effective teaching in all grades and in all curriculum area . These generic skills can be classified as :

= Pre instructional skills

= Instructional skills.

= Post instructional skills

Pre- Instructional Skills

The key to effective teaching is planning . You must plan well to teach well . But what skills does one need in order to plan well?

Planning must answer the following:

1- What content should be taught?

2-What are the desired learner outcome?

3-What are teaching material will be needed?

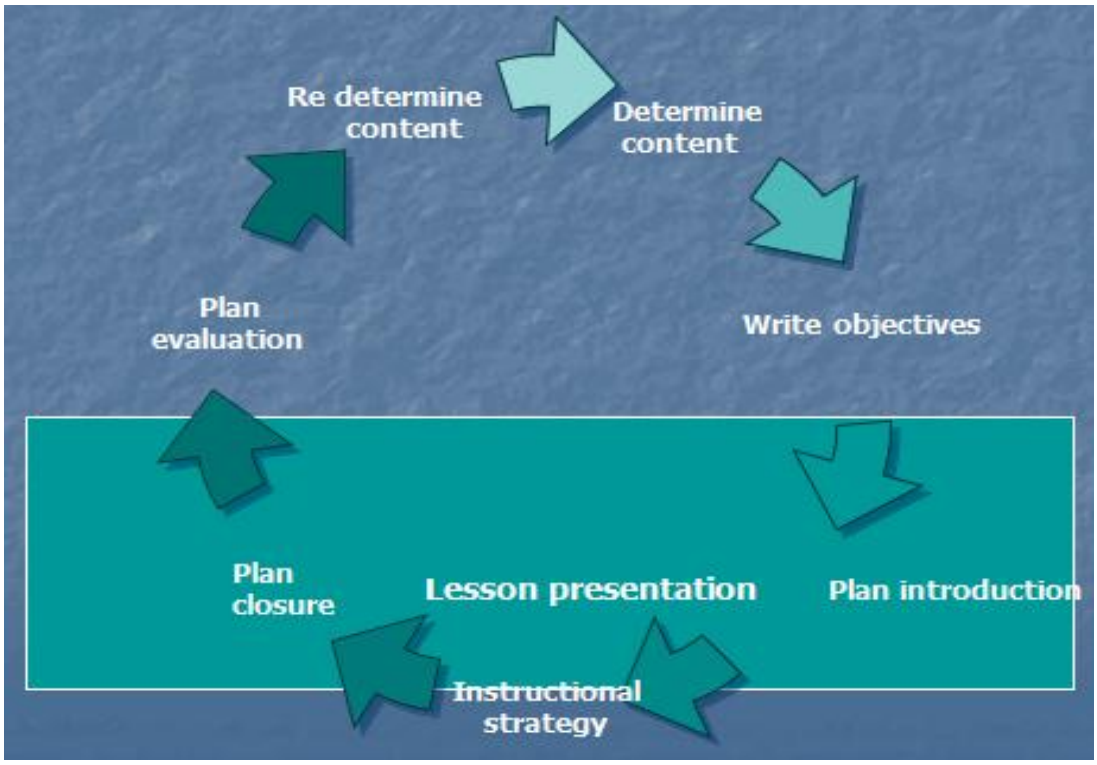
4- What is the best way to introduce the subject?

5- What is the best instructional strategy for the intended learning

7 -How should the student be evaluated?

6- How should lesson be closed ?

Basic seven step planning process



Step 1 :Identifying the content

Involves selecting the content to be taught .the content can be determined by analyzing student needs ,curriculum guides ,or by examining recommended textbooks .student needs usually determined from past class evaluation and from class observation during last lesson.

Step 2 :Write objectives

to decide exactly what student should know, and exactly what attitudes and values should be developed with regard to that content

Step 3 : Plan introduction

It is to gain the undivided attention of the students this introduction is commonly referred as the set induction or the establishment of cognitive set

Step 4 : Select instructional strategy

Your task here is to select the strategy that best fits your student maturity levels ,learning style and the classroom environment .

Step 5 : plan closure

Step 5 involves ending the lesson .the closing must be planned so that the lesson content is made meaningful and is understood..

Step 6 : plan evaluation

In step 6 you must determine whether you have accomplish what you want .

Step 7 : Re determine content

Step 7 uses the evaluative information in step 6 to determine the next lesson s content.

Instructional skills

once you have planned a lesson , you must implement it . Implementing a lesson so that maximum learning take place is a difficult task that requires special skills essential to all teachers:-

1.Central to instruction is the ability to communicate . You can not teach effectively if you are unable to communicate with your students.

2. Moreover you can not communicate effectively without gaining student attention and arousing their interest . This requires skill in the use of stimulus variation ,Questions, and reinforcement.

3.management of the learning environment is also a skill that all effective teachers must master. You must be able to gets students cooperation ,maintain their involvement in learning task

implementation of well –planned lesson requires a number of special skills ,you must be able to:-

1. establish cognitive sets (set induction).

2. communicate.

3. use stimulus variation.

4.use reinforcement effectively.

5. use questioning techniques.

6.Manage a classroom.

7.Establish lesson closure.

8. Evaluate objectives.

Post Instructional skills

There are two post instructional skills essential to effective evaluation .you must be able to analyze collected evaluative information and make judgments regarding evaluative information.

Cooperative learning

- Cooperative learning refers to the use of small groups and teamwork to achieve a variety of academic and social gains in the classroom setting. Improved social relation in the classroom accompanied by improved academic achievement , promote student's self-esteem in the cooperative classroom.

- Student who participate in cooperative learning group typically experience a social orientation , characterized by an " attitude of concern for others ", a commitment to the values of fairness and social responsibility , and the ability and inclination to act these values in every day life

Cooperative learning and academic achievement

Cooperative learning techniques promote academic achievement . Student of high , average ,and low ability gain equally from the cooperative experience .research show that among the most successful approaches to improving student's achievement are cooperative learning methods in which group rewards are based on each group member's individual learning.

The best learning effort of every member of the group is necessary for the group to accessed .and the performance of each group member must be clearly visible to the other group members. Each student in

cooperative group is individually accountable for his or her own learning , as well as for learning of other group members.

Characteristic of cooperative learning activities

(1) Group goals:

Group goals are common to most cooperative learning methods , this means the teacher and the students set goals for performance. Group members work together to help one another learn so that the group can achieve its goal .the group receive an reward in the form of certificate of achievement for doing good work and reaching the group goal. group member feels satisfaction from achieving the goal.

(2) Individual accountability.

It is achieved by giving each student a unique task and a special responsibility to carry out during group work. You can also structure individual accountability by making each group member individually responsible for his or her performance on quizzs

(3)Equal opportunity.

Equal opportunity for success is structured by giving each student an equal chance to contribute to success of the team. Team competition occurs when team compete to achieve the best results

(4) Simultaneous interaction.

In traditional classroom student often sit silently for most of the day.in traditional classroom , teachers do 80 percent of the talking ,with only20 percent of the time left for student to talk . Think about what this means . If a lesson lasts for an hour and the teacher talks for 50 of the 60 minutes , that leaves 10 minutes for the student to talk. If there 25 or 30 student in the class, each one has less than half of a minute to talk , that's not much time. Think about what happens when student work in cooperative groups. If there are four students in a group and group has even 40 out of the 60 minutes to work, each student can talk for up to 10 minute .Simultaneous interaction means that instead of one person talking or

asking a question at a time , many students can have turns at the same time

(5) Equal participation.

When structuring equal participation , you want to ensure that students participate equally in their group. Some students talk more than other , some students are very quite . Low achievers may choose not to participate . Some students don't feel good about themselves .you might be thinking that you already know of several ways to structure equality

Strategies for mastery learning

1- numbered heads together.

Your students usually work in team of four and site together. You instruct them to number off . In each team students call off " one – tow – three-four". you ask a question and give students three minute to discuss it in their team. Then you call on a number randomly "m either one, two , three, or four". Let's say you call out number one. All number ones should be prepared to answer the question. By using this strategy , you structure a situation that requires all students to think about the question and prepared to answer it ,no one know which number you will call.

2- pairs Check . Pairs check is another excellent strategy that helps students review and study .have pupils in each team form pairs . You present a problem . The first partner solves the problem ,the other is the coach .when the pupil solves the problem ,the coach checks the answer . If there is disagreement , they ask you for help .if they both agree on the answer , the coach praises the partner . Partners changes roles , you present another problem, and they follow the same steps.

3- inside-outside circle. inside-outside circle is another strategy .divide the class in half . The first half sit in a circle ,forming the inner circle . The another half forms a circle around them; you pose a problem or a question to review . The student work together to arrive at a solution .you can walk around and monitor the pairs or lead whole-class discussion to

discuss solutions. For the next problem ,you can have students rotate so they work with a different student.

4-send –a-problem Send a problem is an excellent strategy for review . Student work in teams to review the lesson or unit. Working together ,they create problems or questions for their classmate to answer .once they write several problems, they send them to the next teams. Team members solve one another's problems and answer the question

Strategies for developing thinking skills

Practicing thinking skills enables your students to create new ideas ,apply what they learn , and build understanding of concept. Unlike mastery structures, which help students review what they learn, thinking skills strategies enable them to think and reflect.

1- think- pair-share

Students are in their teams. You pose a problem that requires thought.

Students have some time (you specify the amount)to think in their own.

Then they pair off with a partner and discuss their ideas. Finally ,students share their thoughts with the whole class.

2- brainstorming

Brainstorming is a strategy that fosters creativity and the development of new ideas. You pose a problem or ask a question. Student work together in their teams. They think quickly and share ideas with others . Silly ideas are included . There is synergy in the group as one student's ideas build on another's .the recorder writes what student say. In the end students work together to formulate a solution to the problem .

Strategies for sharing information

1-round robin

When there is something to discuss, students form around robin , taking turns answering and contributing , every one gets a turn as you go

around the room. It's not necessary to have a recorder , as this is an oral strategy.

2- round table

Roundtable is just like round robin, except that student write their ideas on paper, and paper passed around . There can also be a recorder who writes the contributions.

Writing objectives

Objectives

- define learning.

- provide valid reasons for installing objectives.

- define and contrast educational goals , informational objectives and instructional objectives.

- name and define the four components that make up a properly written instructional objectives.

- write objectives that include four component of well stated objective..

- name and describe the three domain of learning.

Learning :can be define as change in students performance as result of experience

Effective teaching: should be directed toward targeted change in performance..

An objective:: can be defined as clear description of your instructional intent ..an objective is not a statement of content but a statement of what your student should get out of the lesson.

Teaching Model

The model show that:-

the first task: is to establish your objectives.

Second,: you teach toward the acquisition of the stated objectives using the select approach

Finally: you evaluate students attainment of the stated objectives.

If the student do not achieve the attainment of the stated objective you may either select a different approach or may alter the original objectives

Value of Objectives

1- in the first place ,your teaching approach will be dictated to large extent by your objective

2- . your objectives set the framework for your evaluation.

3- objectives assist you in communication with your students . When your objectives are shared with the student ,student know what is expected of them.

Educational Goals:

- are extremely broad statement that are used to describe the intent of schooling , a course , or a unit - the terms educational goals and general objectives are used to denote broad general intent

- educational Goals are extremely broad and may take weeks, - months, or even year to achieve . The broad terms of the goal is the entire intent of the course ,or unit, that is what teacher wishes to accomplish in the broadest possible sense.

examples of educational goals :

1. the student will become a knowledgeable citizen.

2. the student will live a healthful life.

3. the student will appreciate art and music.

5. the student will learn to read

6. the student will think clearly and rationally.

- Note the use of the verbs: become, learn ,live, appreciate, know and think , these verbs are not stated in observable and measurable terms.

Informational and instructional Objectives

Instructional Objectives:

- are narrower statement of the intended learning of a unit or specific lesson.

- the terms used here, informational objectives ,instructional objectives : behavioral objectives ,performance objectives and working objectives.

- Objectives: are written at two levels , informational objectives ,instructional objectives

Well-Stated Objectives

- A well stated objective should include four components : the performance , a product , the conditions, the criterion .

1- Performance:

-A well-stated objective must be written in terms of what students are expect to do , not what the teacher is to do .

- special care must also be taken to select the proper verb when writing objectives. each verb in your objective must mean the same to you, and interested individual . Subjective terms , such as learn , realize, and understand , should not be used in writing objectives. These terms are open to interpretation and might have different meaning to different individuals.

- use terms that denote observable actions (overt) or behaviors .for example .your intent might be for students to be able:

to identify (in writing).

to explain (orally)

to list……

to construct…….

the students will identify (circle)

the student will distinguish (check)

the student will compare . (in writing)

the student will add . (write the sum)

- if the objective represent an internal ,covert process, you would be wise to add an overt indicator verb for clarity .

2- The product:

-The product is what students will produce by their actions the product can be:(a written sentence , a written sum , listed names , a demonstrated skill , or a constructed object).

- examples : -

(the portion of the statement that has been underlined is the product - of the action)

the student will identify the nouns in a sentences.

the student will list the main ideas in a short story.

the student will write the numerals to ten

the student will classify leaves into groups based in texture.

- the product then is the planned outcome resulting from the instructional process.

3-The conditions

-Under what conditions will students perform the intended action ?

Will they be allowed to use an open book ?what material will be used? Where will they perform? These questions are answered in the conditions component of your objective.

-this component includes the information ,tools or equipment and material that will or will not be available to students ; any special limitations as time or space.

-Example of condition:

Given a list of 20 authors….

After reading chapter 2…

Using class textbook…

Without the use of references…..

multiple –choice test …….

…….before the class…….

……during a 10 – minute interval…….

4-The criterion:

The fourth and last component of well –stated objective is the level of acceptable student performance . Here you state the level of behavior you will accept as satisfactory or the minimum level for showing mastery : THE criterion level may be stated as follows:

a.As the minimum number acceptable:

…… at least three reasons……

…….. All five step ……

b. As the percent or proportion acceptable:

……..with 80 percent accuracy ……..

……90 percent of the 20 problems……

……. Nine of the ten cases…….

c. As acceptable limit of time:

……..within 10 minutes …….

…….in less than 5 minutes……

d. As a combination of acceptable standards:

……..at least two problems within a 5-minutes

Classification of Objectives

Cognitive domain:

Objective in the cognitive domain are concerned with imparting Knowledge and thinking skills. The objectives can range from simple recall of information to complex creation of new ideas .some performance verbs include: define, distinguish , identify , restate , , explain , infer, apply, use , choose , classify , categorize, write ,design , assess , , compare , and contrast .

Examples of objectives include such statement as :

1. the student will explain (in writing) the importance of math

2. the student will design experiment to test the effect of three different soaps on clothing .

Levels of cognitive learning

1- knowledge learning.

Refers to simple recall of previous learned material . This may involve the recall of terminology , basic principles , and specific facts , and places. No manipulation or interpretation of the learned material is required . It can be expressed such verbs as identify , define, list , match , write , state, name, ,label, and describe

- example;-

. the student will spell at least 70 percent of the words

. the student will list the name of 12 of last 15 president of USA.

2- Comprehension:

a. It is the lowest level of understanding ,and may involve changing the form of previously learned material or making simple interpretations . Abilities include translating material to new forms ,explaining and summarizing material. And estimating future trends.

B. it can be expressed with such verbs as translate ,convert, - generalize ,paraphrase, rewrite, summarize , differentiate , defend, infer, and explain .

c- example:

- After reading a short story, the student will summarize the major plot

- After the civil war, the student will explain the condition in the south and north that led to the war.

3- Application:

a. It entails the use of learned information in new and concrete situation it may involve the application of rules , general ideas, concepts ,,laws , principles, and theories. Application level objectives can be expressed with such verbs as use, operate, produce, change, solve , compute, and prepare.

b. Example:

The student will prepare a graph showing Egypt s experts for the last 10 years.

4-Analysis:

a. Entails breaking down material into its component parts so that it can be better understood. it may involve identification of components ,analysis of relationships between parts.

b. analysis level objectives can be expressed with such verbs as - discriminate ,select , distinguish , separate, subdivide ,, identify , and break down.

c. Example;

The student will break down a story plot into various subplot.

5-Creation

A - It may involve the making of unique communication , plan proposal , or scheme for classifying information.

b. creation can be expressed with such verbs as design , plan , compile , compose, organize , compare , justify , conclude , , criticize ,

c. Example:

- the student will compose an original story from an unusual situation.
- given materials , the students will design a hat.

Levels of Affective learning

learning intent in the affective domain is organized according to the degree to which an attitude, feeling , value ,or emotion has become part of the individual …

four levels are included here:

1- receiving :involves being willing to attend freely to stimulus (listen ,and look). It can expressed with such verbs as follow ,select , rely , choose , point to ,ask , hold , give and locate .

Example :

The student will listen for respect words(please , thank you ,sir . - Madam) in stories read aloud in class.

When asked , the student will hold various science animals (snakes , rabbits ,)

2. Responding: involves active participation . It involves not only free attending to stimulus but also voluntarily reacting to it in some way . It requires physical ,active behavior . It can be expressed with verbs such as read , conform ,help .answer , practice , report , present , greet , tell and perform.

