TEACHING MATHEMATICS TO STI.IDKNTS TO THINK MATHEMATICALLY AND PRODUCE NEW CONCEPTS AND PROCEDURE

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Abstract

Knowledge of subject matter is important in teaching but more important is the ability of a teacher to be able to teach his subject in a way that his students will understand and be able to apply the knowledge to other areas of life. Most teachers leach mathematics the way they were taught some ten years ago by someone who also taught the subject the way he was taught by some outdated teachers, This paper therefore, had to look into approaches for teaching mathematics for effective learning. Teachers of mathematics are advised to adopt any approach that will make students to think mathematically and produce new concepts and procedure.

Introduction

Some teachers agreed that teaching is a collection of purposeful activities, which occur with awareness. Me sire (1994), argued that students should be assisted in linking new knowledge to previously learned knowledge and in building a hierarchical structure where ancillary concepts are placed below, and linked to major concepts. In any teaching situation we have three components:

1 -Teacher.
2- Students.
3- Subject Matter.

Interaction between these three components results in teaching. Teaching methods vary during interaction among these factors and particularly the role of the teacher and students in the leaching situation. Therefore; there are two major roles for the teacher and students in any leaching situation.

1- Students centered teaching refers to students being active and construct their own knowledge by teacher guidance.
2- Teacher centered leaching refers to teacher being active in the classroom to teach students. In this case students are passive instead teacher is active and try to transmit knowledge to students.

What are we Teaching in Junior Secondary School? We are teaching three kinds of subject matter in junior secondary schools. In other words, mathematics curriculum has three different meanings: 1-Students learn mathematics and science, because they need to solve problems, communicate with mathematics language and also they want to connect ideas and students need reasoning in problem solving situation and so forth.

2- Students memorize arithmetic facts and rules meaningfully. For example, three times nine equal 27 or in (he number sequence each number has an indicated place and value.

3- Students get skill and mastery in writing mathematical symbols like 1, 2, 3, 4 and so forth, also drawing geometrical shapes like square.

Therefore, in teaching situation we have to apply a lot of techniques to let students understand mathematics and use (heir understanding in new situation. For example in J S 1 students after understanding the meaning of numerals they want to write and read by symbols. So they need to have

mental image and a motor plan to write any of the symbols. Therefore, when writing them, they need practice and reinforcement lo settle down the behaviour. It means the teacher should apply behaviourist approach. Regardless a lot of usefulness of new approaches in cognitive domain, in teaching situation commitment to one particular approach is hard and sometimes impossible.

What is the Problem? In the real classroom situation looking to one of the three major components of mathematics education (teaching, learning and curriculum) without considering the effects of the others is impossible. Because teaching, learning and curriculum are interrelated in practical situation. Wertheimer's

(1959), argued that some mathematics and science classrooms and mentioned that, our mathematics teaching is. not preparing students as productive thinking mathematically or scientifically. Teachers, educators, researchers tried to categorize the main problems in teaching mathematics. For example, Schoenfeld (1988), has indicated that students did not pay attention to mathematical problem as multi solution problems or they look at (key word) in word problems instead of reading, analyzing, reasoning, connecting known parts of the problem and producing new concepts. Therefore, we are not teaching mathematics to our students to think mathematically and produce hew concepts and procedures. NCTM (1988), has accounted ten standards for mathematics content and procedure. Moreover Hiebert (1986), has divided mathematics curriculum lo two main parts:

1- Conceptual knowledge.
2- Procedural knowledge.

Comparing NCTM standards with other industrialized country's curriculum, Mathematics conceptual knowledge in JS I are similar, but with different perspective and length of teaching. Researchers found that mathematics problems are multi-solution problems, and students come to school with a lot of mathematical knowledge (Peterson, 1994). Teachers should consider their knowledge and give them opportunity to construct their knowledge based on what they already know.

