

Methods of Teaching

How to teach is a really difficult problem for the teacher. Teaching, as it is generally said, is an art. Methods are the ways to understand and practice the art. Different methods of teaching have been proposed or propounded by different educational thinkers or schools of thought in education. The following methods have been discussed in detail:

Lecture method, dogmatic method, inductive-deductive method, heuristic method, analytic-synthetic method, laboratory method, project method, topical method, concentric method

Lecture Method

It is the method of presenting the word picture of an idea; or the method of imparting information through a speech. Lecture is another name for speech, and when you are speaking continuously to a class or an audience, you are considered to be lecturing. It is the method of depicting everything in words.

Procedure

The teacher prepares his talk at home and pour it out in the class. The students sit silently, listens attentively and try to catch the point. Supposing “profit and Loss” the topic in hand. The teacher goes on telling and explaining ‘Well boys/girls, profit and loss is always to be calculated on the cost price, because the cost price is our investment in the bargain if you invest less and earn more you gain; therefore gain is to be calculated by subtracting cost price from the selling price. When you invest more and earn less, you lose; therefore loss is to calculated by subtracting selling price from the cost price, so on and so forth’. The method takes the form of “One Man Show”, where the listeners remain passive.

Advantages

1. When the number of students in class is very large, this method is the only way out. The teacher’s voice is heard clearly in the farthest corner of the class room. All the students are provided with an equal opportunity to listen and learn.
2. When a heavy syllabus is to be covered in a short time, lecture method is suitable.

3. The situation becomes impressive, when the teacher is delivering his lecture frequently, the students are listening attentively and there is pin drop silence among them. An outsider form a good impression of the discipline in the school.
4. The method is convenient for the teacher, because he does not have to give individual help.
5. There is always a natural sequence between the ideas of a topic and this sequence or interconnection can be best maintained in a lecture. Sequence of ideas in a carefully planned lectures makes the topic understandable. The present idea follows from the previous idea and leads to next idea. This interrelationship of ideas facilitates learning.
6. The teacher and the taught feel satisfied at their respective places. After delivering a lecture, the teacher feels satisfied that he has finished a part of syllabus. After listening to a lecture the student feels satisfied that something new has been taught to him. Such satisfaction may be denounced, as false but it is there.
7. In certain topics, like insurance, budget, interest and income tax, an introductory talk may be found most impressive and useful.

Disadvantages

1. The method gives a false sense of satisfaction which is dangerous and harmful.
2. Receiving and memorizing bits of information is not so important a purpose of the study of mathematics as it is thought to be? Rather, its study is more concerned with the thinking and reasoning power of the learner.
3. The students may remain inattentive during the lecture.
4. The students remain passive.
5. Experimentation is totally neglected. There is no opportunity for the students to discover and find out facts for themselves.
6. There is no scope for the development of close contracts between the teacher and the taught. The teacher cannot give individual guidance because he cannot properly judge the difficulties and potentialities of an individual.
7. There is a rapid and burden flow of ideas in lecture. Everything may not be comprehend by young learners.

8. If somehow or other, a student fails to catch any essential point in a lecture, he would not be able to understand the subsequent ideas, because the ideas follow logically.
9. It is a sort of putting everything from above, where different abilities and capacities of the child are not made use of.
10. Homework is likely to be very heavy.

Conclusion

It is an informational method which goes against, independent and original thinking of the learner. There is no student participation in the learning process. Very few mathematical topics lend themselves to effective treatment by this method. The teacher talks continuously. Most of the time his face is towards the class, and the back is towards the blackboard. This is defective. He should mostly face the blackboard. It must, however be conceded that, on topics like income tax and insurance, lectures by experts from outside may be arranged and would be found useful but lecture method is highly unsuitable as a regular method in class work.

Dogmatic Method

In this method of teaching mathematics rigour is extremely emphasized. Rigour means the strict enforcement or observance of rules). The dogmatists say that the foremost educational value of mathematics is the training in exactness which it amply provides. Mathematical knowledge observes a high standard of exactness. Any deviation or departure from this standard of exactness will defeat the very purpose of teaching mathematics, and will consequently lead to inexact, aimless and slipshod thinking. The advocates of this method say that the inefficiency of mathematical teaching is mainly due to lack of rigour.