.examples:

- The student will volunteer to help with a class mathematic project

- The student will report that story enjoyable to read.

3. valuing: refers to voluntarily giving worth to an object , phenomenon , or stimulus ,.behaviors at this level reflect a belief, appreciation or attitude. The verbs used; initiate , ask , invite , share , propose, read ,study and work.

Example: when given a center choice , the student will ask to the learning center

4- commitment: involves building an internally consistent value system and freely living by it. A set of criteria is established and applied in choice making . It can be expressed with such verbs as adhere ,defend , alter , integrate , relate , act , listen , serve , influence , use ,verify .

- Commitment level example include:

a. The student will defend the importance of at least one governmental social policy.

b. The student will freely a judgment in the light of new evidence.

Levels of Psychomotor Learning

Learning intent in the psychomotor domain range from acquiring the basic rudiment of motor skills to the perfection of a complex skill . In this text three levels of learning are included in the psychomotor taxonomy:

(1)imitation: refers to the ability to carry out the basic rudiments of ➢ a skill when given direction and under supervision .imitation level

objective can be expressed with verbs such as construct , , drill , ,change , clean , manipulate, follow , and use.

Imitation –level examples include: ➢

- Given written instruction ,the student will construct at least five geometric models

-The student follow basic instructions for making a simple model.

(2) Manipulation refers to the ability to perform a skill independently . The entire skill can be performed in sequence. Manipulation level objective can be expressed with verbs such as connect ,create , fasten, make ,sketch , weigh, and manipulate.

examples include

1-Given several different objects , the student will weigh each.

2-Given an oral description of an object , the student will sketch it.

3-Precision: refer to the ability to perform an act accurately, efficiently. precision - level objective can be expressed with verbs such as focus , , adjust , construct ,manipulate , and build.

–precision -level examples include:

The student will accurately adjust a microscope.

Presentation skills

The teacher assumes a role similar to that of a presenter of a radio or television programmer . Who presenting new fact , concepts, principals , explaining difficult ideas .and clarifying issues or relationships.

In order to become an effective presenter there are five skills which it is important to master. These are:

1. set induction. .١

2. closure..

3. stimulus variation.

4. clarity of explanation.

5.use of example.

First :Set Induction

1-The concept of pre- instructional procedure or set comes from research on learning . This research indicate that the activities which precede a learning task have an influence upon the outcome of that task. ■

<u>The function of Set Induction</u>

1-Focus the student s attention on what is to be learned by gainin gtheir attention , e .g . The teacher begins on movement in aquatic animals by introducing a glass containing a variety of aquatic animals into the classroom. ■

2-Transition set. It provides a smooth transition from already covered material to new material.. It may use examples from pupils general knowledge to move to new material by use of ■

3-To provide a structure or framework for the lesson . ■

when they are told 4-teacher can be influence pupils behavior best in advance what expected of them. This calls " the expectancy function of teachers " or advance organizers . ■

5-set should attempt to create an organized framework for the body of the lesson, ■

e.g. supposing you wish your pupils to make detailed observation of movement in aquatic animals ,to say " I want you all to observe the aquatic animals " is not only a weak set but will probably cause disruption in your classroom . To improve your set you might extend ■

it by saying “we shall be studying movement in three different aquatic animals . First of all I shall ask you to examine one of these animals in the glass dish which will be provided for each of you and to observe its movement.

Second :Closure

Closure is a complement of set induction . It draws attention to the end of specific learning sequence , or of an entire lesson by focusing attention on what has been learned.

It needs to be carefully planned and for this the teacher needs to watch the clock, allowing adequate time to initiate closure before the lesson due to end.

Effective closure reinforces what has been learned by reviewing the key points of lesson and relating them to other material the student have already learned.

The function of closure

1-The objective of closure is to help the student retain the important points presented in the lessen , thus increasing the possibility that they will be able to recall and use that information at another time .

2- closure is sometimes used during the course of a lesson e .g :

(a) to end discussion by calling on a pupil to summarize the major points covered ;

(b) to end a laboratory exercise by calling on different pupils to list the steps carried out . The results obtained and conclusion drawn.

(c) to follow up a film, TV program , guest speaker, by a discussion of the main points made with a view to reinforcement.

(d) to follow up a homework assignment reviewed in class by using praise and encouragement ,e.g. “ that was a difficult assignment. I am pleased with the way you tackled it” .

Third :Varying the stimulus

the purpose of this skills is to arouse pupils s attention to focus it upon the content of the lesson . While the most effective way of doing this is to make the content itself interesting . An interesting subject can be made tedious by the manner in which it is presented

.this skill of varying the stimulus is based on learning theory which indicates that uniformity of the perceived environment tends to lead people into mental inactivity ,while changes in the perceived environment attract their attention and stimulate mental activity.

It is of course possible for some change in the environment to distract attention away from the content of a lesson , so it is important that the way in which teacher vary the stimuli should focus pupils attention on lesson objectives.

Stimulus variation refers to teacher actions , sometimes planned and sometimes spontaneous , that develop and maintain a high level of pupils attention , during the course of lesson .

Stimulus variation techniques

1-Teacher movements

Teacher movement can have an important effect on pupils behavior,

e .g, the physical shift from one part of the room to the other causes pupils attention to be focused directly on the teacher during presentation , however, remember that random nervous movement can irritate and interrupt rather than improve communication.

The front of the classroom, the “stage” can be divided into six sections . The front three areas are generally stronger than the back ,and the center is stronger than either side .the left side(as seen by the audience) is stronger than the right.

2-Focusing behaviors

Focusing behaviors is the teacher way of directing pupils attention, this control is mainly accomplished by the use of either verbal statement ,specific gesture or movement, or some combination of the two:-.

(a) verbal focusing involves particular words, statement or direction , e.g, “listen to this”, “look at this diagram”, , “ watch what happens when I add this liquid to the solution” ,” observe the way in which the animals moves”

(b)gestural focusing consists chiefly of eye movement , facial expressions and movement of head ,arms , body. Gestures are important means of communication between teacher and pupils. They are used to :(I) gain attention (II) to indicate emotions

(i) gaining attention

watch how an experienced teacher maintains eye contact with an entire class. This important in gaining attention. Other example to movement which accomplish this aim are using a pointer to indicate an object, turning the body in the direction of an object . Clapping the hand to gain attention.

(ii) indicating feeling or emotion

For example smiling , frowning , raising the eyebrow, nodding the head to give encouragement. Gesture can be used qualify verbal cues ,

e.g “,try to answer “ said with a glare conveys a different meaning from the same phrase uttered with an encouraging smile.

(c) verbal – gesture focusing combine gesture and verbal focusing . , e.g, teacher point to a diagram and says,” look at this diagram” teacher uses a pointer on a map to follow the course of a river and says “ follow the course of this river”

3-Changes in speech pattern

Variations in quality ,tone and rate of speech can increase pupils attention, e.g. a change in the teacher rate , volume or tone of speech

can increase the pupils attention. Planned silence or pausing can also be most effective in capturing attention by contrasting sound with silence . It can create suspense or expectation , e.g. sudden pause in the middle of a sentence three seconds is an adequate length of pause.

4-Changing interactions

1. teacher/ group interaction

This is a teacher –centered type of interaction, where the teacher lectures or demonstrates to the class as a whole e.g. the teacher demonstrates a method for extracting chlorophyll from a leaf, so that it may be tested for the presence of starch.

2.teacher/ pupil interaction

This is a teacher-directed rather than teacher – centered interaction style .in this situation the teacher questions specific pupils by name in order to promote pupils expectation or discussion.

3.pupil/pupil interaction

Some example of such interactions are:

(a) class discussion in which the teacher plays a management role redirecting pupils question to other pupils for comment and clarification e.g. “ how would you answer john s question peter”

(b) a class working in small group on project work or experimentation which is discussed among themselves.

(c) situation where pupils go to the board to show the steps they used to solve a problem.

(d) pupils engaged in role-playing or acting.

5-Shifting sensory channels

During a lesson pupils process information by means of the senses (sight , touch ,smell .taste, and hearing), . research indicate that pupils

ability to process information can be increased by appealing to sight and sound alternatively e .g ., listen/ look/ listen.

(a) (listen/look) a teacher explains verbally and follow this by drawing a diagram on the blackboard on which he questions pupils., or

(b) (look/ listen/ look). A teacher shows a short film which he follows by a question and answer sequence , and then shows the film again.

(c)Listen/look ; touch / look; listen. The teacher explains the structure of feather using a large diagram; then he provides feathers for pupils to touch , feel , and draw. This activity followed by a group discussion.

(d) Touch/listen; the teacher allows student to feels three different samples of soil- a clay ,a loam and a sandy soils. This is followed by a class discussion.

Fourth : Clarity of explanation

to explain is to relate an object , event ,or actions or to some other object ,event ,or action ; or to show the relation between an event and a principle ; or to show relationships between principles .

Giving explanations , appears to be much more difficult than making factual report. clarity of presentation has considerable influence on the effectiveness of classroom teaching.

among the factors which are important in contributing to effectiveness in making an explanation are continuity , simplicity , explicitness.

1-continuty:

(a) Sequence of discourse:.

the connections between the various points dealt with in a lesson should be made obvious . A lesson may have any one of several kinds of connection thread (e .g. deductive ,inductive , historical) .pupils do not understand something ,because they do not see the relevance of diversion to the main theme.

\If a teacher diverges from the main line to go off at various directions , it is difficult for the pupils to know the point upon which their attention should be focus.

(b) fluency:-

The teacher can also help pupils to understand an explanation by the use of short sentences .the ability to talk appears to depend partly on mastery of the subject-matter and social confidence in the class situation.

2- simplicity :

(a) avoid a grammatical complexity :

if the relationships are complex consider communicating them by visual means . By using diagrams , tables and models.

(B) vocabulary :

The use of terms without explanation or definition of their meaning does not add to the simplicity of an explanation .use simple language for effective communication .

3-Explicitness

One indication of vagueness is the frequent use of phrases such as " of course " " you know" .and common example is vagueness about size and number , with the use of words such as " a little " ,"some" or " many" , "small" , "large" in situation where pupils may make false assumption as to actual amount or size .

(a) A clear explanation :
a clear explanation depend upon (i) the identification of the components to be related e. g. objects , events , processes, and (ii) the identification of the relationship between component, e .g. causal , justifying ,interpreting .

(B) explaining statement:

To make explicit between ideas or processes Use one of the words or phrases given below:

Because	as a result of
Why	therefore
So that	in order to
By	through

Inductive and deductive approaches

There are two basic approaches to use of examples:

1. the inductive approach

Where you start with examples , and make an inference or generalization upon the basis of those example.

2.the deductive approach

Where generalization is stated first and then applied to a number of example.

Guidelines for the effective use of example.

1. start with simple examples and work towards more complex \.

2.start with examples relevant to pupils experience and level of knowledge.

3.relate examples to principal, idea ,or generalization being taught.

4.check to see whether you have accomplished your objective by

asking the pupils to give you examples which illustrate the point you were trying to make .

Questions

Classifying Questions

One of the best-known classifications is blooms taxonomy of educational objectives . There are six levels of Blooms taxonomy , and Questions at each level require a response which uses a different kind of thought process .

you should be able to formulate questions on each of these six levels in order to encourage your pupils to employ a variety of cognitive process. The six level are:((knowledge- comprehension – application – analysis – synthesis – evaluation)

knowledge

When your purpose is to determine whether pupils remember certain specific facts ,ask recall question.

Examples:

(a) Name two kinds of blood-vessels in the body?

(b) Who wrote the play A Midsummer Night Dream?

(c) What is the capital of France?

A recall answer does not go beyond the information previously presented ,nor does it change the form or organization of information.

This category has some drawbacks. The main one is that teachers tend to over-use it. Another drawback is that knowledge questions assess only superficial understanding.

Words often found in knowledge questions are:

Who? Define

What? Recall

Where? Recognize

When? name

Not all recall question call for brief answer ,for example:

Give the names of the thirty heaviest element and their atomic weight

Comprehension

When your purposes is to help pupils organize facts in such a way as to make some sense of them , ask comprehension question . These questions will require the pupil to select those facts that are pertinent in order to describe, compare or contrast .

Examples :(a) describe the kinds of problems faced by immigrants.

(b) how did life in eighteenth century differ from life today?

Sometimes comprehension questions also require pupils to translate ideas from one medium to anther , for instance to interpret material presented in the form of graph or tables.

Examples : (a) from the above graph give the average annual rainfall for this country?

Application

When your purpose is to encourage your pupils to apply information they have learned in order to reach an answer to problem , ask application question . These question require the pupils to apply a rule or process to a problem in order to determine the correct answer.

Example ::when organisms are living densely packed in small area are they more likely to compete if they belong to one specie than if they belong to many different species?

Words commonly found in application question are:

apply	employ
classify	give an example
use	choose

Analysis

When your purpose is to help pupils not only to remember and organize information , but also to analysis it for underlying reasons such as cause and effect , analysis questions are asked .

1. identify motives , reasons and causes for specific occurrence.

Examples : what factors influenced ……

2. to consider and analysis available information in order to reach a conclusion.

Examples : " now your experiments are complete , what is your conclusion about the factors affecting the growth of seedling?

3. to analysis a conclusion , inference or generalization based on evidence.

Example : what causes children to disagree with their parents?

Words frequently used in analysis question are.

Why ?

what factors?

draw conclusions?

determine evidence (support)

synthesis

When your purpose is to help pupils to form relationships and put things together in new or original ways, ask synthesis question. These question are used to develop the creative abilities to pupils .

Such question may require pupils to make prediction, To make original communication or solve problems .application questions require one answer or single correct answer to problem but synthesis question allow a Varity of creative answers.

Example: what do you suppose would happen if we run out of coal and oil?

under what conditions might the countries of the world be likely to unit

How would you summarize the effect of the socialist

movement in improving the conditions of working?

Words and phrases often used in synthesis questions are:

predict

produce

write

develop

what would happen if …….?

Evaluation

When your purpose is to help pupils choose among alternatives by judging which best fits some stated value ,ask evaluation questions. These questions do not have a single correct answer but require the to judge the merit of an idea , a solution to a problem. They also ask the pupil to offer an option .

Example:-

a. which story most accurately describe life on an English farm?

B. should this statement be defended or rejected? For what reasons?

C. would you justify this choose?

D. Do you consider that a factory which pollutes a river should be

closed , even if this will result in unemployment ?

words

(judge- assess – decide – justify)

Summary

lower –order thinking

Remember specific facts which were previously taught or general knowledge

higher – order thinking

Change the form of information in order to compare

contrast

explain

summarize

analysis

synthesis

evaluate

Discussion skills

Objectives	**Related teaching skills**
A. To help pupils to give more Complete and thoughtful response	1.pausing 2. prompting 3.seeking further clarification 4.refocusing a pupil response

B. to increase the amount and quantity of pupils participation

(Skills) 1. redirect the question to several pupils.

2.framing questions that call for sets of related facts.

3.framing questions that require the pupils to use higher c order- cognitive thought.

Helping pupils to give more complete and thought response

1- Pausing

Before we discuss pausing , let us look at the common practice of " rapid- fire questioning" or calling on a pupil to respond immediately after a question . If teacher s objective is to sample what the class knows within short time and elicit brief response "rapid fire question" is an appropriate skills .

On the other hand , if the teacher s objective is to provide an atmosphere more conducive to discussion , in which pupils have time to organize longer and more thoughtful response .

He must pause for three to five second after a question.

Discussion skills

Pausing serves a twofold functions in your classroom:-

a . It provides an atmosphere more conduce to learning and discussion.

b. The pupils learn to use the pause to organize a more complete answer.

Some pupils may begin to day dream, hoping they will not be called on, others may raise their hands without first thinking . Therefore when you first start using pausing behavior , you should help the pupils learn what you want them to do. Immediately after a question verbal prompts can be presented , such as"please think over your answer carefully , when I call

on you , I want A complete answer ‘ then pause for three to five second before you call on someone.

2-prompting

Prompting is the probing skill used when the pupil gives:

(a) An “ I do not know “ response .

(b) A very weak response.

(c) a partly or completely incorrect response.

Lets us begin with situation in which a pupil fails to respond , or give I do not know, after such a response , you might rephrase the question in order to examine the possibility that the question was too vague.

For example: what do you think about war? Can rephrases “ why has war been called a necessary evil ?

Prompting strategy is based on a series of questions containing hints that help the pupil develop his answer . For example , a pupil may not be able to answer a question about the effects of the black death,

But he may begin to response to a series of questions beginning with “ what happened during the black death ? Followed by “ why could plague spread easily and quickly throughout the land in fourteenth century?

The essential steps of prompting are as follow:

1. the teacher asks a question

2.the pupil gives an I do not know or weak response.

3.the teacher gives the same pupil a hint or asks a question designed to lead him to a better answer.

4. The teacher may use a single prompt or a series of prompts to guide the pupil to a better answer to the initial question.

3-Seeking clarification

In some instances a pupil may give a response which is poorly organized ,lacking in detail or incomplete . Here you face a situation in which the pupil is not wrong , but in which his answer still does not match the response you seek. Under these circumstance you use the probing skill of seeking clarification.

