

Discovering and Uncovering Content Should Take Precedence over Covering and Recovering Content in Teaching Mathematics

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Abstract

The paper tries to reveal or unveil some ancient culture that have a bad influence on the quality of methods used in teaching mathematics. Some important of discovering and uncovering content which should take precedence over covering and uncovering contents in mathematics are discussed. These include a critical thinking/creative aplomb, discovering and uncovering the content while making judgment for understanding, Textbooks are resources; not curriculum, Understanding as the main point, the three stages of lesson plan and methods used in teaching mathematics. Recommendations for discovering and uncovering contents which should take precedence over covering and recovering content in mathematics are made.

Keywords: *mathematics, teaching, methods*

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I. Introduction

Mathematics is a science that deals with the study of quantities, numbers and shapes and the relationship between them (Hornby, 2006). Mathematics was derived from the Greek word “mathema” which means study, knowledge and learning. Since mathematics deals with study, knowledge and learning; there is no way mathematics can be properly understood without the teacher being practical in what he/she is teaching the student. Discovering learning is processes of teaching where by students find out things themselves by studying the problems and asking questions to the teacher. It is all about students drawing conclusions and asking questions on where they are confused. This helps the students to learn new things with joy; there by making them confident of their innovations. Discovering learning creates an active learning environment that facilitates discussion, questioning and getting the students (both lazy and bright) students fully involved in the teaching and learning processes.

Discovering and uncovering content is the process of exposing the contents of the curriculum to the students without hindrances for active participation in teaching and learning process in mathematics. When a student was asked to solve one problem in mathematics he had done in class, he couldn't solve anything except to tell me that his teacher solved it from the text book. This practically shows that he/she didn't understand anything from that topic taught in the class by that teacher.

This is an indication of the curriculum that is gotten from the chapters in the textbook; instead of the teacher planning his/her lesson from the content of the curriculum (Diana Fenton and Nancy Van, Erp, 2017).

Covering and recovering content in mathematics is the process of hiding the content of the curriculum from the students or a teacher just picking/selecting topics from the contents of the text books instead of selecting from the contents of the curriculum.

II. Discovering And Uncovering Content

Discovering and uncovering content should take precedence over covering and recovering content with the following reasons and importance:

- **Critical Thinking/Creative Aplomb:** Critical thinking is the process of analyzing information in order to get value judgment or conclusion on that information. Creative aplomb means being able to present your creativity and critical thinking in that confidence manner especially in a difficult situation. Discovering and Uncovering content helps students in this regard. Teachers should create enabling environment where the students can discover their ability and stand firm to it. Teachers should not fail to guide the students when there are moving astray or away from what the supposed to know. Teachers should also plan their lessons well with text book as a resource not as a curriculum in order to maintain the status quo. According to Kelly and Kelly (2013) teachers should have creative aplomb on how they plan and deliver their lessons to students. This he described as “do something” mindset. Teachers should make the actual changes by being a role model in their words and actions instead of believing in lessons and teaching can make a change. This

when done will help to produce students that can fit in academically or otherwise in any place they find themselves in life.