Procedure

The rules and the formulae are given to the class to cram. The teacher tells the pupils what to do, what to observe, how to attempt and how to conclude. He works out the model sums on the blackboard and the pupils have merely to follow the patterns. The steps of the solution of the problem are brought home to the students who then follow them in their minutest details. The model or the pattern as presented and advocated by the teacher or the book is to be strictly adopted and imitated by the learner.

Merits of Dogmatic Method

1. The method saves time, energy and a good deal of loose or usefulness thinking.
2. It can be adopted with advantage at a stage when pupils are adequately advanced in mental development.
3. It promotes skill, efficiency and speed in the solution of problems.
4. It glorifies memory.
5. At the revision or application stage emphasis on rigour is most desirable and appropriate.

Drawbacks

1. In this method, rules and formulae form the beginning of knowledge, whereas these are truly the ends of knowledge.
2. The stress is laid on rigour and no attention is paid to the specific abilities of students. Mechanical cramming is enforced without any regard for the individual's capacity.
3. There is no emphasis on development of powers to acquire and apply knowledge, independent thinking and originality; so the real of teaching mathematics is ignored.
4. The subject becomes dull and uninteresting for the students. Mechanical methods cannot promote interest.
5. Most of the mechanically memorized information is likely to be forgotten soon.
6. It is the method of imparting information which is a wrong approach to the teaching of the subject.
7. If mechanically memorized facts just slip from the memory at the time of need, the student fails to recall or reconstruct them.
8. The student repeats and adopts others ideas. He becomes a slave of the ideas of the others.
9. Students without real mathematical ability but with good cramming capacity begin to consider themselves successful students of the subject, which is a dangerous notion.

Conclusion

This method suits neither the child nor the subject. The mind of the student is stuffed with information and the understanding of the subject finds no place. Therefore, if popularized, this method will cause stagnation in teaching. Still it has one commendable aspect, that is, its spirit

should influence the student when he is applying or revising knowledge and when he is quite mature and advanced in the study of this subject.

Inductive and Deductive Methods

It is a combination of two methods. To be able to understand this combination, one shall have to understand them separately.

Inductive method

It deals from concrete to abstract, particular to general and from examples to general rule. It is the method of constructing a formula with the help of a sufficient number of concrete examples. It is based on induction which means proving a universal truth by showing that if it is true for a particular case and is further true for a reasonably adequate number of cases, it is true for all such cases. A formula or generalization is thus arrived at through a convincing process of reasoning and solving of problems. After a number of concrete cases have been understood, the student successfully attempts the generalization.

Procedure

Example

Ask students to draw a few sets of parallel lines with two lines in each set. Let them construct and measure the alternate and corresponding angles in each case. They will find them equal in all the cases. This conclusion in a good number of cases, will enable them to formulate the relevant generalization.

Example

Ask them to construct a few triangles. Let them measure and sum up the angles in each case. The sum will be the same in all the cases. Thus, they can safely conclude that the sum of angles of a triangle is equal to two right angles

Note: For more example see book “Teaching of Mathematics by Kulbir Singh Sidhu”

Merits of the Inductive Method

1. It helps understanding. It is easy to understand a mathematical principle established through a number of simple examples. Any doubts about the “how and why” of a formula are clarified in the very beginning.
2. It is logical method. So, it suits mathematics.
3. It gives the opportunity of active participation to students in the discovery of a formula.
4. It is based on actual observation, thinking and experimentation.
5. It curbs the tendency to learn things by rote and also reduce homework.
6. As it gives the freedom from doubts and helps in understanding, it suits the child.