Unlike prompting , seeking clarification starts at a different point on the response continuum ; the teacher is not adding information ; he is requesting the pupil to do so.

Example:

a. how you make your answer clearer?

b. can you state the another way?

Note that these questions do not include any of the hints that are using in \prompting.

Clarification may also be used when the pupil give an answer that is basically satisfactory , but which the teacher believes can be improved by the pupils if he discuss his response further . In this case teacher ask the pupil why he gave the answer , or ask him to justify or explain his answer.

Example:-

a. can you restate your answer? I am not quite sure

understand you completely?

b. can you tell me why you are right?

4-refocusing

when the teacher receives a response that match the one he wants. Refocusing may be used to relate his answer to anther topic he has studied.

The skills used to help the pupil consider the implications of his response within a broader conceptual framework. He is asked to relate his answer to another issue.

Example a. Idea : rules and law are intended to govern behavior.

teacher :how do the player know what they are and are not allowed to do while they are playing (football)?

James: there are rules and if you break the rule a penalty is given.

teacher: how does this relate to our studies of government?

(refocus)

James : I suppose laws are like rules . If you break the law in some way, you are punished.

Example b:

B. idea : people s beliefs influence their behavior.

teacher: the watusi believed their cows were sacred .

Andrew : how did this believe influence their behavior ?

Andrew :even when there was a famine they would not ea their cows .they would starve.

teacher: how was this case similar to what we read about the Sepoys rebellion ,Andrew?

(refocus)

Andrew : the Sepoys were soldier in the British army in India . Someone told them that the cartridge used in their guns were greased with from pigs . Before a solder loaded the guns he had to

bite the cartridge . Because the Sepoys were Muslims . They believed this was against their religion and rebelled.

Improving the amount and quality of pupils participation

1-Redirection

In using the technique of redirection , the same question is directed to several pupils . The question is neither repeated nor rephrased . To use redirection effectively , you must choose a question which call for an answer of related facts or allows a variety of alternative responses.

Example:

a. The police in our town carry out many duties. How many can you list? John , can you name one?

b. What do you feel is the most exciting part of the story?

c. What might happen if water became a scarce resource ?

1-Redirection

In order to use redirect effectively , many teachers must also correct a tendency to repeat the question for each pupil. One way to handle the problem is to tell the class beforehand what you are planning to do : I am going to call on some of you to answer a question that have more than one answer

The second gain , which can be used to advantage later ,is that by requiring several pupils to respond to the same question you can begin encouraging pupils to respond to each other.

2-Questions calling for sets of related fact

Since most teachers ask questions requiring short answers , it easy too

see pupils response as briefly as possible ;

E .g is the purpose of your local police force the protection of life?

If you want discussion you should phrase the question as follows:

What are the duties of our local police force?

Another variant is a little more subtle . In this instance the teacher appears to be calling for a long response , but the question is so phrased that a brief answer will suffice.

e.g. why does the less careful consumer buy strictly by brand name?

The question might have been asked in another way, what are the advantages of buying strictly by brand name.

Success lies in using questions which require longer and better response

Higher- order question

Besides encouraging pupils to give longer response you should also try to improve the quality of their responses. The kinds of questions the teacher ask will reveal to the pupil the kind of thinking which is expected of him

Type of higher – order question example

Comprehension

tell us what you know about travel by train or aero plane.

Comparison

compare travel by aero plane wit travel by train?

Explanation

why do train run according to schedule?

Application

using the railway map we have jus studied , name the city to which it is easiest to travel to from any part of the country?

Analysis .. why are some cities better served by rail than others?

Synthesis .. how could the railway system in Egypt be improved?

Game Based Learning

In recent years, educators and researchers have been looking for new and innovative ways of instructing students. There have been many schools of thought regarding how best to teach and many different tools for teacher to use. However, one new tool that has taken some time to take root has been the game as a means of teaching. This is partly because, for years, games were associated with entertainment and wasted time. Over the past few years though, there has been a steady growth in the use of game-based learning, which has led to a new and effective means of teaching in the classroom.

The Growth of Game Based Learning

According to the education group Educes, game-based learning is becoming much more popular now that people are more familiar with technology and familiar with how games can be used in the classroom. Today, game-based learning is occurring at the highest levels of education, including universities and schools of business.

Ryann Ellis, writing for the Association for Talent Development, noted that educational games are becoming increasingly popular as well. The association indicated that there were ten types of education-oriented games that were being popularized and that their use was increasing. Ellis pointed out that resistance to learning was declining in academia, particularly as new research indicated that game-based learning was effective at improving academic outcomes.

Education games were becoming increasingly popular thanks to parents who were increasingly looking for ways to educate their children. While game-based learning is best conducted in the classroom, where teachers can provide guidance and instruct students toward learning goals, parents want their children to learn outside of the classroom as well.

For this reason, the past decade saw an explosion in the development of education apps. People were also increasingly more interested in training themselves as well, leading to the growth of brain training games. Taken all together, this increase in demand had led to an increasing number of

games meant to educate as well as entertain, many of which could be adapted to the classroom.

However, perhaps one of the biggest drivers of game-based learning has been the lower costs to educate people associated with new technology. In previous years, print based materials have required parents to constantly replace those materials with new ones as students worked their way through them. Modern technology can condense print materials to apps, provide access to extensive, informative resources, and eliminate the need to constantly replace materials with new ones.

Game Based Learning Versus Gamification

On the surface, it may seem as if game-based learning and gamification are the same thing. Both seem to indicate that games will be used to educate. However, the two concepts, while they can be similar, they are also distinct in several ways.

Gamification is a process in which game elements are added to education and other non-game situations. The gaming element is added into a situation. Gamification is rooted deeply in marketing, where gamification was developed in the form of rewards programs in which frequent shopping was rewarded. Gamification has also been added into social media, as exemplified in Foursquare and the use of badges to reward people for visiting restaurants. These are examples of how scores were basically added into the habit of visiting certain restaurants and stores and rewarding people for those habits.

At the classroom level, gamification has been done by adding game elements to otherwise traditional instruction. Gamification often means adding a basic infrastructure in which traditional class lessons are completed with the added element of teams and scoring. Rewards can also be added in this situation to motivate student completion of their in-class lessons. Gamification can be fairly powerful and provide some significant motivation for students, who feel more compelled to engage with their materials when they are in a competitive environment or when they have rewards to work toward.

Game based learning is a good bit different from gamification. With game-based learning, true games are used to provide the learning

experience. When using game-based learning, teachers can either use games developed specifically for the classroom or adapt existing games. Existing games that were originally designed for general entertainment purposes have been modified to meet the needs of classes. One example of this was in the game *Neverwinter Nights*, a fantasy game that was modified to present an image of the Revolutionary period of American history.

Not all games need to be adapted though, and many games are developed specifically for education purposes. Instructors who remember the early 1980s may be familiar with one of the most widely known education games in history, *The Oregon Trail.* The success of this game has led to its widespread fame and the game is still rereleased in updated versions from time. So, when teachers are considering how to integrate game-based learning, they can either adapt existing games or integrate games that are designed with education purposes specifically in mind.

To really summarize the point, gamification adds game elements to a course. Game based learning, meanwhile, relies on games to deliver instruction. Both can be used to maximize academic outcomes, but each has a very specific place in education and function differently.

Learn more about gamification.

Examples of Game Based Learning

Educational gaming has come a long way in the last few years. Here is just a small sample of games that can be used to teach subjects as diverse as history, literature, and mathematics.

History

History is a subject in which games can easily be integrated, not the least of which is because history is so ripe for gaming in general. As previously noted, *The Oregon Trail* is still being updated every so often and rereleased. The game asks students to manage resources and travel across the country to settle in Oregon during the 19th century when settlers moved out into the western United States. Along the way, they

travel to many destinations that were located along the trail and learn a little about the country's geography and history.

A world history instructor taught his students about the Gallic Wars by combining traditional instruction with the game, *Total War: Rome II.* The instructor began by having his students watch a video about the war and read Caesar's accounts of the fighting. Then, they played a game of *Total War*, taking control of Rome's forces. The game was played as a class, with the game projected on the screen and decisions made through peer feedback. The teacher also asked students to identify differences between the game and historical records, using this as a chance to teach critical thinking skills.

Literature

For students of literature, one game that they might find appealing is Inkle's 80 Days. Named TIME Magazine's Game of the Year and recognized for Excellence in Narrative at the Independent Games Festival, *80 Days* is based on the Jules Verne novel of nearly the same name, *Around the World in 80 Days*. Structurally, the game follows the basic beats of the novel as the protagonists, Phileas Fogg and Passepartout, attempt to circumnavigate the globe in 80 days.

However, the game takes some liberties with the story, and players can meet with characters from other Verne novels. An encounter with Michel Ardan, from the novel *From the Earth to the Moon*, will end the game with players traveling to the heavens. Another route will have the players meet Captain Nemo from *Twenty Thousand Leagues Under the Sea* and have them travel the ocean floors. The game lets players choose destinations around the world to travel to and plan the supplies they need to take. Because of its globe hopping nature, the game doubles as a lesson in geography as well, but the true value of the game is the excellent writing that stays true to the novel's roots while updating the format for a modern audience.

Math

Topics like history and literature lend themselves fairly easily to game-based learning, but it can be harder to find games in STEM topics. However, it's not impossible. Edutopia listed a few apps that can be

integrated into the classroom to help students learn math more effectively, for example. However, some of these apps cost money, and teachers are already constrained by limited school budgets. So, it's best to focus on those apps that are for free.

Sushi Monster, for example, is targeted at younger learners and includes colorful visuals and interesting characters. While engaging with this whimsical world, students are asked to master different areas of elementary math. The app challenges students in escalating levels of difficulty. It may be comforting for teachers to know that the app was designed to help meet Common Core standards. *Math vs Zombies* takes a similar approach, creating a colorful, cartoonish world in which young learners solve math challenges to change zombies back into their human forms.

Before high school teachers despair that there aren't games for older levels, they should know that there's one incredible example of a game focused on calculus education known as *Variant Limits*. The game places students into a 3D world on an imaginary planet facing a catastrophe. To save the planet, students must solve calculus problems that escalate in difficulty until the world is saved. The game has all the production values of many modern games and yet still places an emphasis on education, with 79% of students reporting an increase in their understanding of calculus.

Features of Game-Based Learning

There are several important reasons why teachers should consider moving to a game-based instructional method, at least for portions of their lessons. First, game-based methods are flexible and can be used either among individual students or among the entire classroom. Inkle's *80 Days*, for instance, is probably best used individually, while the group-based decision making used in *Total War* made that game well suited for the entire classroom.

Another advantage of game-based instruction is that these games take unique turns every playthrough. As such, they can be reused over several sessions to produce distinctly different outcomes. It remains to the teacher to tailor the game so that instructional outcomes are

maximized, but the game as a tool itself is powerful enough to be used time and again.

Of course, the most important feature of game-based learning is the impact such an approach has on engagement among students. Games can produce an emotional connection to the material, which raises the level of engagement that students feel in their classes. Higher engagement can increase the likeliness that students retain what they learn. When students are more highly engaged, they become more motivated to learn and retain content knowledge.

Game based learning tends to be a more active approach to learning, since it gets students involved hands-on with their materials. Small nuances to game-based learning can improve the outcomes as well. Introducing a competitive element can increase engagement and motivation as well, improving outcomes. The ability to add a competitive element is highly contextual and depends on the type of game being played. To use *80 Days* again, there's no real competition except to see who can make the fastest trip around the world. This involves comparing records of journeys and doesn't have a direct, head to head competitive element. A game like *Civilization*, on the other hand, involves direct competition between players and may be better suited for adding a competitive element.

It's also important to acknowledge the advantage that games have due to their novelty. Over the course of their academic lives, students become accustomed to certain approaches to teaching that are employed in classrooms. Lectures are among the most common means of teaching, even if such approaches make students passive learners. However, becoming used to certain teaching methods may make students apathetic toward the efforts of their teachers because of how familiar students are with the process. The old statement that "familiarity breeds contempt" may apply to students who are too accustomed to the traditional methods of instruction. Novel, new approaches may help reach these difficult students thanks to the fresh approach toward instruction.

Outcomes of Game Based Learning

All this talk about the advantages and features of game-based learning wouldn't mean much if game-based learning did have some strong outcomes. Fortunately, research has shown that game-based learning can have multiple positive outcomes for students. According to a report released by three researchers, Vandercruysse, Vandeaetere, and Calrebout, game-based learning is correlated with improved attitudes toward subjects that students often dislike, such as math. Students also showed a general enjoyment of games, including educational games.

Encouraging enjoyment of a subject is important because it keeps students engaged with learning materials, which researchers also found. In one example, students learned about history using a mobile city game. The students also showed strong engagement with the material. A similar effect was found in other courses as well. Gaming was also useful because it could be used to educate students about personal matters and health. The researchers found that games could help students learn about difficult health subjects, such as diabetes, and encouraged students to communicate with adults about health issues and gave them a strong sense of control over their own health.

Among the strongest demonstrations of the effect of game-based learning was the impact to cognitive learning. Research showed that students who played educational games demonstrated better knowledge outcomes on a subject versus students who learned in a traditional manner. For instance, game-based learning led to increased retention of science knowledge among students. In another case, students were able to retain vocabulary learning more strongly, showing the broad impact game-based learning might have. It could be used to effectively teach a wide array of subjects across the educational **Conclusion**

spectrum.

Of course, there are a lot of factors that can impact learning outcomes among students that might influence the outcome of these results. Students may at times be impacted by their own lack of mastery with a technology. On the other hand, a game's overall design might fail in its

presentation, which may create lower engagement among students. However, the general findings from a review of the literature indicated that game-based learning could have very strong, positive outcomes among students. As such, game-based learning has the potential to radically change teaching approaches.

It's not always easy to find games that fit your classroom, but the search is often worth it. Research has shown that game-based learning can actually have several positive outcomes, with students feeling more engaged and active with their materials. Educational games have also come a long way over the last decade and now deliver an amazing, educational yet entertaining experience. Games can be simple, fun apps that any student can use on their phones or be complex gaming experiences like *80 Days* or *Variant Limits.* The games available to educators today are much more engaging and effective tools than those that were available even just a few years ago, and they can be a potent tool for helping students learn even difficult subjects.

Project-Based Learning

Imagine you're in school learning about geometry. You listen to your teacher, complete some problems in class, do some more problems for homework out of your textbook, complete a few worksheets, play a review game, and take a test.

Now imagine another scenario. Two of your teachers get into a car accident in the parking lot. You work with your classmates to examine the parking lot and come up with a new design that will both minimize accidents and maximize parking spots. In the process, you learn about geometry, civics, law, engineering, and public speaking.

Which lesson or experience do you think would be more memorable? Hands down, the second experience, <u>which actually happened</u>, would be more memorable, educational, and practical than the first. This second experience is a wonderful example of Project Based Learning.

What is Project Based Learning?

You can't just slap a rubric and the term "project" on a class activity and call it Project Based Learning (PBL). According to Edutopia, PBL is "a dynamic classroom approach in which students actively explore real-world problems and challenges and acquire a deeper knowledge."

With true PBL, students work over an extended period of time to answer a question or solve a problem. The cornerstone of PBL is that students are learning through authentic, real world scenarios. When students have come to a conclusion or solved the problem, they present their findings publicly, which creates authenticity.

The true definition of PBL is somewhat vague by nature because it encompasses so many different educational processes and tactics. Continue reading to learn more about why this technique is so effective, and how you can implement it in your classroom.

Benefits of Project Based Learning

The greatest benefit to PBL is that it's real. Students gain practice addressing and solving the problems they will face in the real world when they graduate and begin their careers. PBL also instills an intrinsic love of lifelong learning as students enjoy seeking answers to questions they are interested in. In an educational climate where it's hard to avoid teaching to the test, PBL offers meaningful learning and growth opportunities.

The implementation of PBL was studied by researchers for Procedia, a journal of Social and Behavioral Sciences. They found many benefits, including exposing students to skills essential to success in the workplace: teamwork, conflict resolution, decision-making, and communication. They also found that PBL helps students improve their critical thinking and productivity.

A lot of these skills are termed 21st century skills, and they are essential to success in higher education and the workforce. PBL offers an avenue for these skills to be developed and strengthened. Students don't learn critical thinking by listening to a teacher lecture on critical thinking; they learn by thinking critically.

In addition to all of these benefits, learning the actual subject matter is one of the biggest benefits, yet it almost seems secondary due to the nature of PBL. Students don't need the traditional direct instruction and regimented practice when they are learning through firsthand experience.

How to Implement Project Based Learning

Teachers can't just choose any random project, slap a rubric on it, and call it PBL. According to the Buck Institute for Education, an organization that seeks to make PBL accessible, there are eight key elements to successful PBL. For each element listed below, you'll see a brief explanation, along with an example of what this element might look like in action.

Knowledge and Skills Derived from Standards

If this first component is missing, the project is pointless because there is no end lesson in mind for students. The project may be fun, but it lacks educational purpose. All projects should be focused on preparing students for success in school and in life.