- **Discovering and Uncovering the Content While Making Judgment for Comprehension:** The big ideals and important questions should be well comprehended at this stage; uncovering of the content can start. Wiggins and Mc Tighe (2005) are of the opinion that contents should be uncovered instead of the believe that textbook is the curriculum. Discovering the content and uncovering it involves the students for a example in quadratic equation suggesting different approaches of solving quadratic equation like use of formula, completing the square methods, factorization etc. The students can also suggest other applications of the method in real life situation when the contents are uncovered and they are given the leverage to do that. This when done can incorporate both peer and teacher feedback as the students arrange and rearrange their results, thereby making judgment for comprehension.
- **Textbooks Are Resource; Not Curriculum:** It is no longer a news that some teachers and administrators believe that textbooks are curriculum that contains all the lessons in a sequential order, that should be taught in a given semester or year. The semester begins on the first page and the aim is to finish it all by the end of the semester or year (Diana and Nancy, 2017). The teachers should allow the learners to discover the content instead of just covering the content. Teachers should not rely fully on the textbook, rather they should plan their lessons in other to meet the needs of the learners. The teachers should design the lesson in such a way that it geared towards making the students learning rather than teachers teaching. According Marlowe and page (2005) Teachers should shift their focus from “how should this be taught” to “how best can my student or students understand this”?.
- **Understanding The Main Points:** The main aim of every teacher is to ensure proper understanding of the main points by the students instead of a mere delivering of lesson. Anybody can deliver the content but only good teachers can ensure that the content is well understood by students. Accepting that responsibility helps us on how we go about planning for learning; Putting individual differences into consideration and the complex content. The textbook is arranged by someone reasoning or how someone feels that topics should be arranged, so teachers should not depend on it as a curriculum but as resources. The teacher should plan his/her lesson in such away that it will be relevant to the students understanding.
- **The Three Stages Of Lesson Plan:** The three stages of lesson plan helps the teacher on discovering and uncovering content which should take precedence over covering and recovering content in mathematics. In a good lesson plan; textbooks is used as a supplement to get information like any other resources. Erickson (2006) provide a three (3) paths teachers should bear in mind when planning their lesson as follows
 1. Teachers should identify and address the concepts and standard of teaching.
 2. They should create formative and summative text, to check the understanding of those ideas by the students.
 3. Teachers should plan a daily instructional strategies and discovering and uncovering of content approach for proper understanding,

III. Methods Used In Teaching Mathematics

Teaching method are the principles the teacher adopts to enable student (s) learn the concept. These strategies are determined by the nature of the learners and the subject (topic) to be taught by the teacher.

According to Fawad (2020), the methods used in teaching mathematics includes:

- Lecture method
- Inductive method
- Deductive method
- Heuristic method
- Analytic method
- Synthetic method
- Problem solving method
- Laboratory method

1. Lecture Method: It is the oldest teaching method in which knowledge is delivered through speech. It is teacher centered because the teacher takes part as an active participant while the students are at the receiving end in most of the teaching and learning processes. According to Joyce (1992) lecturer methods is referred to as direct instruction, active teaching, training model and explicit instruction.

Advantages and Disadvantages of Lecturer Method

The lecture method Advantages and disadvantages according to (Sidhu 1992; seller, Roberts, Giovanetto Friedrich & Harnmagen, 2007) are as follows:

Advantages:

1. It helps to introduce new ideas
2. Lecture method is the fastest way to deliver knowledge especially when the syllabus is large
3. It helps in teaching a large class
4. It is economical because there is no equipment involved in it. Only one teacher can teach too many classes.
5. Lecture method helps to raise the interest of the students.

Disadvantages

The disadvantages of lecture method according to (Sigh, 2007; Sellers et. Al, 2007) are as follows:

- This is a teacher centered approach so student cannot contribute actively in teaching and learning process.
- It does not encourage critical thinking ability in the students
- It is boring sometimes because no activity is involved in it.
- Lecture method does not develop teacher – student relationship.
- It is not suitable for students in lower classes.

Applications

Lecture method can only be used to explain in details some basic topics in mathematics textbooks. It can be used to teach sets, algebra, matrices, geometry, trigonometry and statistics. It is only the procedures and its relationship that the real life can be explained using lecture method not the mathematical problems (solutions).

2. Inductive Method

Inductive method of teaching is the process by which the teacher proceeds from simple to complex, from known to unknown, from specific to general and from example to rule or formula. In it students are given some similar examples or questions related to an already solved examples. Then students try to establish a formula, law, rule or principle by careful observation.

If the result is true for similar examples or problems; it would be true for such kind of examples also.

Advantages and Disadvantages of Inductive Method of Teaching

Advantages

1. It is suitable for primary and secondary classes.
2. It is used to introduce a new mathematical concept, rule or formula.
3. It helps students to think logically and make learning environment interesting.
4. Inductive method of teaching helps students to play active role in teaching and learning process.
5. Students can easily remember the laws and principles which they prove by themselves.
6. It facilitates reasoning and experimentation.