Are Teachers Professional! The main problem is that Teachers do teach mathematics in a way they have been taught; and they have strong believes lhat make restriction to change ideas about teaching procedures (Cooney 1996). He also argued, that reform at classroom level is in its infancy. Teachers' believes are the main issue in term of changes in their teaching; but as Guskey (1986) suggests; changes in teacher's believes and attitudes follow changes in students outcomes which, in term, follow changes in teacher practice.

Models of Teaching: In the recent years of the last century; researchers, educators and teachers buildup many teaching models and have recommended to novice teachers and practitioners. Most of teaching models based on learning theories of two major institutes of educational psychology, behaviorist and cognitive domains. These models have advantages and disadvantages. So teachers have options to apply appropriate model in their leaching. For example, most of mathematics teachers will apply problem-solving model in mathematics classes. Bruce and Marsha (1992), categorized the models of teaching in four major families.

1- Social family.
2- Information-Processing family.
3- Behaviourist Family.
4- Individual teaching "(tutoring) Family.

In each family are some models, that teachers can apply the appropriate model in her/his teaching situation. Apparently teachers are willing to apply their own model rather than models that have been recommended.

Four Major Approaches in Teaching Mathematics

1 ***Skills Approach'***, Teachers arc teaching students for skills mastery. These teachers believe prescribed curriculum in teaching mathematics. They are trying to transit rules, formulas, and basic arithmetic facts to students. They are expecting quick answer from students and students try to memorize instead of meaningful understanding.

2- Conceptual Approach: Teachers are Leaching for understanding. In this approach, the teacher is as a guide to ensure that students memorised meaningfully. Students are not enough active in learning situation for example Ausubel (I96X), meaningful verbal learning theory. He emphasized linking students previous knowledge to new knowledge by advance organizers.

3~ Problem Solving Approach: In this approach students are active and teacher is as a consultant beside students problem solving activities. Teacher helps students to device solution strategies and students get opportunities to construct their mathematical knowledge.

4~ ***Investigative Approach:*** Based on NCTM standards and social constructivist's views, investigative approach developed and grown-up by mathematics teachers in-the recent years of the last century. The main assumption is that basic skills, concepts, and inquiry process are all necessary for mathematical power. Therefore teachers teach for skills mastery, understanding and mathematical thinking. It means teachers teach mathematics in a meaningful fashion.

Investigative approach emphasizes deep understanding of mathematics, student's engagement in the process of mathematical inquiry and positive attitude, active position to learn mathematics to apply for

solving problems in different situations.

More About Teaching Mathematics

Davis (1992), recommended many solutions to existing problems in mathematics education. He is arguing about students that have been observed in mathematics class that, students with a large amount of disparities have been participated in the class. Teacher was trying to impose formal algorithm to solve mathematics problem, instead some students had their own strategy to solve problem that teacher did not give any value or attention to student's creative performances.

To solve student's disparities problem in mathematics classes, there are a large body of research in teaching mathematics (Secada, 1992). Instead, some country follow well developed countries procedures or their teachers create several approaches according to their practical teaching experiences. These creativities are a topic of discussion in mathematics teacher's education classes. Overall there is a lot of leaching methods that, teachers examined in the recent years. These methods of leaching are based on research findings, but they are not last solutions. Teaching to divers students has many difficulties. For example, there are a lot of variables that is not possible to control all of them in the same time. Children in a randomly assigned mathematics class have different socio-economic positions, different ethnic groups and also different languages. Therefore to eliminate all these problems are almost impossible, but by employing some models or method of teaching can reduce the influences of such factors from teaching environment.

Direct Instruction

Direct instruction is a highly structured form of teacher's behaviours that are thought to support student's engagement in learning mathematics. For example, Everston et al. (1980), found a consistent pattern of relationships between teacher behaviours and enhanced students achievement in mathematics. Timss (1996), found that most of Japanese mathematics teacher's use 90% of time to direct instruction-instead American teachers only use 50% of the class lime as active teaching. The best example for direct instruction is Active Mathematics Teaching (AMT) originally developed by Good and Grouws (1977 and 1979). Direct instruction is effective for conveying a large amount of highly structured mathematics concepts for different student backgrounds (Grant, 1989).