Drawbacks of the Inductive Method

1. It is limited in range in range. It contains the process of discovering the formula with the help of a sufficient number of cases, but “what next”?, is not provided in it. The discovery of a formula does not complete the study of the topic. A lot of supplementary work and practice is needed to fix the topic in the mind of the learner.
2. Inductive reasoning is not absolutely conclusive. Three or four cases are picked up to generalize an observation. Therefore, the process establishes a certain degree of probability which can, of course, be increased and made more valid by increasing the number of cases.
3. It is likely to be more laborious and time consuming.
4. At the advanced stage, it is not as useful as some of the unnecessary details and explanation may make teaching dull and boring.
5. Its application has to be restricted and confined to understanding of rules in the early stage. Once a formula has been established, time should not be wasted in rediscovering it for every subsequent problem

Deductive Method

It is opposite to inductive method. Here the learner proceeds from general to particular, abstract to concrete and formula to examples. A pre-constructed formula is told to the students and they are asked to solve the relevant problems with the help of that formula. The formula is accepted by the learners as a pre-established and well established truth.

Procedure

Immediately after announcing the topic for the day, the teacher gives the relevant formula. To explain further the application of the formula to problems, he solves a number of problems on the blackboard. The students come to understand how the formula can be used or applied. Then a few problems are given to the students. They solve them on the same lines as have been explained by the teacher.

Area of a rectangle = Length \times Breadth

Simple interest = Principal \times Rate \times Time/ 100

And the profit and the loss is always calculated on the cost price. The students apply these formulae to solve the problems and then memorize them for future use.

Merits of the Deductive Method

1. It is short and time saving. The solving of a problem by pre-determined formulae takes little time. Authors and teachers, therefore like to adopt it (give preference to others).
2. It glorifies memory as students have to memorize a considerable number of formulae.
3. At the practice and revision stage, this method is adequate and advantageous.
4. It combines with the inductive method to remove the incompleteness and inadequacy of the latter.
5. It enhances speed and efficiency in solving problems.

Drawbacks

1. It is very difficult for a beginner to understand an abstract formula if it is not preceded by a number of concrete instances.
2. Pure deductive work requires a formula for every type of problem and an extensive use of this method will demand blind memorization of a large number of formulae.
3. It will thus cause an unnecessary and heavy burden on the brain. It may even result in brain fag.
4. Memory becomes more important than understanding and intelligence that is educationally unsound.

5. If the pupil forgets the memorized formula which is very likely to happen in case of blind cramming he/she is at a loss and cannot recollect and reconstruct the formula easily.
6. The students cannot become active learners.
7. It is not suitable for the development of thinking, reasoning and discovery.

Conclusion

The deductive method will give a good follow up if it is preceded by understanding through induction. Any loss of time due to the slow speed of induction can be made up through the quick and time saving process of deduction. Induction leaves the learner at a point where he/she cannot stop; the after work has to be completed by deduction. The two methods are such good partners that the shortcomings of the one are offset by the other. There are two clear cut major parts of the process of learning a topic, establishing of formula and application of that formula. The establishing of formula is the work of induction and the application of formula is the work of deduction. Blind practice leads one nowhere. Thus, the teaching should begin with induction and end in deduction.

Heuristic Method

The term Heuristic is derived from a Greek word which means I find. Here, the child is put in the place of a discoverer. The method involves finding out by the student, instead of merely telling of everything by the teacher. It aims at removing the shortcomings attributed to lecture method. Contrary to lecture method, it demands complete self-activity or self-education on the part of the learner. It is a method by which pupils learn to reason for themselves. Professor Armstrong was the originator of this method. He devised it for the teaching of science. This method has been found useful in the teaching of mathematics also. It is a sort of attempt to develop in the learner a particular attitude, now popularly known as the scientific and heuristic attitude.

Procedure

Take the problem of the discovery of the characteristics of parallelogram. Give students many parallelograms already drawn on sheets of paper and ask them to find out the qualities of the different elements of a parallelogram. Naturally, the students will start judging and measuring the elements of different parallelograms, their findings about the quality of its opposite sides and

the equality of the sum of its adjacent angles, will perfectly agree. Thus, their respective observations will enable them to generalize about some of the characteristics of a parallelogram. They can further be encouraged to draw their diagonals and find out after actual measurements that these bisect each other on every parallelogram.