Disadvantages

1. It is only experienced teachers can use it in a right way.
2. It is labourious and consumes a lot of time.
3. It does not help in improving problem solving abilities.
4. The laws/formula used to solve one example does not help to solve the other similar examples.

Application of Inductive Method of Teaching.

It can be used to establish laws, principles, formula and methods instead of solving mathematical problems. It can be used in all branches of mathematics, but establishing laws or formula at the secondary school level is only involved in algebra, matrices and to some extent geometry.

3. Deduction Method:

It is a method of teaching in which the teacher proceeds from general to specific and from rule to an example. The formula, rules, method constructed can be used or applied to solve problems. In this method we can prove a theorem with the help of undefined terms, defined terms, axioms and postulates. We can derive other theorem from different rules and principles (Singh, 2007).

Advantages and Disadvantages of Deductive Method of Teaching

Advantages

According to Sekhar (2006), the following are the advantages of deductive method of teaching

1. It helps the teacher to complete the syllabus easily.
2. Deductive method is very short and easy.
3. It helps to improve the computational ability of students
4. It helps the students to remember formula or rules easily.
5. Deductive method of teaching helps to prove different theorems using already defined formula or principles.

Disadvantages of Deductive Method of Teaching

1. Deductive method of teaching does not help in improving reasoning ability in the students.
2. It is not good for lower level classes.
3. It difficult for students to remember so many rules and formulae.
4. Deductive method of teaching cannot make students creative.

Application of Deductive Method of Teaching Mathematics

Deductive method is used to solve problems which does not have complicated procedures.

4. Heuristic Method of teaching

Heuristic was derived from Greek word "heurisko" which means "to find out".

Heuristic method is also known as discovery method of teaching; this is because it gives students room to find out things by themselves. By this method students are encouraged to reach the solution by constructing the knowledge themselves. According to Suchman (1962), heuristic method is also known as inquiry method. Since the students discover the solution themselves through the helps of the teacher, it is called discovery method or programmed instruction.

Advantages and Disadvantages of Heuristic Method of Teaching

The advantages and disadvantages of heuristic method according to (Singh, 2007; Sidhu, 1995) are as follows:

Advantages of Heuristic Method of Teaching

1. It improves student's creativity.
2. It enhances reasoning and thinking abilities in the students
3. It explains ideas in a better way.
4. Heuristic method of teaching makes the students confident; since they discover the solution by themselves.
5. Heuristic method of teaching is a student centered approach.

Disadvantages of Heuristic Method of Teaching

1. The method consumes a lot of time.
2. It is good for skilled teachers.
3. It is not good for students that have less aptitude towards understanding the concept of mathematics
4. It is not good for teaching all kinds of mathematical problems.
5. It is not good for a class with low strengths.

Application of Heuristic Method of Teaching

Heuristic method of teaching is helpful when students are not capable of solving problems related to one particular concept that needs teacher's guidance.

5. Analytic Method

Analytic method of teaching is the process of breaking down the mathematical problem into smaller parts before solving the solution.

It starts from unknown to known parts of the problem. Analytic method of teaching is also known as descriptive method of teaching.

Advantages and Disadvantage

Analytic method according to Sekhar (2006) advantages and Disadvantages are as follows:

Advantages

1. It enhances scientific attitude
2. Students always plays an active role in analytic method of teaching
3. Heuristic method of teaching does not need memorization of procedures by students.

4. Analytic method of teaching helps students in logical reasoning especially when they discover solutions by themselves. (Agarwal, 1992).
5. There is no chances of doubles in analytic method of teaching since it is purely logical in nature.