How To: Look at your curriculum and decide what standards of learning you want to cover with your project. Also decide which 21st century skills you want to strengthen through this project.

Challenging Problem or Question

This challenge should be appropriate for students' level of understanding and prior knowledge. It should not be too challenging, but should meet students where they are at developmentally. This is what is going to drive the entire project.

How To: Depending on their level and experience with PBL, you can help guide students through the process, but the problem or question should be something students are motivated to learn more about. This might be the most difficult part of PBL for teachers; here is a great resource to help you develop your problem or question.

Sustained Inquiry

PBL doesn't happen overnight. Students should spend extended time doing an in-depth study through their project. It should not be something students can quickly research and formulate an answer. Sustained inquiry is what helps students think deeply and critically.

How To: Do not just assign a project with a due date and leave it at that; that is not PBL. Work with your students to address the problem through multiple iterations. If students think they have come to a conclusion quickly, help them re-examine their problem or question to dive deeper into the issue.

Authenticity

Students see right through lessons and projects that are inauthentic, often calling them busy work. All PBL should be based on authentic real-world applications. In addition, projects should pique students' interest.

How To: The best way to make sure PBL is authentic is to make sure the project has a point. For students, this could mean actually solving a problem in the real world, answering a question that is meaningful to them, doing a mock up of a real problem (court case, business plan, etc.), or meeting a real world need.

Student Choice

Teachers should provide guidelines, but students should largely have choice in how the project unfolds. This ties in with authenticity, and it is often the student choice that helps to make the project authentic.

How To: Don't "assign" a project with a completed project description and rubric. Depending on their maturity, allow students to help create as much of the project as possible- from the question itself to the assessment of learning at the end of the project. The more choice students have, the more intrinsically motivated they will be.

Reflection

The learning should not abruptly end when the project ends. Reflection offers students time and space to internalize what they have learned. Continual reflection throughout the project also allows students to make changes as they work.

How To: Reflection can be done through multiple channels, both formally and informally. Students can keep journals as they work through the project, teachers can check in with students at regular intervals, students can discuss their projects with each other, and students can also reflect via public feedback.

Critique and Revise

After students have a chance to reflect on their project and what they learned, they should also have a chance to make changes. Changes should be based on their own reflection as well as constructive criticism from their peers.

How To: Formative rubrics can be a great way for students to receive feedback and make changes; rubrics can be filled out by students themselves, their peers, their teacher, and/or a public audience. This can also be done more informally via conversations with the same individuals.

Public

Part of making a project authentic is giving it a public audience, and students should have the opportunity to do this in some fashion at the end of their project. Making the project public also motivates students to do their best work.

How To: There are many ways to get creative with this, and the public sharing will vary widely depending on the type of project. Some ideas include presenting findings at a school board meeting, displaying and discussing projects at a science fair or showcase, or presenting a plan to a town committee.

Note that there is some variation to the order and nomenclature of these PBL elements, but any true project based learning will include these general ideas in one form or another.

Are There Any Drawbacks to Project Based Learning?

PBL can be difficult for teachers to administer and facilitate, especially for teachers who are more of a sage on the stage rather than a guide on the

side. For many teachers, it's hard to relinquish control and trust that students will still learn without a rigid lesson plan. There is a fine line between relinquishing control and completely handing over the reins, and it can take some time for teachers to find that balance.

Thorough training in implementing PBL can be very helpful. It's a unique teaching and learning model that takes time to get used to. Just as students should be critiquing and revising as they work through their projects, so should teachers as they learn how to implement this instructional practice.

Another potential drawback is that while PBL is great for learning 21st century skills, it doesn't always hit every fact students may need to know on standardized tests. Most people agree that real, engaging, and authentic learning should be the goal, but unfortunately, we live in a world where teachers, schools, and students are judged based on their performance on tests.

Conclusion

While it may take some time to master, PBL can be an extremely beneficial learning strategy for students. If you are interested in starting to use PBL in your classroom, seek out formal professional development to give you the tools and resources you need to successfully implement PBL for your students.

Holistic Education: A Comprehensive Guide

Now more than ever, educators and education administrators are looking for new ways to effectively teach students. From teachers to politicians, debates are ongoing about how to best train up the next generation. New and innovative ways of delivering instruction have been imagined, and new philosophies of education developed. One philosophy of teaching

that has received little attention by the public is the philosophy of holistic education.

Holistic education is rooted in experiential learning and centers education on the relationships that people create with each other. These relationships form the core of the educational environment. Holistic education is considered a form of alternative learning because of its emphasis on creating a different learning environment from what is typically practiced.

True to its name, holistic education places an emphasis on the whole growth of a learner instead of emphasizing only specific parts of the human experience. It deemphasizes materialism while promoting growth in all areas of the human experience: intellectual, emotional, social, and so forth. Proponents of a holistic education argue that it promotes balanced relationships between not only people, but between people and their environment. Taken all together, holistic education emphasizes democratic learning, emotional health, and relationship growth, to a far greater degree than the traditional learning environment.

Origins

Compared to other philosophies of education, the school of holistic education is a relatively new movement that only coalesced in the 1980s. Holistic education was a response to the existing framework of education that dominated at the time, known as a mechanistic worldview of instruction. However, proponents of holistic education did not specify any one method or technique for teaching. Instead, holistic education was conceived as a challenge to traditional assumptions about how to best teach students.

The origins of holistic education can be traced to ancient concepts of instruction that emphasized the whole person rather than an individual segment of the person's experience. As only two examples, both native indigenous cultures and the ancient Greeks conceived of the world as a single whole. Using this as a reference frame, education cannot be separated from the rest of a person's experience. Enlightenment ideals that emphasized analytical and scientific reason downplayed the intimate and emotional connections that individuals had with their surrounding world.

By the 20th century, there was a shift back toward emphasizing the whole of the human experience. The Waldorf school movement tried to bring together a student's intellectual, artistic, and practical skills using an integrated, holistic approach. The Montessori school movement also placed emphasis on the spiritual qualities of the child and not just the intellectual aspect. Maria Montessori, founder of the Montessori movement, felt that people underwent a spiritual development that best occurred within a nurturing environment. The 20th century therefore saw several approaches to holistic education, though there was no single idea about how to implement it.

Common Philosophies and Themes

In many respects, holistic education may come across as fragmented in implementation. However, there are several recurring themes in holistic approaches that help characterize this school of thought. These themes are grounded in the interconnectedness of people both with other people and with their environment.

Interconnectedness could be considered the overriding theme that defines holistic education. Using the holistic approach, teachers emphasize the notion that humans have a kinship with one another. People, to a degree, have responsibility for the welfare of others. As such, all decisions have to be made with consideration for how those decisions impact the community. Consequently, a second theme of holistic education is the importance of relationships. Students are taught to appreciate the different skill sets that people possess and to learn cooperatively with their peers.

Out of the interconnectedness people share, a sense of community is developed, which is a third theme common to holistic learning. Students are taught to accommodate different views and beliefs that other people possess. As such, another theme that is common is the importance of caring, and students are taught to demonstrate a caring attitude toward others.

Two related themes that underpin holistic learning include the management of personal growth and development of personal goals. Students are considered critical learners who will need to develop the life skills necessary for lifelong development. Students are taught to

appropriately assess their strengths and how those strengths can benefit both themselves and others. Part of growth includes the creation of personal goals that students can pursue. Holistic learning considers the development and pursuit of personal goals an important part of maximizing a student's potential.

Finally, the last theme common to holistic learning is the role of the environment. Students are taught to respect the world around them. Their actions will impact not only themselves but others and future generations. As such, students are taught to assess how their actions will impact the environment, since the environment affects more than themselves.

In Practice

As can be seen by a review of the philosophies underpinning holistic education, there is a heavy emphasis on helping a student understand the impact of their choices. This goal is accomplished by encouraging self-development and taking into consideration both the world around them and other people. However, what does holistic education actually look like in practice?

Given the emphasis on how decisions impact others and the environment, it should not be a surprise that experiential learning is important in a holistic framework. In one instance, primary grade students from disadvantaged backgrounds were taught without a curriculum. Instead, teams were formed and allowed to explore different learning styles that were most effective with different children. Projects were developed, and families involved with helping students complete those projects. Instruction was primarily done using peer teaching, discussions, field trips, and ongoing assessments of a child's learning styles.

Inclusive practices have also been used in which youth were taught how to assess social problems within their neighborhoods and develop solutions that could address those problems. Goals that instructors set included the acquisition of observation and listening skills, the development of data collection skills, and the creation of interpersonal relationships.

A holistic framework was also adopted for use in education within a prison population. This approach included the creation of study groups among prisoners who had, for the most part, failed to complete their schooling. These teams identified problems within their environment and created projects meant to address those problems. Prisoners found former educators within the prison who reviewed the work they did, while the student prisoners themselves learned how to compile data, conduct surveys, and develop findings that addressed the problems they faced in their environment.

Education programs put into effect at the higher education level made attempts to integrate the transformative and spiritual aspects of holistic education. As a part of his instruction in critical analysis, Edmund O'Sullivan, the director for the Transformative Learning Center at the University of Toronto, had students analyze film. These students were asked to look for elements such as consumer patterns, differences created by ethnicity, and power structures that were present in the films. O'Sullivan asked his students to reflect on the patterns of behavior they saw in the film and discuss ways of living an earth friendly lifestyle. This type of approach allowed for class wide participation in an engaging activity that encouraged critical analysis of existing social constructs.

O'Sullivan's course went one step beyond just analyzing these films. He also encouraged the formation of communities that could work against the patterns the class identified. This took the critical analysis beyond just theory and into the area of practice. Through this approach, O'Sullivan encouraged his students to go beyond the requirements of the classroom and to become independently involved in various social movements.

Another example of holistic education implemented at the higher education level was found in the work of Bob London, a professor of education at California State University. London and his peers created Saturday sessions that explored a different theme every weekend. These thematic classes included sessions that covered topics such as how to use the arts to create meaning and how to use technology as an artistic medium. This approach was among the most experimental uses of holistic education and focused on contemplative approaches to exploring different issues.

This was an example of a course designed almost entirely around the concept of introspection. While many other attempts at holistic education attempted to blend the holistic philosophy with real world problem solving, London's work was highly spiritual and contemplative in its design. As one example, London's students designed a labyrinth that they walked, allowing them to collectively work together. Afterward, students wandered the labyrinth and reflected on how art could be a communal activity. Students also learned the value of slowing down in a world that typically pushes a high pace of living.

Takeaways

When reviewing holistic education, it becomes clear that there is no one method of implementing its principles. Holistic education is less concerned with designing specific practices and more concerned with changing assumptions about how to approach the education process. Holistic education encourages students to reflect on how their actions impact others and the world around them, which requires greater contemplation and less focus on rote memorization of facts and techniques.

However, there are some consistent trends in how holistic education is implemented among students of all ages. It's clear from a review of how holistic education is practiced that centering problem solving on real world issues is a key part of this educational approach. Students were often asked to apply critical thinking skills to problems in their community. Whether these meant adolescents tackling problems within their disadvantaged communities or prisoners addressing issues within the prisons they lived in, students were asked to apply critical thinking skills to real world issues. Holistic education places an emphasis on applying necessary skills in a real-world context exactly because it reminds students that their decisions impact their environment and others.

In the course of dealing with these real-world issues, students acquired numerous skills that are important in higher education and in the workplace. Students learned how to develop questionnaires, analyze the data they produce, and report on that data. Most importantly, they learn how to reflect on issues and think critically about them. Holistic education allows educators to frame the skills that students learn within a real-world

context, and those skills can be transferred and used in multiple circumstances.

A separate segment of holistic education placed an emphasis on the spiritual and mental health of students, as best exemplified in the work of Bob London. This element of the holistic approach may be more difficult to implement within classrooms, given how drastically different it is from normal classroom approaches. However, rather than attempt to implement specific contemplative *techniques,* it may be effective to consider the student as a whole, including their emotional selves. Encouraging a few moments in the classroom for students to reflect on their learning or designing school days to include contemplative periods may help encourage the emotional well-being of a student.

However, it remains clear that holistic education is still an area ripe for exploration. New practices are being developed that attempt to be integrate the principles of this new philosophy of education. While other schools of thought remain more popular in the education field, holistic education may have much to offer through its emphasis on well-being, critical thinking, and the development of solutions to societal issues.

Scaffolding in Education

A key concept in education for the last decade has been the idea of scaffolding. Scaffolding refers to breaking up new concepts so that they can be learned more easily. It's a process that many teachers have used for decades but that has recently received much more attention as an instructional approach. By implementing scaffolding, teachers can improve the likeliness that students will grasp new materials and retain what they've learned.

Scaffolding vs Differentiation

Occasionally, teachers confuse scaffolding and differentiation. However, the two are distinct. In a report issued by the Tennessee Department of Education, differentiation was defined as a framework in which different students received different methods of learning. Scaffolding, on the other hand, was defined as breaking up learning into chunks so that students tackled increasingly more complex material.

In practice, differentiated instruction is characterized by attempts to change the activities that students use to learn about a topic. This might mean providing different materials to students with different learning styles. For some students, highly visual materials may be appropriate, while other students might be more highly tactile learners.

Scaffolding, on the other hand, breaks up even differentiated lessons so that they are delivered in increasingly complex chunks. It breaks up learning new topics into stages in which old ideas are connected to new ones and students are led from guided to independent instruction. There are several ways that this can be done.

Scaffolding Techniques

There are many different scaffolding interventions that can support learning. Some of these interventions include hands-on activities while others rely on the teacher to explain related concepts. The task that teachers use should be appropriate to what is being learned and appeal to the strengths of the students working through the materials. Throughout the scaffolding process, a heavy emphasis should be placed on connecting old concepts to new ones to set a foundation for learning.

Here are just a few of the ways that teachers can set the stage for teaching difficult new concepts.

Advance Organizers

Advance organizers deliver a preview of more complicated materials yet to come. The organizer serves as an introduction and provides basic principles about how students should think about the material. The advance organizer also takes what students have already learned and connects it to the material yet to come. This helps provide a strong foundation for learning new materials.

What are some specific examples of organizers? Graphic organizers provide visuals that students can engage with. During the introductory lesson, students can fill in missing pictures of the visual. This extra level of engagement helps students to better understand the basic principles that will underlie more complex tasks.

Expository organizers are among the most common types of organizers because they are straightforward in their nature. This organizer only requires that teachers tell students what the goal of the lesson is. Teachers verbalize and connect previous lessons to the current lesson and how that sets the basis for future lessons.

A creative form of organizing includes storytelling. This takes the verbalized expository organizer and puts a creative spin on it. With this organizer, teachers take previous concepts and lessons and frame them in a story. The story also includes concepts that will be learned in upcoming lessons. By framing past and current principles in a narrative frame, the teacher creates a more engaging framework in which students learn their lessons.

Concept and Mind Maps

Concept and mind maps are simply visual graphics that show relationships between learning concepts. These maps show previous concepts students have learned related to new concepts that will be encountered. These kinds of maps are especially appealing to visual learners, making them valuable when differentiating and scaffolding learning for highly visual learners.

A mind map is drawn so that related topics are connected by branches, with one central concept uniting them all. For instance, take the concept of mind mapping to make it the central category. Now, think up three major ‘branches’ related to mind maps. One branch could be creativity, another could be planning, and a third one could be beneficial. The creativity branch could be made of smaller branches such as ideas and innovation. The planning branch could be made of smaller branches that include strategies and goals. Finally, the benefits branch could include fun and simple. Now, you have a mind map as the central concept made of three branches, each with their own smaller branches. You can also find connections from different branches.

When applied to education, teachers can use this to connect almost any type of concept. For instance, you may be teaching a science class about cellular structure. As the central concept, you might have human cells. Then, the branches could be composed of stem cells, bone cells, blood cells, and so forth. Each cell could then possess its own set of smaller branches describing features unique to that cell. This approach helps students see the features of each type of human cell but also similar features between cells.

Instruction

Sometimes, the best scaffolding technique is the one that teachers are most familiar with. There’s always a place for simply teaching students, and sometimes teachers can be most effective by giving a straightforward lesson that prepares students for more complex work to come. A prime example of this is language.

When dealing with language, students are given vocabulary lessons prior to reading something difficult. This helps them because students tend to become disengaged whenever they are reading and struggle to understand the words in their assignment. Reviewing particularly difficult vocabulary words before the reading helps students understand how to pronounce these words and what they mean. Teachers can review the reading assignment and identify words that the students might find some particular difficulties with and provide handouts for the students for use during the vocabulary review.

Teachers can also add an engaging element to this process prior to reviewing the words with students. Before reviewing the word list, students can bring the students together in groups and ask them to brainstorm what the words might mean. The teacher can then review the class' ideas to see what similar words they came up with. Finally, the teacher can explain what the word means and the class can identify which brain stormed words were accurate.

The Benefits of Scaffolding

There are a number of benefits to scaffolding instructional approaches in the classroom. Some of these benefits are related to the fact that they have a personal, emotional impact on students. Other benefits to scaffolding include the positive outcomes in grades. Here are just some of the ways that scaffolding can benefit students.