Merits of the Heuristic Method

1. The student becomes an active participant in the learning process.
2. The student thinks for himself/herself and does not merely listen for information.
3. Home study and memorization work become light.
4. It is certainly a psychologically sound method, as it aims at utilizing the active, original, creative and constructive tendencies of the learner.
5. After discovering something by his/her own efforts, the student starts taking pride in his/her achievement. It gives him happiness and mental satisfaction, and encourages him/her towards further achievement.
6. The student acquires a real understanding and clear notion of the subject. It gives him a complete mastery of what he has learnt.
7. The teacher remains in constant touch with his students.
8. It develops in them the heuristic attitude or scientific attitude.
9. It creates in them a spirit of enquiry.
10. The student becomes self-reliant.

Drawbacks

1. It demands extra-ordinary labour and special preparation from the teacher, who is already over-burdened.
2. Every teacher may not be able to use it successfully. The teacher must be gifted with the heuristic spirit.
3. It is a slow method. Too much time is taken up by investigation.
4. There is very little certainty that, the child left to himself will make steady and sufficient progress.
5. Every child cannot be expected to be a gifted discoverer. The immature child has his limitations and difficulties.

6. Specially, in early stages, the child needs guidance and hints. If the teacher does not give him proper guidance, he may get discouraged and disgusted.
7. The teacher has to give well measured guidance, neither more nor less. Over guidance may also harm the initiative of the learner and make him independent.
8. If the students are tempted to consult books and copy from them for the sake of discovery, the method fails in its purpose. Imagine the following situation, the teacher announces, "Today, we shall discover such and such formula, and a student gets up in his seat to relate the formula word by word.
9. It may not be possible to teach all topics by this method. In some cases, discovery may not be possible at all.
10. The method presumes small classes because it demands individual attention on the part of the teacher.
11. Sometimes, the teacher cannot frame good questions. Bad questions have a little to the imagination of the child and do not provoke real thinking.
12. Sometimes the teacher fails to distinguish between false heuristic and true heuristic. Then the method originates into worthless questioning.

Sr. No.	False Heuristic	True Heuristic
1	Is it true that a square has all sides equal?	What do you know about the sides of a square?
2	Do you remember that area of a rectangle = length \times breadth	How do we calculate the area of a rectangle?
3	Tell me whether the profit or loss % is calculated on the cost or selling price?	On which price do we calculate profit or loss %?

Conclusion

At school, use of the extreme form of this method is out of question. The teacher's presence in the class room should mean something. He is not to behave as an individual onlooker but his presence is to inspire and stimulate the learners. In practice, the success of this method depends largely on good questioning. It is the spirit behind this method which matters the most. The teacher should frame the hints and instructions very carefully to avoid over feeding and under feeding. He should let the child be his own teacher and also see his difficulties are removed in time. Whatever be his method of teaching, the guiding principle should be the adoption of the heuristic approach.

Analytic Method

It proceeds from unknown to known. Analysis means breaking up of the problems in hand so that it ultimately get connected with something obvious or already known. It is the process of unfolding of the problems or of conducting its operation to know its hidden aspects.

Procedure

If $a/b = c/d$, prove that $ac - 2b^2/b = c^2 - 2bd/d$

The analysis will start from the unknown part of the statement.

$ac - 2b^2/b = c^2 - 2bd/d$ is to be proved true.

What should be the first step towards the simplification of these two sides of the equation? (cross multiplication).

$ac - 2b^2/b = c^2 - 2bd/d$ will be true

If $acd - 2b^2d = bc^2 - 2b^2d$

What is the next possibility of further simplification?

(Cancelling $-2b^2d$, which exists on both sides of the equation).

$\therefore acd - 2b^2d = bc^2 - 2b^2d$ will be true

If $acd = bc^2$

What next? ('c' can further be cancelled as common on both sides).

$\therefore acd = bc^2$ will be true if $ad = bc$

Arrange it now in a more systematic form.

$ad = bc$ will be true if $a/b = c/d$, which is known and true.

Therefore, by going back through the chain of argument, you can say that

$ac - 2b^2 / b = c^2 - 2bd/d$ is also true.