Cognitive Guided Instruction

Cognitively Guided Instruction (CGI) has been found effective for enhancing students achievement on basic skills and problem solving (Carpenter, Fcnnema, Peterson, Chiang, and Loef, 1990). This approach based on four assumptions:

1. Children construct their own mathematics knowledge.
2. Mathematics instruction should be organized to facilitate children construction of mathematics knowledge.
3. Children's development of mathematical ideas should provide the basis of the sequencing topics of instruction.
4. Mathematical skills should be taught in relation to problem solving and understanding of children.

Cognitively guided instruction is based on four interlocking principles (Carpenter, Fennema, Peterson, Chiang, and Loef, 1990).

1. Teachers' knowledge of how mathematical content is learned by their students.
2. Problem solving as the focus of instruction.
3. Teacher access to how students are thinking about specific problems.
4. Teacher decision- making based on teachers knowing how their students are thinking..

CGI programme has been examined in diverse learners classes, and some researchers as Peterson, Fennema and Caipenter (1990), have proposed that CGI shows promise for the teaching of diverse learners.

Grouping

Grouping students in mathematics classes is more popular way among teachers to meet diverse students' needs. Teachers are grouping students either along lines of ability or in cooperative groups, (Slavin, 1990). In junior secondary school, for instance whole classes may be created along lines of ability (between class ability groups) or teachers may form ability groups within their classes. These kinds of groupings have advantages and disadvantages. The alternative to ability groups that is commonly proposed by some researchers is the use of small cooperative groups of heterogeneous ability. Many studies of small groups and their processes have used direct instruction or active mathematics leaching for the development of a mathematics lesson, but they have grouped children heterogeneously for some part of that lesson (Swing and Peterson, 1982).

Most of these approaches are thought to affect, first enhanced mathematics achievement for diverse population and second, closing the achievement gaps between those population. Over all researchers found that these methods work in diverse students classes and can solve student's low achievement problem with high proportion (Secada, 1992).

Recommendations

1 wish to make the following recommendations:

1. Teachers have to believe that tin- investigative approach is the best and is appropriate to the mathematics instructional goals or guarantees the students achievement. In order to conceive our mathematics teacher, we should have some fixed agreements or some rules. Unfortunately
researchers are following different views from cognitive domain and all research findings are reliable sources but how is it possible to apply those findings in teaching fields are not enough clear. For example, in cognitive domain we are looking at gestalt educational psychologists findings, social-constructivist, radical constructivist and Piaget followers and many other views and recommendations without enough teacher's training in all these approaches.
2. Teaching situations are not a fixed and unvaried environment. Therefore, it is impossible to teach mathematics within a specific method or technique. For example, when the teacher teaches quadrilateral in the junior secondary, he/she has to give practice (skills approach) beside student's mental image and correct motor plan from the symbol.
3. We have to remember William James definition from teaching, he says, teaching is art. It means teaching has only one rule. Teach meaningful and applicable.

Conclusion

The question is: Why school age children are not willing to understand mathematics concepts, procedures and apply mathematics procedures in other situations? In order to find answer, we have to look at some of educational, psychological, social, political, scientific, and economical aspects of education system and their influences in mathematics teaching in junior secondary classes.

Virtually, there are many positive points to consider and hopefully challenge to solve existing problem. For example, technology availabilities, scientific standards, political supports, school funds and so-forth are positive points to rely-on, and teach mathematics, with purpose of understanding all students mathematics meaningfully. There are also some constraints as segregation, teacher's negative beliefs about students understanding of mathematics, parents lack of cooperation in the teaching phase and etc. But problem is solvable. The next question is: what are the solutions? I am not going to prove that (here is only one solution to the educational problems. Because there are a lot of solutions to the problems. One of the major factor as a solution is mathematics-teaching approach. Actually some of the mathematics teachers are not teaching effectively? We all believe that, teachers have a lot of freedom to apply any kind of teaching approach to teach mathematics in their classroom. Why are they not using the best approach such as investigative approach?

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