Disadvantages of Analytic Method

1. Analytic method of teaching is not good for all mathematical problems
2. It is not suitable for lengthy syllabus.
3. It is good for skilled teachers only.
4. It consumes a lot of time.
5. It is only good for well-trained teacher who can apply it properly in the class room.
6. It is only applicable for the class with low strength but not suitable for public secondary schools in Nigeria.
7. It is difficult for student with less aptitude towards discovering new concept.
8. Analytic method of teaching cannot be used to finish lengthy syllabus in time.
9. Teacher sometimes fail to ask proper questions in the process of discovering new concepts thereby distracting the students.

Application of Analytic Method in Mathematics at Secondary Level

At secondary level, such problems like algebra, geometry, proportion (variation) and ratio only can be applied using discovery approach.

6. Synthetic Method

Synthetic method is the opposite of analytic method because we proceed from the given or known elements in the problems to the desired solution or unknown. In this method, we put together different elements or small portions given in the problems to draw conclusions until the unknown or desired result is found (Sidhu, 1995). This method is simple and led by analytic method. Process of analysis in analytic method helps to clear the basics of any concept. Synthetic method is based on concepts learnt already. This means that it is important to go through the analytic method to become master of specific mathematical concepts then synthetic method can be used to solve the problems more quickly.

Advantages of Synthetic Method

This method has also some advantages (Agarwal, 1992; Sekhar, 2006) as given below:

- i. It improves the memory of students.
- ii. It is fast because of deductive reasoning.
- iii. Synthetic method is brief and short.
- iv. Teachers can finish the lengthy course in time through synthetic method of teaching.
- v. It gives students opportunity to practice mathematical procedure or formulae.

Disadvantages of Synthetic Method

Disadvantages of this method are as follows (Sidhu, 1995; Singh, 2007).

- i. It is not student centered.
- ii. It does not develop reasoning ability in the students.
- iii. Students have to remember so many steps without reasoning.
- iv. Synthetic method of teaching does not employ heuristic approach.
- v. If a student forgets any mathematical proof then it is very difficult to recall it step by step.
- vi. It does not elucidate the concepts fully.
- vii. It is neither scientific nor psychological in nature.

Application of Synthetic Method in Mathematics at Secondary Level

Synthetic method can be used to prove mathematical problems. It is also useful to find out something unfamiliar with the help of given conditions in the problem statement. These problems can be found in topics like algebra, ratio and proportion (variation) and geometry at secondary school level.

7. Problem Solving Method

Instructional methodologies should be one geared towards improving the reasoning ability of students. In this way, they become capable to find out the solutions of different kinds of problems not only during the studies but in their daily routine matters as well. Every child has the inquisitiveness to discover things and this mindset of the children can be utilized in a better way through problem solving method. Problem solving is the most important instructional methodology for mathematics (Collier & Lerch, 1969). Bruner, Oliver, Greenfield

(1966) and Gagné (1970), the most famous psychologists, also gave the top priority to this method. In this method, students are given such problems which cannot be easily solved or their solutions are not palpable. According to Fawad (2020), A student tries to reach the goals or solutions through the set of events or procedures. Gagné (1970) calls these events or procedures as lower order capabilities in which formulas, rules and concepts are used from which a student is already familiar.

Advantages and disadvantages of Problem Solving Method

Problem solving method has also some advantages and disadvantages.

Advantages

These are the following merits of this method (Taplin, 1995; Singh, 2007).

- i. This process is scientific in nature.
- ii. Problem solving method is student centered.
- iii. It is helpful to improve the reasoning ability of the students.
- iv. Problem solving method of teaching gives Students the opportunity to apply their previous knowledge through problem solving.
- v. Students learn how to face totally new circumstances by solving different kinds of questions.
- vi. Teacher can evaluate the abilities of his or her students easily.
- vii. This method improves logical thinking in the students which leads towards creativity.

Disadvantages

There are some disadvantages of this method as well (Sidhu, 1995; Singh, 2007).

- i. This method consumes a lot of time.
- ii. Problem solving is usually not recommended for lower classes.
- iii. Textbooks do not provide enough help to apply this method because such books are usually written in a traditional or outdated way.
- iv. Logical thinking is involved in this method therefore physical kind of activities are totally neglected.