Scaffolding Improves Comprehension

Each student is different and learns at a different pace. Because of this, some students often fall behind. They simply don't comprehend the material and find themselves being outpaced by their peers. Scaffolding can address this issue. Scaffolding is particularly effective when teaching about a new topic, which is when many students struggle. New materials provide unique challenges since students are asked to learn about entirely new topics with which they have little experience. Scaffolding is an approach proven to increase learning outcomes.

Scaffolding Enhances Problem Solving

Scaffolding helps teachers to connect already learned concepts with material that is part of a new lesson. This previously learned material helps set a foundation for new materials to be learned. Students also start thinking about new materials using some of the same approaches they used to tackle their previously learned materials. Connected old concepts to new ones guides students in understanding how to deal with new materials. This may involve seeing connections when discussing a new type of cell in a science class or could involve remembering how they dealt with math problems in previous lessons and using similar approaches to dealing with more complex math challenges.

Scaffolding Creates Higher Engagement

An important way that scaffolding works is by improving student engagement. There are a variety of activities that teachers can use that get students more directly involved with their class work. Plus, the close support teachers can provide during scaffolded instruction can keep students from becoming discouraged. By building on knowledge a student already knows, it keeps the student from getting lost when learning new content and keeps them involved in their lessons. Scaffolding reduces student frustration and keeps them interested in what they're learning.

Scaffolding Creates a More Positive Classroom

Scaffolding is an approach that can help reduce frustration and anxiety in the classroom. These two factors can have a number of negative outcomes and push students away from learning. Scaffolding takes these negative factors out of the class by removing typical points at which students struggle. Traditionally, teachers teach a lesson and then students independently practice.

Scaffolding creates a supportive environment with higher levels of engagement between students, teachers, and their peers. Using scaffolding brings together a number of positive practices associated with improved academic outcomes, including peer learning and increased teacher support. These classrooms integrate lower stakes activities in which students are free to fail without having to worry that they will have their grades suffer. They can feel free to experiment with a teacher providing support or can enjoy the support of their peers as they work through complex materials.

Scaffolding creates a more easygoing classroom with a much more supportive structure in which students don't have to stress themselves out about how well they do. This approach makes it easier to encourage student innovation and participation and lessons the anxieties students feel about coming to class. Every student has one particular subject that they don't feel confident about, and scaffolding can remove the negative perceptions they might have of those classes.

Challenges of Implementing Scaffolding

There are challenges that every teacher has to face when it comes to implementing scaffolding. For instance, scaffolding can take a good bit of time to set up originally. Teachers have to review existing lessons, identify points in their lessons where scaffolding is needed, and come up with scaffolding activities that can enhance learning. This can be time consuming when teachers first attempt to implement scaffolding. However, as with many other shifts in teaching style, the bulk of the work needs to be done when a teacher is first changing their style. Activities can be reused later on and speed up the planning process.

It's choosing the activities themselves that can pose a problem for teachers. As previously pointed out, scaffolding is different from differentiated teaching. Scaffolding activities have to be able to meet the strengths of students with very different learning styles. Teachers have to take the time to understand the strengths of their class and come up with activities that will be broadly appealing to students of many learning styles. Alternatively, they may have to identify different scaffolding activities individual students can complete that appeal to their strengths. It's this process of identifying strengths and weaknesses that can be time consuming.

Appropriately scaffolding instruction can be particularly difficult for novice teachers. More experienced teachers often have an easier time identifying different learning styles of students in their classes. These teachers often have an easier time adapting their lessons to meeting these different learning styles. For new teachers, it can be harder to identify what works within their classes and how to differentiate their scaffolding activities in such a way that no student is left behind.

However, one of the most difficult aspects of scaffolding can be knowing when to let go and stop scaffolding for students. After a period of introducing students to new materials, teachers have to be able to let their students work independently on their materials. It can sometimes be difficult to understand just when to let go. It's also human nature to want to retain control. However, it's important for teachers to understand when to stop holding their students' hands and let them progress forward independently instead of providing scaffolding for the students to use.

However, if teachers adhere to a four-stage format, they are more likely to implement successful scaffolding in the classroom.

The Four Stages of Scaffolding

North Illinois University recommends a four-stage method of scaffolding that progresses from teacher led activity to independent learning. In the first stage, an instructor introduces the subject and performs a task related to that subject. During this period, they connect previously learned material to material that is about to be introduced and show how a newly learned task can be completed. This is a period that allows students to observe and later model the teacher's behavior.

Afterward, the teacher can ask for the class as a whole to participate in completing a similar activity. During this time, the teacher takes feedback from the class about what to do next when completing the task. Some activities may lend themselves to the teacher writing a list of these recommendations and trying out each of them. Regardless of whether a list can be created, the third step of the lesson involves bringing groups together to complete a similar activity. In groups, students can work together and use peer instruction to help guide each other through the activity.

The last stage of the lesson involves teachers allowing students to complete a similar task on their own. At this stage, the teacher removes the scaffolding entirely and allows the students to work independently. Building on the knowledge they've gained over the three previous stages, they can more effectively tackle a similar problem independently. Of course, even with a four-stage process, some students may not have fully grasped the lesson. This fourth stage is an important point in which teachers can assess student progress but also determine how effective their scaffolding process was.

It should be noted that while the four-stage process provides a framework for teachers to follow, they should only use it as a loose framework and not a rigid structure. For instance, the model provided by North Illinois University assumes that the teacher acts primarily as a lecturer during the first stage and doesn't include some of the introductory activities we've previously discussed, like the creation of mind maps.

However, the first stage of a teacher's instruction can be brief and be merged into the second stage, with students filling out activities as the teacher introduces the concepts and completes related tasks. Then the class can break out into groups and finish tasks before moving to independent work. The four-stage model provides an outline that teachers can learn from, but they should feel free to compress it when necessary or make some stages longer if the topic is particularly complex.

Conclusion

Scaffolding can be a little time intensive when first attempting to implement in the classroom and can be particularly difficult for new teachers to grasp. However, it's a powerful means of helping students learn new concepts and helps them retain new information more easily. By connection old ideas to new ones, teachers set a foundation for learning those new concepts. Then, by gradually working toward independent practice, teachers can progressively challenge students to successfully deal with these new concepts on their own.

Integrated approach

1-LECTURE-CUM-DISCUSSION METHOD:-

This method is a combination of lecture method and discussion method. This is very helpful in building an active verbal interaction between the teachers and students. The teacher delivers the lecture and provides some time (10 minutes) after the lecture for discussion among the students and teacher in the classroom. The student's views, comments experiences, problems, difficulties in understanding any point or portion of the lecture come to teacher's knowledge and teacher replies, and clarifies the doubts. It is an important strategy in stimulating the students interests and assess their understanding of the concept. It is a process in which interaction goes on in between teacher and students, where in question and answer are asked and given by both the teacher and students making the process interactive, and effective. The basic purpose of this method is to disseminate information and attain educational objectives by learning. The discussion in the class is intended to be a give and take between teacher and students. This method helps students to apply critical thinking power in various situations. Higher learning skills like analyzing, synthesizing, generalizing are given front seat.

PRINCIPLES OF LECTURE-CUM-DISCUSSION METHOD:-

The Principles are as follows:-

1. The teacher should be aware of needs of learners.
2. The teacher must arouse interest in the subject and sustain in the mind of students.
3. Teacher must use visual aids and use ICT.
4. The teacher must take enough time to build mental pictures, with new concepts, previous knowledge, moving from simple to difficult ideas, for better conceptual development.

ROLE OF TEACHER

The teacher has to perform following roles:-

1. Encourage students to participate in discussion.
2. Ensure, student's attention span is maintained.
3. Pre plan and prepare properly for discussion and support ideas with factual evidence and examples.
4. Encourage student taking than teacher talking.
5. If possible give time before hand so that, the discussion becomes productive.
6. Do not dominate rather get the discussion started set goals, summarize, mediate and clarify.

MERIT OF LECTURE-CUM-DISCUSSION METHOD:-

1. It creates democratic environment in the class.
2. Develops and improves communication skills of students.

3. It brings about attitudinal change among students.
4. It helps in assessing the factual knowledge of the students.

LIMITATIONS OF LECTURE-CUM-DISCUSSION METHOD:-

1. It is helpful for mature students.
2. If it is not properly used, then the principle of “learning by participating” is not achieved.
3. If teacher does not handle students effectively then the students may be in disciplined rather than participation.
4. If not managed properly, it will not help all types of students in the class.
5. Teacher must control his emotions else this may result in wrong output.

SUGGESTION FOR IMPROVEMENT:-

1. The teacher must maintain good eye contact with students in order to make the process meaningful.
2. The teacher must actively involve students.
3. The teacher must instruct clearly.
4. Must keep the group focused on the task.
5. Teacher should use good time management techniques and evaluate students as they learn in the class.
6. Teacher should not read extensively from lecture notes or text books.
7. Teacher must not ignore participant’s comments and feedback.

2-LABORATORY METHOD:-

This method in commonly thought of as a hands on and minds on approach to teach science where in students have the opportunity to gain some experience with phenomena associated with their course of study. In this method either student participate alone or in small groups. They produce or manipulate various variables that are under exploration. The degree to which student

has control over exploration can vary over a wide range. Here the students learn by actual doing rather than my observing the experiments. As young children do it by themselves, the experience is impressed more firmly in their minds. Thus this method in psychologically sound as it satisfies the natural urge for activity. This method broadens interest of the students. They learn many virtues through laboratory activity. The experience in a laboratory is very rich in personal satisfaction as they gain it firsthand. The sense of excitement and challenge help them to achieve some tangible him.

PRINCIPLES OF LABORATORY METHOD:-

1. It follows the principle of learning by doing.
2. It follows psychological principle, where students age, lord and interest is taken into consideration.
3. The work should be Pre-organized and Pre-selected.
4. Teacher must see that, students are allowed to work independently without much interference.
5. The teacher must ensure that apparatus and equipments should be checked pair hand.
6. Teacher must see that students are able to follow in struction and record their observation properly.

ROLE OF TEACHER:-

1. Teacher must be a facilitator of the process of doing experiments by students.
2. Teacher must check the apparatus previously, so that it goes on smoothly.
3. The practical work must be Pre-organized and Pre-selected.
4. The skills of handling apparatus, drawing, diagrams, careful observations taking necessary precautions, must be developed among students.
5. The teacher must be that, the student is doing experiment properly by following proper procedure.

MERITS OF LABORATORY METHOD:-

The Merits are listed below:-

1. This method follows child-centered approach.
2. It makes students active and alert.
3. It gives scope for learning by doing and students do a lot of thinking themselves.
4. Different skills are developed.
5. It paves way for exploration experimentation and verification of scientific facts and principles.
6. It inculcates good virtues like, honesty, truthfulness, dignity of labour etc.
7. It helps in developing sprit of enquiring.
8. It helps in developing higher order this king capacities like reasoning, analyzing, synthesizing etc.

LIMITATIONS OF LABORATORY METHOD:-

The limitations of this method are as follows:-

1. It is expensive and uneconomical.
2. It is time consuming as it takes much time in some experiments to

come to conclusion.

3. It expects a lot from students and teacher.
4. It does not guarantee that, students would be equally efficient in solving problems outside laboratory.
5. All students cannot be expected to be skilled workers.
6. Most of the students are either not ready or lack to ability to undertake original work.

SUGGESTIONS TO IMPROVE:-

1. This method should not be considered independently but should form a part of the total science programme.
2. The practical work must be pre-planned.
3. It is imperative that same individual laboratory work must be done by every student.
4. Instead of performing the experiments started in the book should be little modified for better result.
5. Before experiment in performed the purpose must be clarified to the students.

3 -OBSERVATION METHOD:-

In this method, the student observes and acquires knowledge. Through we cannot call this as a specific method of science teaching but as a matter of fact almost all science begins with observation the students observe nature, in groups, in lab at school at home or in gardens.

result of this process information of a concept of nature which in permanent in mind. The training of pupils in observation is really strong his mind with suitable experiences all thoroughly classified and digested. Science provides remarkable. A raining in observation and reasoning. The learners reasons from the once established facts and form concepts about further observed phenomena .

PRINCIPLES OF OBSERVATION:-

It is based on following principles.

1. Principle of freedom.
2. Principle of experience.
3. Principle of play-way.
4. Principle of individual effort.
5. Principle of activity.
6. Principle of logical thinking.
7. Principle of purpose fullness.

ROLE OF TEACHER:-

A lot is expected / demanded of the teacher in this method:-

i) He must be man of knowledge and give adequate references for further observation.

ii) He should possess curiosity, scientific attitude, interest, sprit of investigation so as to inculcate such qualities among students who in term observe and discover many things.

iii) He must provide an atmosphere for freedom in the classroom in order to encourage students to make observations.

iv) He must be a guide, a working partner and friend of the students.

v) He should devise and plan different activities according to the age, ability and interests of the students.

vi)

MERIT OF OBSERVATION METHOD:-

1. The work of the teacher becomes interesting.
2. The students see think give logic and thoughtful answers.
3. The students learn the similarities and dissimilarities of objects clearly and easily.
4. The knowledge acquired in permanent.
5. Students develop interest in subject.
6. Students become self-dependent, self-reliant and self-confident.
7. The problem of home-work in solved.
8. The relation between teacher and taught becomes intimate and healthy.

LIMITATIONS OF OBSERVATION METHOD:-

1. It is too much to expect children observe and retain knowledge. The students are in nature sometimes and their knowledge and thinking power in limited.
2. It is not suitable for all the topic of science.
3. This method is information. The practical part of it remains underdeveloped.
4. It is not economical from time point of view.
5. This method is also not economical as it requires a lot of preparation and maintenance form school point of view. Where is students can observe many things.

SUGGESTION TO IMPROVE:-

1. The students must be given full freedom during observation.
2. Interest and curiosity must be developed in students prior to making observations.
3. The teacher must check and observe things beforehand.
4. The teacher must put questions and pinpoint students observation as and when required.
5. The school must have science corner where in students observation and activity goes on continuously.
6. A science bulletin board, A museum shelf, Aquaria and terraria must be there in school where in students develop a constant interest in the subject.
7. A weather station must be setup where in students observe the weather develop interest.

4-PROJECT METHOD

This method was propounded by W.H Kilpatrick. This method was perfected by J.A Sternson. The base of this method lies in the philosophy of pragmatism. This method emphasizes on building a comprehensive unit around an activity which may be carried out in school or outside. The essence of this method lies in the fact that a group of students do a purposeful task. This implies the students undertake the activity in a group or individually over a period of time. It may include a number of activities and the end product is in the form of written report or a display. “A project is a whole-hearted purposeful activity proceeding in a social environment”- Dr. William Kilpatrick.

“A project is a problematic act carried to completion in its natural setting”. – Stevenson. “A project is a bit of real life that has been imported into school. – Ballard.

Thus, project is a purposeful activity and planned activity which is achieved in social, natural situations created in schools.

PRINCIPLES OF PROJECT METHOD:-

1. The Principle of freedom.
2. The Principle of purpose.
3. The Principle of activity.
4. The Principle of interest.
5. The Principle of utility.
6. The Principle of correlation.
7. The Principle of sociability.
8. The Principle of experience.
9. The Principle of reality.
10. The Principle of learning by doing.

TYPES OF PROJECT:-

All the project can be divided majorly into two types.

(i) Individual Project.
(ii) Group Project.

According to W.H. Kilpatrick projects are of four project.

i) Producer projects
ii) Consumer projects

iii) Problem projects
iv) Drill projects.

PRODUCER PROJECT: -

Here the emphasis is on actual construction of a material object or article.

CONSUMER PROJECT: -

Here the emphasis is gain on obtaining either direct or vicarious experience, such as reading and learning stories, listening to a musical delectation etc.

PROBLEM PROJECTS:-

The main purpose is to solve a problem using intellectual process, such as determining the density of a certain liquid.

DRILL PROJECTS: -

This type of project emphasizes on attaining a certain degree of skill in a reaction as learning a vocabulary.

Steps of Project Method:-

1. PROVIDING A SITUATION: -

The teacher provides a situation to the students which must create same problems and students must feel interested to work.

2. CHOOSING AND PURPOSING: -

The students are tempted to choose a project. The teacher should stimulate discussion by suggestion. While choosing the project the teacher should bear in need that it should be of real need to students. The purpose of project must be clearly defined

to the students. The project must be common and acceptable to all. In case of wrong choosing, teacher must help students tactfully to see that the students choose a better project. They should be asked to write down the reasons for selection.

3. PLANNING: -

The success of the project lies in the good planning. The students should plan out ht whole project under the guidance of teacher. Every child must be encouraged to participate in the discussion and make suggestion. All the students are encouraged to write down the plan neatly and properly.

4. EXECUTING: -

Execution of different activities to different students on the basis of their capacity leads to successful completion of the project work. It is the longest step and requires meticulous assignment of duties to different students or groups the teacher must guide and encourage students. It is the duty of the teacher to keep watch on the process of activities and instruct as and when require

EVALUATION

This is very important step as; the students review the project and find out mistakes if any. Self-Criticism is very important at this stage. The students discuss their work and rectify their mistakes and recollect useful knowledge. The teacher sees that the objectives of the project have been achieved.