Merits of the Analytic Method

1. It is logical method. It leaves no doubt and convinces the learner.
2. It facilitates understanding. It also strengthens the urge to discover facts.
3. The steps in its procedure are developed in a great manner. No cramming of a fixed step and a set pattern is necessitated. Each step has its reason and justification.
4. The student is throughout faced with such questions as "How to prove the equality of two angles"? "How to simplify the two sides of an equation"? "What are the possible ways of resolving a statement into simpler elements etc.?" Thus, the student grapples with the problem confidently and intelligently. He gains in comprehension and skill.

Drawbacks

1. It is a lengthy method.
2. With this method, it is difficult to acquire efficiency and speed.
3. It may not be applicable to all topics equally well.

Synthetic Method

It is the opposite of the analytic method. Here, one proceeds from known to unknown. In particular, synthesis is the complement of analysis. To synthesize is to place things that are apart. It starts with something already known and connects that with the known part of the statement. It starts with the data available or known and connects the same with the conclusion. It is the

process of putting together known bits of information to reach the point where unknown information becomes obvious and true.

Procedure

If $a/b = c/d$, prove that $ac - 2b^2/b = c^2 - 2bd/d$

Synthetic Proof

$a/b = c/d$ (It is known and hence the starting point)

Subtract $2b/c$ on both sides? (But why? Why and how should the child remember to subtract $2b/c$ and not any other quantity?)

$$a/b - 2b/c = c/d - 2b/c$$

$$\text{or } ac - 2b^2/bc = c^2 - 2bd/cd$$

$$\text{or } ac - 2b^2/b = c^2 - 2bd/d \text{ (Cancelling } 1/c \text{ on both sides)}$$

Hence the identity is proved.

Merits

1. It is a short and elegant method.
2. It glorifies memory.

Drawbacks

1. It leaves many doubts in the mind of the learner; and offers no explanation for them.
2. Without a satisfactory answer to so many questions that arise in synthesis, the pupil is perplexed when a new problem is set to him. Even the recall of all the steps of synthesis may not be possible for the learner.
3. It does not provide full understanding.
4. There is no scope of discovery and thinking in this method.
5. Memory work and home work are likely to become heavy.

Conclusion

The pupil taught by the method of synthesis is just like a man led blind fold to the desired goal. Since analysis is lengthy method, it needs the help of synthesis for the removal of this defect. It will not be useful if it is not followed by synthesis. In the teaching of mathematics, these two method should go together. Analysis leads to synthesis and synthesis makes the purpose of analysis clear and complete. Analysis helps in understanding and synthesis helps in retaining knowledge. Analysis forms the beginning and synthesis forms the follow up work. The two method are interdependent. Teacher should realize that he may offer help for the analytic form of the solution and that synthesis work should be left to the pupils.

Sr. No.	Analytic Method	Synthetic Method
1	It proceeds from the unknown to the known facts.	It proceeds from the known to the unknown facts.
2	It starts from the conclusion and goes to the hypothesis.	It starts with the hypothesis and ends with the conclusion.
3	It is a process of thinking (exploration).	It is a product of thought.
4	It is a process of exploration and demands thought.	It is a process of presentation of the previously discovered facts.
5	It pulls apart or analyzes the statement under solution.	It puts together or synthesizes known facts.

6	It is a general method.	It is a special device.
7	It is lengthy, awkward, slow, roundabout, and involves trial and error.	It is concise, elegant, quick, straightforward, and does without trial and error.
8	It answers satisfactorily any question that may arise in the mind of an intelligent pupil.	It does not satisfy the doubts and questions arising in the mind of the learner.
9	It is a method for the thinker and discoverer.	It is a method for the crammer.
10	There are close contacts between the teacher and the taught.	There are no such intimate contacts between them.
11	The students can recall and reconstruct easily any steps if forgotten.	It is not easy to recall or reconstruct any forgotten steps.
12	It develops originality.	It develops memory.
13	It is informal.	It is formal.

14	It is psychological.	It is logical.
15	It is formational.	It is informational.
16	It is based on heuristic lines.	There is no heuristic approach in it.
17	It is fore-runner of synthesis.	It is the follower of analysis.