Application of Problem Solving Method in Mathematics at Secondary Level

Problem solving method is used to solve some complicated problems which cannot be solved with the help of single law or formula. At secondary level, word problems are usually applied in solving such kind of problems like of algebra, trigonometry, ratio and proportion (variation).

8. Laboratory Method

Mathematics is different from the subjects involving readings hence practical work is its major part. Laboratory method has the ability to deal with practical work in mathematics. It is a method of “learning by doing”. That is why, different kinds of tools and equipment are used in it to perform practical work which includes drawing of different shapes, taking measurements of geometrical figures and making of charts and graphs (Fawad, 2020). Students go through different experiments in laboratory or classroom and learn by observing and calculating themselves. In this process, learners get opportunity to draw conclusions and generalize different laws and formulae. Therefore, this method can be said an extended form of inductive method (Sidhu, 1995).

The role of a teacher in this method is to oversee the whole process and give proper instructions to the students at each step. He or she should keep some points in mind to make this method successful (Singh, 2007).

- i. Essential equipment related to the laboratory work should be arranged in advance.
- ii. Educators should continuously observe the practical work of every student and guide him or her accordingly (Fawad,2020).
- iii. Every student should be encouraged throughout the practical work.
- iv. All necessary concepts should be cleared before starting experimental work.

If the students are many and required equipment is not enough then students can be divided into small groups for proper understanding.

Advantages and Disadvantages of Laboratory Method

The laboratory method has also some advantages and disadvantages (Sekhar, 2006).

Advantages of this method are as follows.

- i. The method is student centered method.
- ii. Students participate actively so they do not get bored.
- iii. It is based on discovery approach.
- iv. Knowledge gained through practical work is last long.

- v. Students gain confidence as they establish laws and formulas by themselves.
- vi. Practical utilization of mathematics is realized by the students.
- vii. When students work in the groups then their learning becomes fast because they share information and ideas together.
- viii. The laboratory method of teaching strengthens teacher-student relationship.

Disadvantages of Laboratory method of teaching

Laboratory method has the following disadvantages.

- i. It has a very lengthy process.
- ii. Laboratory method of teaching is restricted to those topics only in which practical work is involved.
- iii. In Nigeria, it is very difficult for so many schools to spend a lot of money on tools and equipment involved in this method.
- iv. Teachers have to practice a lot before applying this method in the classroom or laboratory to avoid mistakes.
- v. Students cannot practice this method to establish laws or principles independently.
- vi. It is more effective in primary school classes as compare to secondary level.

Application of Laboratory Method in Mathematics at Secondary Level

This method is mostly used for practical geometry. At the secondary level, laboratory method of teaching can also be used to establish or verify the laws and theorems in sets and trigonometry. These laws and theorems are usually proved through inductive method but laboratory method can be used at alternative basis to create interest among the students.

The methods elucidated above can be used to explain more why discovering and Uncovering content should take precedence over covering and recovering content in mathematics.

IV. Recommendations

The following are my recommendations:

1. Teachers should make the students cultivate the habit of critical thinking & creative aplomb
2. School managements should make sure that discovering and uncovering of content should take precedence over covering and recovering content in mathematics
3. Teachers should make sure that textbooks should be used as resources not curriculum.
4. The government should provide an enabling environment for teachers to work, by giving them funds where necessary.
5. Teachers should plan the lessons properly by making sure that they use the three stages of lesson plan as stated above.
6. Teachers should make sure that students understand the main points instead of a mere delivery of the lesson.
7. Instructors or teachers should make sure that they adopt appropriate teaching method(s) in imparting knowledge during teaching and learning processes for student's proper understanding of the concept in the content.

V. Conclusion

The paper looked at Discovering and uncovering content should take precedence over covering and recovering content in mathematics. Critical thinking and creative aplomb, Discovering and Uncovering the content while making judgment for comprehension, Textbooks are resources; Not curriculum understanding the main points and the three stages of lesson plan were discussed.

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