5. **RECORDING**: -

The students keep a complete record of entire activity. How they planned, discussions were held, how duties are assigned, how criticism were made, which will help them in their future work.

EXAMPLES OF PROJECTS: -

i) Arrangement of science fair.
ii) Preparation of soap/chalk/candle/ink etc.
iii) Improvise apparatus.
iv) Beautifying campus.
v) Establishing science museum.
vi) Establishing physical science laboratory.
vii) Painting iron apparatus to present it from rusting.

ROLE OF TEACHER: -

1) Teacher must be a friend, guide and working partner.
2) Teacher must have through knowledge of individual student and allot work accordingly.
3) Provide democratic atmosphere.
4) He should learn with students and should not claim to know everything.
5) He must be inexperienced, initiative and process tact for creating positive ambience.

MERITS OF PROJECT METHOD: -

1) It promotes Co-operative activity.
2) It arouses and maintains interest of students.
3) It keeps the students on freedom of thought and action while doing the work.
4) It develops scientific attitude.
5) It widens the mental horizon of student.
6) It develops dignity of labour.
7) The students learn by self activity.
8) It supports all the laws of learning i.e., law of readiness, law of exercise, law of effect.
9) The correlation of subjects is best followed in this method. The subjects are not treated as water tight compartments.
10) This is a psychological method.

DEMERITS OF PROJECT METHOD: -

1. The knowledge is not acquired in a sequential manner.
2. There may be a chance of overlapping of subject matter.
3. If not planned and executed properly them, it may not be completed in time.

4. It is a time consuming process.
5. It may be a costly affair where in same items/things may not be available at times.
6. There may be overdevelopment of individualism and under development of co-operation and group responsibility.
7. If the topic in wrongly selected them the objective may not be achieved.
8. It gives to students a superficial knowledge of great many things. Therefore it is not suitable for all types of students.
9. This method is not suitable for a mature teacher.
10. The whole syllabus, for higher classes cannot be accomplished with this method.

SUGGESTIONS TO IMPROVE: -

1. The topic should have same educational value.
2. Project should be selected according to the student's interest.
3. Entire course should not be planned only using this method.
4. The objectives of the project must be clear and defined.
5. Students should be assigned various duties according to their capabilities.
6. The students should be given freedom to interact among themselves.

5-PROBLEM SOLVING METHOD: -

Science subject is one of the important subjects in school education. However, really the traditional teaching methods are challenged for their inability to foster critical thinking, holistic learning environment among children. The science subject must develop science process skills where children, observe, measure, classify, process information, interpret think on solving problems, analyze, synthesize, formulate conclusions, etc. but, it should be kept in mind that, creativity in an essential element of P.S.

In a problem solving method, children learn by working on

problems. This enables the students to learn new knowledge by facing the problems to be solved. The students are expected to observe, understand, analyze, interpret find solutions, perform applications that lead to a holistic understanding of the concept. This method develops scientific process skills. This method helps in developing brainstorming approach to learning concepts.

The students thinking on problem and their understanding of the science behind it is based on common sense. It does not start from textual knowledge. Rather it proceeds from experiencing to gradually forming concepts through books at later stage. It is a process from practice to theory not vice versa. Knowledge here is not a goal but a natural out came of working on tasks. Students live in the real world and like to deal with concrete things where they can touch, feel manipulate things then the method is useful in igniting the process of science learning.

PRINCIPLES OF PROBLEM SOLVING METHOD: -

1. Principle of learning by doing.
2. Principle of purpose.
3. Principle of freedom of thought.
4. Principle of learning by experiencing.
5. Principle of utility.
6. Principle of scientific attitude.
7. Principle of interest.

8. Principle of reality.
9. Principle of concreteness.
10. Principle of objectivity.

STEPS IN PROBLEM SOLVING METHOD: -

1. Selection of problem.
2. Presentation of problem.
3. Collection of facts.
4. Drawing an outlines.
5. To reach a satisfactory conclusion.
6. Evaluation.
7. Writing report.

1) SELECTION OF THE PROBLEM: -

A remember of problems are confronted by the students in the class or outside. They are made to select a problem as per their capacity and interest.

2) PRESENTATION OF PROBLEM: -

Each student is made to feel responsible for presenting the problem in front of the teacher and class as per his insight. The students are free to give their suggestions on the problem.

3) COLLECTION OF FACTS: -

All the facts related to problem are collected either by a students or group. As a number of facts will be collected, it will help the students to keep the most pertinent facts and discard rest.

4) DRAWING AN OUTLINE: -

This is most important phase as a proper outline at this stage will lead to purposeful activity. The teacher will guide students to draw exact plan and follow it properly so that the solution to problem is reached. It is more or less like planning stage, where in a clear indication of outline leads to better result.

5) **TO REACH A SATISFACTORY CONCLUSION: -**

It is the longest step and requires outmost patience. The tentative solutions which are offered by students are properly noted down. A good number of arrangements, discussion, brainstorming results in reaching a satisfactory conclusion. The teacher has to be very careful at this stage as, if may lead to wrong conclusions. The discussions must be healthy and conducive atmosphere must be provided in the classroom for it.

6) **EVALUATION: -**

The students review the entire process and find out each and every stage where in they have made any mistakes. Self-criticism and Self-realization will give training of self confidence. The teacher must see that objective have been achieved.

7) **WRITING REPORT: -**

A complete report must be written by students. This will include, how they planned, what discussions were held, how duties were assigned, how satisfactory conclusion was reached

etc. the writing of report will be maintained as a record which will be used in future course of time.

ROLE OF TEACHER: -

1. Teacher must work as a facilitator.
2. Teacher must keep in mind that if in a child-directed learning not teacher-directed.
3. Teacher must provide situation for all students to come formed and contribute towards the success of the activity.
4. He must be alert and active to arouse interest among students.
5. Teacher must provide democratic atmosphere.
6. He must be initialize, tactful and we experienced.

MERITS OF PROBLEM SOLVING METHODS: -

1. Students develop democratic feting.
2. This method follows the principle of learning by doing.
3. They learn to use old facts in new references.
4. They become capable to generalize.
5. Students learn to find solution to their problem.

DEMERITS OF PROBLEM SOLVING METHOD: -

1. It is not economical from time and money point of view.
2. There is always a doubt of drawing wrong conclusions.
3. There is short of talented teachers to practice this method.
4. This is not suitable for all level students.

SUGGESTIONS TO IMPROVE: -

1. The time period must be fixed.
2. The objective should be fixed for a problem.
3. Proper attention must be gain by teacher towards students activities.
4. All students should be given equal opportunity to put forth their problems and ideas.

5. As far as possible the process of group formation should be psychological.
6. Apart from improvement of teaching the objective of this method should be development of routine problem solving skills.

2.0 LET US SUM UP: -

As we have seen all above methods have their pros and cons. But, effectiveness of teaching depends upon the method that teacher adopts. Group teaching does not happen over right. For effective teaching, knowledge of different methods of teaching science in essential. The teacher however must be free to choose any method that he thinks is suited to the students. For many decades now, which is not practiced i.e., creating excitement of science, use of new and innovative methods must be practiced now. Same are discussed here.

In lecture-cum-discussion method is best suited for all lords of students. The basic purpose of this method is to disseminate and encourage them to take part in the discussion.

However, teacher has to see that all students are given equal chance or else this will loose its charm.

In laboratory method, the student controls and observed the changes under investigation.

Students learn by actual activity students learn many virtues through laboratory activity.

Observation method encourages students to develop a keen power of observation and acquire knowledge. This aims at training students mind to store suitable experiences for reasoning and establish facts observation of nature develops a sense of satisfaction and develops awareness towards protection of nature.

Project method has certain steps to be followed by students. This method in based on philosophy of pragmatism. The sense practicalism develops an attitude to undertake the activity and complete it scientifically.

Problem solving method develop skill of finding solutions to the problem on their own. The students thinking on problem and their understanding of the science behind anything helps them to solve problems of their life objectivity. Students live in the real world and like to deal with concrete things.

At the end, we can conclude that it is you teachers who have to keep in mind, which method is suitable to which type of students under what circumstance. Every method has its merits and demerits. The choosing of methods depends upon your intelligence, resource fullness.

UNIT AND EXERCISE: -

1. Discuss briefly the advantages and disadvantages of lecture-cum-discussion method.
2. Describe the laboratory method of teaching science keeping its merits and demerits in mind.

3. Identify a topic where in you can adept problem solving method.
4. “Observation develops optical reasoning and concentration power”. Explain?
5. Discuss the project method for teaching science. Illustrate it.
6. What are the merits and demerits of laboratory method of teaching science.

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TEACHING GENERAL SCIENCE

3.0 Objectives: -

In this unit, an overview of following points will be given to you. After reading this unit, you would be able to:

- Formulate instructional objectives of teaching science.
- Plan a teaching unit of science.
- Plan a lesson effectively according to different approaches.
- Know the process of developing improvised teaching aids in general science.

3.1 Introduction: -

If you are keen in making lesson plans which may help you in achieving your identified objectives, then they should be stated clearly. If objectives are not clearly defined, it is impossible to evaluate a student, a lesson, a unit, a course or a programme effectively. This leads to teaching disaster. Unless you have clear picture of instructional intention, you will be unable to select test items it the objectives are clearly defined, then students know which activities are relevant for success of the teaching learning process.

A meaningfully stated objective is that clearly communicate the readers the writer's intention- It states the behavioral outcome

students after completing a chapter. The most important characteristics of useful objectives are that it identifies the kind of performance that will be accepted as evidence that the learner has achiever the objective.

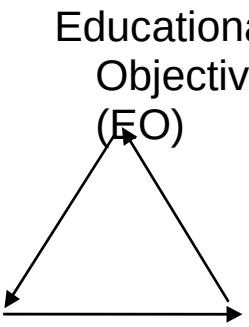
According to B.S. Bloom

"Educational objectives are not only the goals towards which curriculum is shaped and towards which instruction in guided, but they are also the goals that provide, the detailed specification for the construction and use of education techniques".

According to E.J. Frust,

"An educational objective may be defined as a desired change in behavior in a person that we are trying to bring about through education".

If we look back at the objectives of teaching science in early twentieth century, then we see major stress was on teaching of facts. As the time passed and various committee and commissions recommended changes according to need of changing time, still we see the stress was on acquisition of knowledge.



This show learning experiences are provided by teaching activities to achieve educational objectives and change of behavior is evaluated in terms of educational objectives.

Objectives are of two types: -

i) Educational Objectives.

ii) Teaching / Instructional Objectives.

Educational Objectives: -

These objectives are broad and related to educational system and school.

Teaching / Instructional Objectives: -

These objectives are narrow and specific and are concerned with classroom teaching. The educational objective stretches to a longer period of time say from primary level to university level, where as instructional objectives may be realized within the stipulated period of 40 minutes duration. For example – Educational objectives is “To develop the feeling of national integration”. This includes several teaching objectives like knowledge, understanding, application, interest, attitude of national integration.

3.2 Formulation of instructional objectives: -

Benjamin S. Bloom has divided the cognitive objectives into

six categories. But, instructional objectives are related to classroom objectives we will see them one by one.

(A) Classroom Instructional Objectives: -

1. The pupil acquires knowledge of scientific facts, terms, concepts, principles, theories.

Specifications: -

i) The pupil recalls……
   a) The facts, terminology.
   b) The definition of various laws, principles.
   c) The names of different parts of flower, leaf, plants.
   d) The concept of classification of substances.
   e) The names of types of diseases.
ii) The pupil ‘lists all the elements on the periodic table.
iii) The pupil recognizes…….
   a) Different apparatus used in various experiments

The pupil develops an understanding of various scientific termsfacts, definitions, concepts, laws, theories, procedures, etc.

Specifications: -

i) The pupil sees a relationship between different facts, concepts i.e., mass and volume.
ii) The pupil cites examples of metals and metalloids.
iii) The pupil classifies plant kingdom and animal kingdom.
iv) The pupil selects appropriate for performing experiment.
v) The pupil compares the characteristic of metals, non-metals etc.
vi) The pupil defects errors in a given example.
vii) The pupil rectifies errors in a given statement, diagram, formula, example etc.
viii) The pupil verifies the answer by substituting the values in a given problem or equation.
ix) The pupil uses an appropriate method to solve a problem, to do titration.
x) Pupil cites illustrations of different types of chemical equations.

2. The pupil applies his knowledge and understanding in new and unfamiliar situation.

Specifications: -

i) The pupil analyses the given example into what in given and what to be found out.
ii) The pupil formulates hypothesis to organize the elements.
iii) The pupil collects relevant data related to a hypothesis.
iv) The pupil selects relevant data, i.e., facts and principles for a particular situation eg. Relationship among different group elements.
v) The pupil judges the adequacy of data or procedure or apparatus eg. to check laws of reflection, refraction, etc.
vi) The pupil suggests new illustrations for different types of llences, propagation of lights etc.
vii) The pupil predicts various applicability of laws.
viii) The pupil solves the problems on velocity, momentum, etc.

ix) The pupil interprets various graphs, charts etc.
x) The pupil translates statements into symbols.

3. The pupil develops the skills required for science learning.

Specifications: -

i) The pupil checks the feasibility on instruments before using them.
ii) The pupil rectifies the defects in the instruments e.g. the presence of air bubble in the burette during titration.
iii) The pupil sets up appropriate apparatus for perform different experiment.
iv) The pupil measures with reasonable accuracy the length of pendulum and period of oscillations.
v) The pupil reads the log table, mathematical symbol, different tables.
vi) The pupil records the observation accurately and neatly.
vii) The pupil makes accurate observations while reading graphs, tables etc.
viii) The pupil uses the relevant data to reach at a solution.
ix) The pupil draws conclusions.
x) The pupil summarizes observations after the experiment.

B) Personality Objectives

4. The pupil develops interest in science

.

Specifications: -

i) The pupil reads, on his own, a number of books, magazines, newspapers related to scientific information.
ii) The pupil visits places of scientific importance and interest e.g. planetarium, laboratories, science centres etc.
iii) The pupil participates in activities like debates, projects, talks, elocution, in or out side school.
iv) The pupil collects, picture, specimens, data, of scientific importance from books, journals, gardens etc.
v) The pupil prepares models, charts, pictures etc.
vi) Contributes exhibits censuring scientific facts for display in or outside schools.
vii) The pupil writes articles, news items related to scientific concepts.
viii) The pupil prefers to attend to programme related to science on TV, Radio, etc.
ix) The pupil meets scientist astronauts etc.
x) The pupil helps in maintenance of a science laboratory, science club, museum, herbarium etc.

5. The pupil develops positive scientific attitude.

Specifications: -

i) The pupil respects research finding or new approaches contrary to existing theory.
ii) The pupil accepts those conclusion based on logical reasoning.
iii) The pupil expresses his ideas in a logical sequence.
iv) The pupil arrives at a judgment after weighing all possible evidence carefully.
v) The pupil considers new ideas, discoveries, inventions free from prejudice.
vi) The pupil reconsiders his own judgments and beliefs in the light of new knowledge and theories.
vii) The pupil cooperates with others in arranging scientific,

models, charts, materials, etc in proper places.

viii) The pupil faces problems with full confidence.

6. The pupil appreciates the contribution of science in every walk of life and knowledge.

Specifications: -

i) The pupil expresses his appreciation of man's effort to conquer nature and natural forces.

ii) The pupil recognizes the contribution of scientists to the modern world.

iii) The pupil derives a sense of pleasure in understanding the achievement of science
e.g. god particle, travel to space, satellites etc.

Check your progress: -

1. Define educational objectives.
2. What is instructional or classroom objective?

3.3 Unit Planning: -

"A unit is as large a block of related subject matter as can be over viewed b the learner".

- Preston

‘Outline of carefully selected subject matter which has been isolated because of its relationship to pupils.

- Sanford

“The unit is an organized body of information and experience designed to effect significant outcomes for the learner”.

- Wisely

Thus, a teaching unit keeps in view the needs, capabilities and interest of pupils. It provides organized body of information and experience. This aims at significant outcome from the learners.

Points to be kept in mind while planning for a unit: -

1. It must be related to social and physical environment of the pupils.
2. It must take into account the previous experiences of pupils.
3. It must provide now experiences to the pupils.
4. It must not be too lengthy, so that pupil’s interest is sustained.
5. It should be flexible so as to allow different types of students to explore their capacities.
6. It should be the result of cooperative planning of teacher and pupil as far as possible.

Steps of Developing a Teaching Unit

1. Preparation or motivation: -

   The pupils establish the purpose and one motivated to achieve it. The motivation must be self-directed. This is required throughout the lesson.

2. Knowing the previous experience: -

   It is always advisable to start with the pupils where they are this is helpful in knowing the background so that duplication or danger of non-understanding can be arrived. This can be done by questioning.

3. Presentation: -

   In this step new experiences are given to the students. These may be direct or vicarious care must be taken to present adequate amount of new experience that can be digested by pupils.

4. Organization of learning: -

   The student should get opportunity to bring their learning together so that they may establish relationship between the new experiences and assimilate them.