Laboratory Method

Mathematics is a subject which has to be learnt by doing rather than by reading. The doing of mathematics, gives rise to the need of a suitable method and a suitable place. Laboratory method and the mathematical laboratories are proper answer to it. This activity method leads the pupil to discover mathematical facts. It is based on the principles of learning by doing, learning by observation, and proceeding from concrete to abstract. In one sense, it is only practical form of the inductive method. It is more elaborated and practical form of the inductive method. It makes the subject interesting as it combines play and activity.

Procedure

The construction work in geometry is on the whole a laboratory work. The drawing of a line, construction of an angle, construction of a triangle or a quadrilateral or a parallelogram, etc., all involve the use of some equipment and therefore their nature is that of practical or laboratory work. There can be many more illustrations to explain the procedure. For calculating the area of a triangle, cut out a triangle of card board. Find the weight of the unit area of the card board and then find the weight of the triangle. This weight divided by the weight of the unit area of the same card board will give you the area of the triangle.

Merits

1. It is interesting and joyful for the learner. He likes to do something with his own hands.
2. It is based on two sound psychological principles, namely “proceed from concrete to abstract” and “learn by doing”.
3. The learner acquires a clear understanding of the subject. he finds or discover facts with his own effort.
4. It provides great scope for independent work and individual development. It helps in the growth of self-reliance.
5. It inculcates the spirit of cooperation and exchange of ideas when the students are required to perform laboratory work in groups.
6. A successful experiment is a source of joy and encouragement to the learner.
7. Shyness of hands is removed, as the learner has to handle apparatus and material.
8. The application of mathematics becomes increasingly evident to the learner. Thus, the subject becomes functional and meaningful to him.
9. Some topics of mathematics are best understood through this method.

Drawbacks of Laboratory Method

1. The method is very expensive. Every school cannot afford to spend a large amount of money on laboratory equipment.
2. Laboratory work is not typical mathematical work; and hence this method, if exclusively used, does not give any training to the learner in true mathematical thinking.
3. It acquaints the students with facts and not with mathematical reasoning.
4. All the topics of mathematics cannot exclusively be taught by this method.
5. It needs thorough planning and supervision, otherwise students may just play with instruments without deriving any substantial gain. Since teacher will be required to pay individual attention, it may not be practicable in large classes.
6. It is exceedingly laborious and slow method.
7. It is not at all easy to make the students discover mathematical facts experimentally, especially in lower classes.
8. It may sometimes degenerate into a kind of manual training only.

9. The tendency of cooking up results or copying may develop among them, as it is not easy to check.

Conclusion

It is difficult and lengthy method but can prove exceedingly profitable if properly employed. A lot depends on facilities available, which vary according to what a particular school can offer by way of staff, laboratory accommodation and equipment. Cost can be reduced a bit if equipment is improvised in the school itself. Young children will then be fascinated by this method. This method should be “a must”, where circumstances favour.

The project Method

It is based on John Dewey’s philosophy of pragmatism. According to Dr. Kilpatrick, “A project is a unit of whole hearted purposeful activity, carried on preferably, in its natural setting”. Stevenson defined it as, “A problematic act carried to its completion in its natural setting”. “A project is a bit of real life that has been imported into the school”, thus says Ballard about it. Project plan is a modified form of old method called, “concentration of studies”. The main feature of the concentration of studies plan is that some subject is taken as the core or center and all other school subjects, as they arise are studied in connection with it. It is based on the principle of learning by doing. It assumes that knowledge grows by application. Moreover, it is based on the fact that the different branches of knowledge are not separable though they are studied separately for some superficial convenience. It is method of spontaneous and incidental teaching. As the project progresses, the learner or the group of learners goes on picking up any piece of knowledge that may happen to be relevant, necessary and useful.

Procedure

There are two types of projects

- (a) Individual project carried out by a single individual
- (b) The social project which is carried out by a group of individuals.

To complete any project, we have five stages in actual practice.

- i. Providing a situation

- ii. Choosing and purposing
- iii. Planning of the project
- iv. Executing the project
- v. Judging the project

There should not be any rigidity about these stages. Modification may be made according to the nature of the project and mental level of students. The teacher has to give the pupils an equitable distribution of work according to their abilities and stamina. The whole project work should be reviewed, judged and evaluated in the end.

To begin with a project should arise out of a need felt by pupils. It should not be forced on them. It should be purposeful and significant. It should look important as its importance will enhance the value of work. It must be interesting. The absorbing interest will sustain pleasure.

Example

Understanding about a local factory may be a project for the students. The following different aspects may have to be dealt with for the accomplishment of the project.

1. The name and the location of the factory.
2. The nature of its raw materials and its produce.
3. The source of its raw material.
4. The geography of its raw material.
5. Whether it is an enterprise of an individual or of share-holders. In the latter case, what are the shares of the different share-holders?
6. The number of persons employed in the factory.
7. Their ranks, grades and salaries.
8. How much percent of an individual's salary is deposited in provident fund?
9. The annual income of the factory.
10. The share of profit for different share-holders.
11. The progress of factory in the matter of production and in come from year to year. The graphs of this progress.
12. The scope of expansion of the factory.
13. The relation of the factory with other local social institutions.

14. What types of qualifications will enable a person to get employment in the factory?
15. An essay on the visit to the factory.

While answering these and many other possible queries, the students will acquire a thorough knowledge of the local industry and at the same time learn many relevant topics of different subjects. The teaching of mathematics will also come incidentally.

Merits

1. It is based on psychological laws of learning. Education is related to child's life and is acquired through meaningful activity.
2. It upholds the dignity of labour.
3. It introduces democracy in education because it necessitates cooperation among students and their acting together for a common cause.
4. It brings about concentration of studies and correlation of activity and subjects.
5. It emphasizes problem solving rather than cramming or memorizing.
6. It inculcates social discipline through joint activities.
7. It develops self-confidence and self-discipline.
8. A projects tend to illustrate the real nature of a subject and produce a spirit of enquiry.
9. Projects can be used to arouse interest, justify the study of topics, encourage initiative and give the students joy at the successful completion of a given work.
10. Teaching becomes incidental because the child expresses willingness and is goaded by the desire to learn.
11. It challenges the capacities and abilities of the child and puts him on the track to think and act.
12. There is an opportunity for mutual exchange of ideas.

Drawbacks of the Project Method

1. Mathematics cannot be taught purely by this method. Incidental teaching will not suffice; planned teaching will have to add to it.
2. The student will not acquire skill and efficiency without collective and individual drill which will be possible through planned teaching only.
3. There is no saving of time, energy and effort.

4. A single opportunity for practical experience cannot develop or promote computational ability.
5. Systematic and continuous teaching is not possible.

Conclusion

This method brings life to the school atmosphere. Learning becomes cooperative affair. Its approach is scientific and psychological. As it is not suitable for drill and continuous and systematic teaching, it is not very desirable to use it freely. If the teacher can devise and plan a good project on something, the students will gain a lot. It leads to understanding and develops the ability to apply knowledge. Its occasional use will always remain an effective tool in the hands of the teacher. The teacher has to work as careful guide during the execution of the project. Costly projects should be avoided. Unsupervised and unevaluated project work will also be of no use.

Some Suitable Projects

A few good and suitable projects are listed here for the teacher's guidance

1. A picnic, its organization, expenditure, etc.
2. Purchase of craft material
3. Running a hostel mess
4. Model of Dam
5. The sports day
6. A variety program
7. Model of the village
8. Running the co-operative shop in the school
9. School bank
10. Collecting rates of a few commodities from a number of shops in the Bazar
11. Use of mathematics in large business
12. Collecting data about national and provincial budget
13. Bus and railway fares from their town to important stations
14. Mathematics in the class room
15. Mathematics in the kitchen

16. Graphs of employment. Death rate, population, etc., in the locality
17. Mathematics in a post office

Topical Method

It is the opposite of concentric method. Concentric method involves the breaking up of a topic into suitable portions, whereas topical method aims at keeping it intact. A topic is taken as a unified whole or as an unbreakable unit. It is based on the principle that any topic when begun should not be left half done. It should be finished in its entirety before the next topic is taken.