5. Summarization: -

   This is usually done at the end of the teaching unit to bring together all the learning. This may be done at internals during the progress of the unit organization and summarizations go together.

6. Review and drill: -

   During the progress of unit, there is a chance of forgetting some part of it and not comprehending same. This requires to review or drill the new content taught for better retention from time to time during the lesson.

7. Evaluation: -

Evaluation should be done to know the level of achievement of students. This can be done either by written from or oral form after short intervals. i.e., after a week or fortnight. This can also be done by interview self-check test, puzzles etc. The final test given grades to the pupils and tests effectiveness of teaching.

Proforma for Teaching Unit

Standard: - Subject: -

Name of the Unit: -

No.	Topics	No. of lessons required	Time required (periods)	Scope of subject content	Procedure to be adopted (Method of teaching)	Teaching Aids
1						
2						
3						
4						

Specimen Unit Plans Subject – Biology Class –

Major Objectives of the unit: - Name of the unit – Reproduction in Plants.

i) Pupils develops understanding and appreciate the vegetative and the, sexual mode of reproduction in plants.
ii) Develop skills of observation, experimentation.
iii) Develop interest in nature.
iv) Develop investigatory method of doing things.

Concepts	No of lessons	Time required	Scope of content	Teaching Aids
1	2	3	4	5
1. Pollution is first step in sexual reproduction	One	One period	Unisexual and bisexual flowers, different seasonal flowing plants, pollination, process, types and factor's responsible.	Fresh or preserved specimen's of unisexual and bisexual flowers chart showing seasonal plants chart showing self and cross pollination.
2. Pollination takes place through a no. of way	One	Two period	Agencies of pollination, characteristics of flowers pollinated by mind and insects, artificial pollination, and germination on stigma.	Chart or film showing pollution by mind and insects, specimens of salvia flower, mounted needles, forceps, brushes, watch-glass etc.

3. Fertilization in caused due to fusion of male nucleus with egg cell.	One	One period	Structure of pollen grain and its germination on stigma, structure of ovule process of fertilization, double fertilization, after effects of fertilization.	Pollen grains, sugar solution chart showing the structure of ovule and path of pollen tube inside the style, fruits of orange, mango, wheat rice etc.
4. Besides reproducing sexually plants reproduce vegitatively.	One	One period	Concept of vegetative reproduction, vegetative reproduction in steps and leaves, advantages of vegetative reproduction, over sexual reproduction vegetative & asexual reproduction budding.	Different underground stems. Asparagus, dahlia, Bryophyllum slides and charts of different modes of reproduction like, budding fragmentation spore format.
5. Vegetative propagation in plants	One	Three period	Artificial ways and vegetative propagation cutting, layering, and grafting, their demonstration and practice by students.	Various specimens and implement to demonstrate cutting, laying and grafting chart showing three way of propagation.

Check your progress: -

1. Prepare a unit plan on living things.

2. Prepare an unit plan on properties of gases.

3.4 Lesson Planning: -

Proper planning of the lessons in key to effective teaching. A daily lesson planning consists of teaching points, specification to be achieved, organization of an orderly sequence of learning activities, actual test items to which pupils are to be exposed Lesson Planning is essential because, effective learning takes place only if content in presented in an integrated and correlated manner G.H. Green says “The teacher who has planned his lesson wisely related” to his topic and to his classroom without any anxiety, ready to embark with confidence upon a job he understands and prepared to carry in to a workable conclusion. He has foreseen the difficulties that are likely to arise, and prepare himself to deal with them. He knows the aims that lesson is intended to fulfill, and he has marshaled his own resources for the purpose. And because he is free of anxiety he will be able to estimate the value of his work as lesson proceeds, equally aware of failure and success and prepared to learn from both.

A daily lesson plan is confined to only one period. The contention presented in the form of teaching points. The learning activities discussed in detail. The test items may be in the form of an essay or short answer or objective type questions.

Suggestions to improve lesson plan: -

1. It is important to highlight only the key concepts or relation and save most of the time for them.
2. It must be made in the context of overall unit plan and should be continuous from day to day.
3. To make the lesson plan fit a long-range schedule the teacher must give careful attention to important ideas of the textbook for a particular day.

Steps in lesson planning (Herbartion steps)

1. Introduction: - This stage prepares the students for new knowledge. This step is important but, must be brief. It must test previous knowledge of the child. Curiosity of pupils can be aroused by some experiment, chart, model, story, discussion etc.
2. Presentation: -
   The actual lesson begins at this stage. The teacher makes use of different teaching aids to make lesson effective. Teacher must involve students to make lesson interesting.
3. Association: -
   The new ideas must be associated with daily life situation by citing suitable examples and drawing comparison with related concepts. This step is important as principles are established.
4. Generalization: -
   An effort must be made so that, students draw the conclusion themselves. Teacher should guide the students only if their generalization in either incomplete or irrelevant.
5. Application: -
   The knowledge gained through the lesson must be applied to certain situations. This step is conformity with the general desire of the students to make use of generalization in order to see for themselves if the generalizations are valid in certain situations or not?
6. Recapitulation: -

At this last stage, teacher tries to ascertain whether his students have understood and grasped the subject or not. This cheeks the effectiveness of the lesson.

All these six steps are herbartion try gives for lesson planning. Teacher can guide lines and in many lessons it is not possible to follow all the methods

Advantages of lesson plan: -

1. It stimulates the teacher to ask questions.
2. It provides freedom in teaching.
3. In induces confidence among teachers.
4. Lesson planning make the work, regular, organized and systematic.
5. It saves a lot of time.

Sample proforma for lesson plans: -

1. For problem solving method: -

Sub: -
Class: -
Objectives: -
Instructional material: -

Topic: -
Time: -

- Creating a situation or posing problem:
- Defining and delimiting the problem:
- Collecting and interpreting
- data: Formulating
- hypothesis:
- Experimentation (Test of hypothesis) : -
- Drawing conclusion:
- Generalization and application:

2. Laboratory Method: -

Sub: - Topic : -

Class: - Time : -

Objectives: -

Material required: -

Introduction: -

Direction for the experiments: -

Grouping students: -

Demonstration (If required): -

Guidance and supervision during laboratory work.

3. Lecture cum Discussion method:-

Sub: - Topic: - Class:-

Time: -

Objecti ve:- Pervious knowledge:-

Introduction

(motivation):-

Assignments to each group

for self-study Date and

period for discussion:-

Initiation of discussion by

teacher Discussion by each

group in turn:-

Role of

teacher:- Main

learning

points:-

Evaluation:-

Follow- up assignments:-

Check your progress:-

1) What are the advantages of preparing lesson plans?
2) What are the determinants of effective teaching? Explain.

3.5 Improvisation of teaching Aids in general science:-

"Necessity in the mother of invention, new emerging needs of science teaching, therefore, calls for improvisation."

-Unesco
Source Book
for science
Teaching

The important objectives of teaching science into arouse the students' attitude and interest towards science .It is possible only when students do something themselves use some improvised apparatus and make save improvements in them. It is obvious that, unless students perform practical activities, they will not understand the facts, laws and principle of science. Therefore students must prepare or improvise apparatus after studying theory properly according to their ability and interest these apparatus can be prepared out of ordinary, inexpensive items. Such apparatus which students prepare themselves with the help of teachers which are inexpensive and display same process of science are called as improvised apparatus.

Many great scientists like, Madam Curie, Dalton, Priestly, Edison, carried out their experiment successfully in the humblest conditions.

Characteristics of improvised apparatus:-

1) The material in simple, accurate and appropriate to the age tends of the users.
2) The process involved in the production of materials in simple and

inexpensive.

3) The materials can be easily and effectively used by the teachers and pupils.
4) The raw materials are easily available in the local environments.
5) The materials don't involve specialization skills and can be made by pupils and teachers easily.
6) The production of materials is not time consuming.
7) The material is free from distractions conflicts or bias.

Need/Importance of improvised Apparatus:-

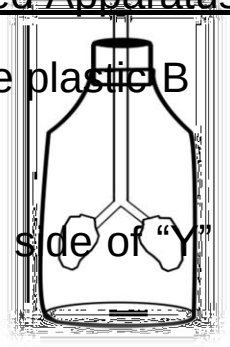
1. Economic Value-these items are prepared art of materials which are considered to be waste or low cost. Thus they have great economics value "Best art of waste"
2. Social value: - The construction of these materials follows the principle of learning by doing. The habit to work together without any disporting in formed and the child moulds himself according to the needs of society and moves towards the goal of socialism.
3. Recreational Value: - Students do the work on their own they keep themselves occupied and utilize their leisure time. Thus, it has got recreational value

4. Practical Value: - While constructing apparatus, they became; organized. They themselves discovered new apparatus, can produce according to the needs, repairs old apparatus can also take interest of doing more.
5. Educational and psychological value: - The improvised apparatus provide opportunities for the exercise and development of ingenuity and the resourcefulness. The pupil find new way of applying their knowledge. They learn to think critically and scientifically.

   Coordination of hands and heads develops as sense of confidence and constructive and creative instincts of pupils are satisfied. They energy of the child in channelized in a proper way.
6. Scientific Value: - The students develop interest in scientific activities and in turn they gain scientific knowledge.

<u>Examples of Improvised Apparatus:-</u>

1. Working model of lungs: - Cut bottom of a large plastic B
2. bottle.



Fit a cork to the neck with “Y” tube in it. On both side of “Y” tube tie a

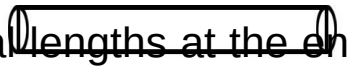
rubber balloon or some small bladder. Tie a sheet of brown paper

o

r rubber sheet the bottom of the bottle, with piece of string knotted

through a hole and sealed with wax. Pulling this string lower the diaphragm and air enters the neck of “Y” tube and balloons dilate. Pressing the diaphragm upwards has the opposite effect.

3. Astronomical Telescope: - Take two card board tubes are fitting each other. Fin two tenses of different focal lengths at the end of each tube. The lens

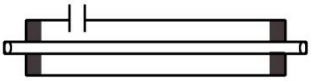


of law focal length says 2cm & 3cm serves as the edge piece and of 15-30 cm as object lens.

4. Davy’s safety lamp: - Take an ordinary spirit lamp empty tin box/empty

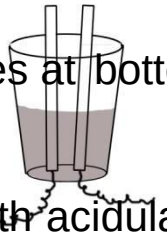
ink- pot and surrender the flame by wire gaze preferably of copper.

5. Liebig’s condenser: - Take metallic pipe of required length and diameters make two holes on each end. One for inlet and other



for armlet. Solder two small tubes are on each hole. Fix the cork at each end.

6. Voltmeter: - Take a plastic glass and make two holes at bottom. Insert



two copper wires one in each hole. Fill the glass with acidulated water and invert two test tubes of water one on each wire. Connect wire to two terminals of batting; water

will begin to decompose into oxygen and

hydrogen.

7. Dropping Funnel: - Take a glass or plastic funnel fit rubber tubing to the funnel. Attach glass tube to it. Attach pinchcock.

LIST OF ITEM THAT CAN BE IMPROVISED.

Physics: -

1. Thermos Flask
2. Thermo Couple
3. Telescope
4. Telegraph system
5. Spectroscope
6. Ripple tank
7. Periscope
8. Kaleidoscope
9. Hydrometer
10. Dip circle
11. Brain
12. Calorimeter
13. Telephone model
14. Steam engine
15. Pascal’s law apparatus
16. Pinhole camera
17. Galvanoscope
18. Electric ball
19. Automatic signal
20. Aneroid barometer
21. Gold leaf electroscope
22. Strom finder
23. Air oven

24. Rain gauge
25. A simple refraction bottle

Chemistry: -

1. Fire extinguisher
2. Model of atoms
3. Sand baths
4. Test tube stands
5. Bunsen burner
6. Apparatus for preparing & collecting gas.
7. Wick holders

Biology: -

1. Osmometer
2. Photometer
3. Preparation of simple slides of plants and animals.
4. Models of plants, animals, etc.

Check your progress; -

1. Name save improvised apparatus.
2. Why improvised apparatus are encouraged for students?

3.6 Let us Sum Up: -

In this unit, we have discussed about formulation of instructional objectives, unit planning, lesson planning and improvisation of teaching aids in general science.

As we know the objectives of teaching science have been changing from time to time the rapid progress of science and technology has changed the objectives of teaching science in school. However major instructional objects remain more or less same. They import fundamental knowledge. Inculcate scientific attitude. Instructional objectives aims at imparting training in scientific method or reflective thinking.

The unit planning involves certain steps. As a unit in a block of related subject matter which are so organized to help divide the syllabus into small workable sections.

For an effective and efficient teaching, planning in essential. This helps teacher to gain confidence. The teaching becomes systematic and organized. The teacher proceeds in a wel chalked out guidelines.

Last but not the least this unit has improvisation of teaching aids in general science, which is the need of time. In the view of economic constraints the developing countries cannot provide all the necessary equipment and materials of science. Many countries are now emphasizing on development of low-cost science materials using locally available resources.

UNIT END EXERCISE

1. State the objectives of teaching science specify each objective in terms if classroom objectives.
2. What is the new of writing objectives in behavioral terms?
3. State the objectives of teaching science topics like volume, density, reflection of light and specify each objective in terms of at least three specifications.
4. What do you understand by unit planning? What steps should be followed in preparing a unit plan?
5. Prepare unit plans for nutrition in plants and animals.
6. What are the various steps of preparation in lesson planning?
7. Discuss different proforma for lesson planning.
8. Discuss the new and importance of improvised apparatus for teaching of science at high school level.
9. What are the characteristic of improvised apparatus? Explain four improvised science apparatus.

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UNIT -4 EVALUATION IN GENERAL SCIENCE

4.1.1 Introduction:

Evaluation is a methodological area that is closely related to, but distinguishable from more traditional social research. Evaluation utilizes many of the same methodologies used in traditional social research, but because evaluation takes place within a political and organizational context, it requires group skills, management ability, political dexterity, sensitivity to multiple stakeholders and other skills that social research in general does not rely on as much. Here we introduce the idea of evaluation and some of the major terms and issues in the field.

4.1.1.a. Objectives/Learning Outcomes

- To explain types of formative and summative evaluation in science
- To classify different types of evaluation in science.
- To make effective use of objectives for achievement tests in science.
- To develop competency through effective use of achievement tests in science.

4.1.2 Definitions of Evaluation

4.1.3

Probably the most frequently given definition is:

Evaluation is the systematic assessment of the worth or merit of some object

This definition is hardly perfect. There are many types of evaluations that do not *necessarily* result in an assessment of worth or merit -- descriptive studies, implementation analyses, and formative evaluations, to name a few. Better perhaps is a definition that emphasizes the information- processing and feedback functions of evaluation. For instance, one might say:

Evaluation is the systematic acquisition and assessment of information to provide useful feedback about some object

Both definitions agree that evaluation is a *systematic* endeavor and both use the deliberately ambiguous term 'object' which could refer to a program, policy, technology, person, need, activity, and so on. The latter definition emphasizes *acquiring and assessing information* rather than *assessing worth or merit* because all evaluation work involves collecting and sifting through data, making judgments' about the validity of the information and of inferences we derive from it, whether or not an assessment of worth or merit results.

Check your progress

Read the following and answer the question:

Q1) What do you mean by Evaluation?

4.1.4 The Goals of Evaluation

The generic goal of most evaluations is to provide "useful feedback" to a variety of audiences including sponsors, donors, client-groups, administrators, staff, and other relevant constituencies. Most often, feedback is perceived as "useful" if it aids in decision-making. But the relationship between an evaluation and its impact is not a simple one -- studies that seem critical sometimes fail to influence short-term decisions, and studies that initially seem to have no influence can have a delayed impact when more congenial conditions arise. Despite this, there is broad consensus that the major goal of evaluation should be to influence decision-making or policy formulation through the provision of empirically-driven feedback.

4.1.5 Types of Evaluation

There are many different types of evaluations depending on the object being evaluated and the purpose of the evaluation. Perhaps the most important basic distinction in evaluation types is that between *formative* and *summative* evaluation. Formative evaluations strengthen or improve the object being evaluated -- they help form it by examining the delivery of the program or technology, the quality of its implementation, and the assessment of the organizational context, personnel, procedures, inputs, and so on. Summative evaluations, in contrast, examine the effects or outcomes of some object -- they summarize it by describing what happens subsequent to delivery of the program or technology; assessing whether the object can be said to have caused the outcome; determining the overall impact of the causal factor beyond only the immediate target outcomes; and, estimating the relative costs associated with the object.

4.1.4(a) FORMATIVE EVALUATION

Formative evaluation is primarily a building process which accumulates a series of components of new materials, skill, and problems into an ultimate meaningful whole

-Wally Guyot

Formative evaluation (sometimes referred to as internal) is a method of judging the worth of a program while the program activities are *forming* (in progress). This part of the evaluation focuses on the process. Thus, formative evaluations are basically done on the fly. They permit the designers, learners, and instructors to monitor how well the instructional goals and objectives are being met. Its main purpose is to catch deficiencies so that the proper learning interventions can take place which allows the learners to master the required skills and knowledge. Formative evaluation is also useful in analyzing learning materials, student learning achievements, and teacher effectiveness. In this sense formative evaluation is a part of the instructional process, underpinning the importance of student involvement. Students need to be involved both as assessors of their own learning and as resources to other students bringing into focus the importance of self and peer assessment besides teacher assessment. Research shows that the involvement in and ownership of their work increases students' motivation to learn. The most significant advantage of formative evaluation is that it makes learning an enjoyable experience because of student involvement, enhanced learning.