Procedure

Topical method is more a system of arrangement of subject rather than a method of teaching. Its adoption depends upon on a suitable organization of the syllabus. The topic is to be taught at a stretch, without a break or a gap. The other approach to this method is that a topic is selected and is made the basis of many other topics. The selected topic becomes the center of correlation while dealing with the unitary method, the student can be acquainted with time and work, simple interest, average percentage and even to some extent with simple equations of algebra. Topics of other subjects may also be mentioned.

Merits of Topical Method

1. Continuous teaching of a topic not only will save the students from divided attentions but may ensure their full and whole hearted concentration on the topic in hand also. A natural link and sequence will exist in the day to day work in the classroom. The student's complete attention, ability and capacity will be directed exclusively to the topic under study for a sufficiently long time.
2. When a topic is treated as center for other topics, it facilitates the learning process. It illustrates the advantages of correlation.

Drawbacks

1. Keeping psychological reason in view, it will be foolish to take up a topic like area in the 4th class and try to finish it at a stretch. The students may be capable of understanding the

elementary portion of the topic at that stage but will certainly not be able to attempt the most difficult problems at that very stage.

2. It is natural that the interest of the students in any topic will cease or wane after a month or so of its start.
3. The method does not provide any opportunity for year to year revision. Most of the knowledge acquired in earlier year is likely to be forgotten by the time the students leave the school. At the school leaving stage, the students are wanted to do a final and overall revision so that when they go out everything should be fresh in their minds. But topical method does not provide such revision.

Conclusion

The method or the system does not possess any significant advantage. Moreover, there is a better substitute in the form of concentric method. The only advantage of this method is that a topic is made a center for other topics which can prove a good step towards correlation. As a method, it is only an idea which should be kept in mind to be used only at the appropriate opportunity.

Concentric Method

The method implies widening of knowledge just as concentric circles go on extending and widening. It is more appropriate to call it a system of arrangement of the subject matter. The study of the topic is spread over a number of years. Beginning from a nucleus, the circle of knowledge goes on widening year after year. An elementary knowledge is given in the introductory year, something more is taught in the next year, something still more is added in the subsequent year and so on. A steady progress is maintained in the acquisition of knowledge of a topic for a sufficient number of years continuously.

Procedure

A topic is broken into number of portions and the portions are allotted to various classes. The criteria are difficulty of portions and power of comprehension of students in an age group. Any gap of knowledge are filled up year after year. Full-fledged knowledge of the topic is ultimately provided. It is mostly concerned with year to year teaching but its influence can be exercised in day to day teaching as well. Knowledge to be given today should follow from the knowledge

from the knowledge given on previous days and should lead to the teaching on the following days.

Merits

1. It is a suitable system of arrangement because it is highly un-psychological to take up a topic like “Time and Work” with a particular class and try to deal with all its aspects in the same class.
2. It enables the teacher to do a portion of a topic according to the receptivity of learner. The learner get as much as they can grasp.
3. Continuance of the study of a topic for a number of years makes its impression more lasting. Previous knowledge or comprehension a topic is revised year after year which helps in its retention.
4. It does not allow the teaching to become dull. The interest of the student remains alive for the short duration of the study of the portion of a topic. Every year, a new interest can be given to the topic.

Drawbacks

1. If a portion is too long, the interest is likely to flag and if a portions is too short, it is not likely to make any lasting or permanent impression on the learner’s mind.
2. It may prove harmful if a teacher becomes over ambitious and exhausts all the possible interesting illustrations in the introductory year. Those who have to teach the topic in the subsequent years are left with nothing to create interest.

Conclusion

The system is worthy of being adopted in the arrangement of subject matter. The organizers have to be very careful so that a portion is neither too long nor too short. It should be a well measured portion. To remove its other drawbacks, it is proposed that the teaching of same students should remain with the same teacher throughout their schooling. Then, the teacher will always reserve some illustrative examples for each year, so that each new portion of the topic can be started with fresh interest and vigour. It should be possible to introduce the topic with interesting illustration every year.