Formative evaluation is a tool used by the teacher to continuously monitor student progress in a non threatening, supportive environment. It involves regular descriptive feedback, a chance for the students to reflect on their performance, take advice and improve upon it. It involves students' being an essential part of assessment from designing criteria to assessing self or peers. If used effectively it can improve student performance tremendously while raising the self esteem of the child and reducing the work load of the teacher.

4.1.4(b) SUMMATIVE EVALUATION

All assessments can be summative (i.e., have the potential to serve a summative functions.

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Scriven(1967) The summative evaluation (sometimes referred to as external) is a method of judging the worth of a program at the end of the program activities (summation). The focus is on the outcome. The

various instruments used to collect the data are questionnaires, surveys, interviews, observations, and testing. The model or methodology used to gather the data should be a specified step-by-step procedure. It should be carefully designed and executed to ensure the data is accurate and valid.Questionnaires are the least expensive procedure for external evaluations and can be used to collect large samples of graduate information. They should be trialed before using to ensure the recipients of the questionnaire understand their operation the way the designer intended. When designing questionnaires, keep in mind the most important feature is the guidance given for its completion. All instructions should be clearly stated...let nothing be taken for granted. Summative evaluation constitutes a public recognition of achievement and we are fairly familiar with most of the tools and procedures of summative evaluation. However, many teachers may find it a challenge to develop effective formative evaluation tools; they may also experience some difficulties in integrating them with classroom instruction.

Summative evaluation is carried out at the end of a course of learning. It measures or ‘sums up’ how much a student has learned from the course. It is usually a graded test, i.e., it is marked according to a scale or set of grades. Assessment that is predominantly of summative nature will not by itself be able to yield a valid measure of the growth and development of the child. It, at best, certifies the level of achievement only at a given point of time. The paper pencil tests are basically a one-time mode of assessment and to exclusively rely on them to decide about the development of a child is not only unfair but also unscientific. Over emphasis on examination marks focusing on only scholastic aspects makes children assume that assessment is different from learning,resulting in the ‘learn and forget’ syndrome. Besides encouraging unhealthy competition, the overemphasis on Summative Assessment system also produces enormous stress and anxiety among the learners.

Check your progress

Read the following and answer the question:

Q2)Distinguish between Formative and Summative Evaluation?

4.1.6 Tools and Techniques of Formative Evaluation and Summative Evaluation in Science

Formative Evaluation(Flexible Timing)		Summative Evaluation (Written-End of term)
Tools	Techniques	
Objective type	Tests	Objective type
Short Answer	Assignments	Short Answer
Long Answers	Quizzes and Competitions	Long Answers
Questions	Projects	
Observation schedule	Debates	
Interview schedule	Elocution	
Checklist	Group discussions	
Rating scale	Club activities	
Anecdotal records	Tests	
Document Analysis	Assignments	
Tests and inventories	Quizzes and Competitions	
Portfolio analysis		

Activity

Read the following and answer the question:

Write down about the various types of Evaluation in Science

Evaluation -Suggested Assessment Tools and Techniques in Science

Experiments, Information gathering and deducing, Presentations on science concepts/ experiments, Investigations for stated problems,MCQs and Science Quiz, Simple and interesting assignments, Group assignments and projects, Model Making, Science symposium/ seminar, Preparation of various compounds/salts, Explanation of different natural phenomenon using scientific principles.

- Class Response Assessment worksheets

Demonstration based, Graph based, Diagram based, Numerical based, Flow chart, Crossword puzzle/games, Writing of Balanced chemical Equations/Formulae/Units,MCQs

- Active-learning assessment tools

Model making, Chart making, Assignments ,Popular Science Book Review, Current Science events/news report, Hands-on practical examination, Class work/home work Assessment, Group work - Seminar/Symposium/Presentation/Bulletin Board Display/Role Play, Survey/Field Visit, Project Work-Group or individual, Short formal written Paper-pen test.

SUMMARY:

Evaluation is an act or a process that allows one to make a judgment about the desirability or value of a measure. Educational evaluation is defined as a systematic, continuous, comprehensive process of determining the growth and progress of the pupils towards objectives or value of the curriculum. Formative evaluation

is thus carried out during a course of instruction for providing continuous feedback to both the teachers and the learners for taking decisions regarding appropriate modifications in the transactional procedures and learning activities. Summative evaluation is carried out at the end of a course of learning. It measures or ‘sums up’ how much a student has learned from the course. It is usually a graded test, i.e., it is marked according to a scale or set of grades. Thus, there are many Implications of Evaluation: namely it helps the administrator-recognize learner’s needs, guidance, helps the teacher-diagnosis, modification of the curriculum, helps the learner-unfolding of the learner’s abilities, helps the parents-feedback to take relevant steps.

4.2 DEVELOPMENT OF OBJECTIVES FOR

used to measure achievement. In this article attention will be directed mainly toward the measurement of cognitive achievements by means of paper and pencil tests. The justifications for this limitation are (1) that

cognitive achievements are of central importance to effective human behavior, (2) that the use of paper and pencil tests to measure these achievements is a comparatively well-developed and effective technique, and (3) that other aspects of intellectual competence will be discussed in other articles, such as those on motivation, learning, attitudes, leadership, aesthetics, and personality.

4.3 OBJECTIVES FOR ACHEIVEMENT TESTS IN SCIENCE:

1) To test the understanding of the pupil to the world in which he lives and the impact of science on society so as to enable him to adjust himself to his environment.
2) To test the acquaintance of the pupil with the scientific method and to enable him to develop the scientific attitude.
3) To test the acquisition of experimental skills such as_
   a) Handling the apparatus and the instruments.
   b) Arranging the apparatus for an experiment
   c) Preserving apparatus , chemicals, specimens, models etc.
4) To test the acquisition of instructional skills such as:-
   a) Improving simple instruments and appliances
   b) Repairing certain instruments and appliances of everyday use.
5) To develop drawing skills such as:-
   a) Drawing and sketching certain objects and instruments
   b) Photography in certain objects and specimens.
6) To test the power of oral expression in science so as to discuss, argue, describe and raise questions using scientific terminology.
7) To test the interest in scientific reading and Hobbies.
8) To test the appreciation of the impact of science on life, both personal and social, the struggle trough which science has advanced and the inspiring work done in the field of science.
9) To test the role of Indian scientist in the development of science.
10) To test the knowledge of judicious use of natural resources and avoid any wastage of natural resources.
11) To test the experimental skills such as to prepare simple useful materials like soap, boot- polish, ink, kaleidoscope, simple camera, magnetic compass, models etc.

Answers to Check Your Progress

4.1.3 ---------- ***Ans1)***

4.1.5 ---------- ***Ans2)***

4.2 ---------- ***Ans3)***

Suggested Readings:

: Modern Science Teaching Sharma, R.C.

UNIT-5

SCIENCE TEXT BOOK AND SCIENCE CLUB

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5.1 INTRODUCTION

The textbook occupies an important place in the curriculum and the teaching-learning process. In the teaching –learning process, the textbook occupies an important place. A good textbook can even replace classroom teaching. The science textbook should aim at aiding the pupils in the development of their personalities, in developing open mindedness, developing appreciation and understanding of nature and not merely their minds with facts.

5.1. a. Objectives/Learning Outcomes

- To explain the essential characteristics of a science textbook.
- To make effective planning for setting up of science laboratory.
- To develop competency through effective presentation of projects for science exhibition.
- To explain the aims and objectives for organizing of science club.
- To develop competency through various activities of science club.

5.2 ESSENTIAL CHARACTERSTICS OF A GOOD TEXTBOOK OF SCIENCE.

1. THE AUTHOR: A good textbook is judged at face, by the author, his qualification and experience.
2. MECHANICAL FEATURES OF THE TEXTBOOK:

The print and paper used and the binding should be attractive, hard and durable. The printing should be clear, legible and appropriately spaced. Pictures, photographs, drawings, or diagrams add much to any material developed for children. These should be as carefully selected, prepared, or considered as the written word. They should be simple without being inaccurate if at all possible. They should be fitted carefully to the script, and as far as possible do what the written word cannot do. The location of the pictures, illustrations, or diagrams is also important. It should be easy for the reader to find the picture and then refocus on the text without loss of time or delay in thought development.

3. VOCABULARY

Vocabulary should also be considered carefully for the older, even high school, readers. Older readers can handle more difficult vocabulary, including sophisticated scientific terms and constructions, and take great pride in so doing. However, they are able to read and participate more actively if they find the reading intriguing, challenging, and, at the same time, not difficult.

4. THE SUBJECT MATTER-ITS NATURE AND ORGANIZATION:

The subject matter should be developed as far as possible in psychological sequence, Care must be taken of the mental growth and interest pupils. There should be consistency of the subject matter and the textbook should satisfy objectives of science teaching. Each chapter should begin with an

introduction and end with a summary. Subject matter should lead to the inculcation of scientific attitudes, disciplinary and cultural values. Each chapter should contain assignments at the end. There should be an inclusion of Edutainment activities for enrichment of science. Headings and sub-headings are given in bold letters. Science as a subject should be correlated to other subjects and accompanied by a laboratory manual.

5. EXPERIMENTATION

Many basic processes such as those described or indicated are included in experimentation. Any time an author has included descriptions of experiments already done or can propose experiments to be done, interest is heightened for most young readers. Children get a lot of pleasure and excitement from what they believe to be “a real science experiment.” Because of this the word has often been used in less than appropriate ways, and care should be exercised in the use of the word “experiment.”

6. EVALUATION:

A real plus in evaluation for any book for children is the knowledge that it will continue to be functional for them after they have “put the book down.” After they have finished reading the book they may spend considerable time thinking about what they have read, asking questions based upon what they have read, duplicating some of the activities or experiments described, or developing related activities or experiments in a creative way.

Check your progress

Read the following and answer the question:

Q3) What are the essential characteristics of a good textbook of science?

5.3 SCIENCE LABORATORY

A laboratory is a space devoted to education, analysis, research, experimentation, and production. Laboratories handle a variety of different materials, from gases and chemicals, from drugs to living materials.

Laboratories vary significantly depending upon several factors, including their intended function, the types of materials that will be handled in them, and how many people they will accommodate. To that end, the design of a laboratory is extremely important.

The first consideration when designing a laboratory is selecting a site. When sitting a lab, it's important to review important criteria such as the health and safety of the population in the surrounding area of the laboratory, public perception, and environmental concerns, as well as engineering and operations plans. The impact of both building and operating the laboratory should be examined carefully. Sites should be chosen so that accidental contamination will have the smallest effect possible and will be able to be dealt with expediently.

Lot size and topography are also important to choosing a laboratory site, as are zoning and covenant requirements and restrictions. The laboratory should be accessible, properly sized, and conveniently located near — or have easy access to — all suppliers.

Once a site is chosen, the next step is to design the laboratory room(s). The first order of business during this step is to determine the preferred room arrangement based on data collected. Things that should be taken into consideration include room size(s) and hood requirements, and how those will affect the room's layout, as well as the locations of exit doors, eye washes, and emergency showers. Another thing that must be determined during this stage is the fire and explosive hazard levels of each room. This

information will be incorporated into the architectural planning in order to ensure that the lab design is not only efficient, but safe.

Once the laboratory room is designed, the next step is to work on designing laboratory wings. Laboratory wings are groups of rooms that are organized into blocks, based on the rooms' similarities in function and requirement. There are six major areas of consideration to be looked at when arranging blocks into laboratory wings. These include: number of floors, adjacencies and separations, flexibility and expansibility, windows, services and utilities, wing location and orientation, and the location of fume hood exhaust stacks.

There are several principles that should be considered during the design phase of a laboratory facility. For example, functions, hazards, and risks will all have to be identified, so that laboratory activities can be grouped or separated as needed. Things like wind direction, and potential cross- contamination between rooms, blocks, and wings, should be taken into consideration, as should the relationship between fresh-air intakes and exhaust stacks.

While it may seem peripheral, at this stage it is important to determine the materials to be used in framing, windows, exterior and interior doors, and corridors. These will mostly be determined by the type of work being done in the laboratory, as well as the type of materials that these areas will be exposed to. Depending upon the use of the laboratory, some materials will be safer and more efficient than others.

Another detail, but an important one, nevertheless, concerns furniture and casework. These items are available in a wide variety of materials, including steel, wood, and polypropylene. Again, the use of the laboratory will determine which materials are best. At this point, lab furniture and casework layouts will have to be determined, as well as whether it makes sense to have a fixed or flexible arrangement. The number of cabinets, refrigerators, and freezers used to store various materials, as well as where they should be placed, will also be decided at this stage.

When designing a laboratory, it always makes sense to call on the services of architects and engineers who specialize in this type of building. There are many issues that are specific to the design and construction of laboratories, and many complex problems to solve. Using qualified professionals will help to ensure the safety and efficiency of the laboratory, regardless of its intended use.

5.4 Science Exhibition-Science Exhibition are valuable for students' cognitive and affective development.

5.4.1 It is important that schools recognize this and support teachers' use of these opportunities to facilitate achievement of learning outcomes. However the enthusiasm of the teachers for visits varied from highly enthusiastic to disillusioned. A major factor expressed for this disillusion was the perception of school administrations as discouraging Science Exhibition. These teachers felt discouraged because they felt the administrative procedures within the school were burdensome and designed to thwart teachers preparing for Science Exhibition. They also felt that there were hassles with having to get appropriate-sized materials (usually commercially, ecofriendly products), the cost of organizing Science Exhibition.

These issues need to be addressed by schools. Administrative procedures should reflect departmental requirements, yet provide both legal and professional support for the teacher. The wider issue of 'duty of care' needs to be better articulated between teachers and schools. The provision of materials and transport for Science Exhibition and their funding have to be seen as part of the schools overall finances and procedures.

5.4.2-BENEFITS OF SCIENCE EXHIBITION

The researchers found that, in the opinion of teachers, the positive benefits derived from Science Exhibition were

-on, real-world experiences

- Hands
- Quality of education, positive attitudes to science and motivation towards the subject

- Improvement of the socialization between students, which would impinge on the classroom, and development of rapport between teachers and students
- Enabling teachers to utilize other learning strategies such as cooperative learning.
- Idea of making and Display of Exhibits and teaching aids.

Check your progress

Read the following and answer the question:

Q3) State the benefits of science exhibition?

5.5 SCIENCE CLUB

awareness about science.

5.5.1-Need & Importance

Progress & prosperity of a nation are essentially linked with the outcome of the results of the teaching of science in its school. We cannot expect much from classroom teaching. A Teacher in a formal classroom situation hardly finds time to go beyond the syllabus. If we really want some positive outcome we need to have some other platform to supplement & enrich classroom teaching & can be very well done by establishing a science club.

5.5.2- Aims or objectives of a science club Aims

1. To help students acquire basic knowledge of Science.
2. To help students develop a scientific way of learning.
3. To develop students' awareness of and concern for scientific issues in personal, social, environmental and technological contexts.

Objectives

1. To arouse and cultivate students' interest in learning Science.
2. To encourage student to participate actively in the activities organized by the Science Club.
3. To promote the use of IT in learning Science.

4. To understand scientific knowledge through experiments.

5.4.3-Organisation of the club

1. Principal/Head master as patron
2. A senior but interested teacher of science as sponsor
3. The following student posts being elected from members for each academic year. President, vice president, secretary, Treasurer, Student members

5.4.4-Set up of a science club

- Approval of Head of the institution
- Proposal for teachers interested to join the club
- Awareness of the students about the purpose of club
- Name to the club
- Holding meetings to take proper decision
- Activities to be discussed & planned properly
- Means to finance the club
- General & specific aims of the club
- Eligibility of the membership
- Rules of electing office bearers & their duties

Check your progress

Read the following and answer the question:

Q3) Discuss the Organization of a science club?

- ….

5.4.6 ADVANTAGES OF SCIENCE CLUB

1. Helps in proper utilization of leisure time
2. Helps in arousing and maintaining interest of the students in the study of science
3. Helps in proper development of heuristic and problem solving attitude among the students
4. Helps in developing the habit of self among students.
5. Helps the students to be acquainted with the latest knowledge and developments in the subject of science
6. Provides the opportunity to students to work together
7. Helps in discussion of classroom topics in detail & thereby know in depth about the subject
8. Provides inspiration & incentive for independent research work
9. Brings parents, teachers, students (society close to school)
10. Helps in the satisfaction of the interests and needs of the gifted children in science.

Check your progress

Read the following and answer the question:

Q1) ***Enlist the criteria for a good textbook of science.***

Q2) ***Why schools need to conduct science exhibition***

Q3) What are the activities conducted by a science club?

Answers to Check Your Progress

5.2 ----------*Ans1)*

5.4.1 ----------*Ans2)*

5.4.5 ----------*Ans3)*

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