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CONSTRUCTIVIST APPROACH TO ENHANCE CONCEPTUAL UNDERSTANDING IN MATHEMATICS:AN ANALITYCAL REVIEW

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ABSTRACT

The present paper is a conceptual paper focusing on adopting constructivist approach in the teaching and learning mathematics. Our present education system emphasizes on preparing students for highly competitive standardized tests and overlooks the importance of fostering critical thinking skills in our students. The conventional teacher centric teaching learning process emphasizing on memorization is usually adopted across length and breadth of Indian schools.. The principles of constructivism, increasingly influential in the organization of classrooms and curricula in schools. The principles appeal to our modern views of learning and knowledge, but conflict with traditional academic practices. We need to reflect on our practice in order to apply these ideas to teaching of mathematics. The current paper may be useful in drawing the attention to teachers of mathematics by which they canhave a brief idea about constructivist approach and models suitable for modern teaching and learning of mathematicseducation at school level , and access to activate the constructivist learning model. Constructivist approach advocates that we are active creators of our own knowledge. To do this, we must ask questions, explore, and assess what we know. Review of literature reflects the effectiveness of constructivist approach in teaching and learning. It also reflects that engaging student in active learning is the most productive means of teaching.

Key words: *Constructivist approach, Critical thinking, Active learning*

Introduction

In this paper, we discuss the practical uses of constructivism in the mathematics classroom. Constructivism is the popular, yet mildly controversial belief that students construct their own knowledge through self-modification of cognitive structures. This self-modification is a largely goal-directed, process by which the student reacts to a cognitive disturbance by changing how he or she thinks about a concept to accommodate the novel piece of information, thus relieving the cognitive disturbance.

Essentially, this means that when the student encounters a hard problem, the student reacts by thinking about it until it makes sense. This challenges the classic behaviourist model where a student is presented with stimuli (problems, exercises, etc.) and shown how to achieve a certain response. The behaviorist model requires some sort of external reward. In contrast, the main tenet of constructivism is that no external reward is necessary; rather, the

"comfort" of the newly modified cognitive structure is rewarding in itself. Constructivism is a part of several psychological theories. The historical roots of constructivism as a psychological theory are most commonly traced

to the work of Jean Piaget, although there are some elements of Piaget's constructivism that come from the early Gestalt psychologists. As collegiate mathematics education teachers and researchers, we have much experience withconstructivism as both a research paradigm and a teaching method. The success of constructivism, both as a
pedagogical technique and as a psychological theory, provides converging
evidence of itsutility.

The Theoretical FrameworkConstructivism

A reaction to didactic approaches such as behaviourism and programmed instruction, constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it. Knowledge is constructedbased on personal experiences and hypotheses of the environment. Learners continuously test these hypotheses through social negation, each person has a different interpretation and construction of knowledge process. The learner is not a blank slate, but brings past experiences and cultural factors to a situation. A common misunderstanding regarding constructivism is that instructors should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves, this is actually confusing a theory of

pedagogy with a theory of knowing. Constructivism assumes that all knowledge is constructed from the learner's previous knowledge, regardless of how one is taught. Thus, even listening to a lecture involves active attempts to construct new knowledge.

Constructivism learning model

Maximus (2003, 55) Defined model of constructivism learning as: "Form to help students build their understanding a scientific knowledge according to four stages of the learning cycle. Emphasizes form on linking science, technology and society, built the four stages as ways of learning and working under specialists in science or technology, and what is in the mind of the

learner when building scientific concepts of in accordance with the philosophy of constructivism, the four phases of the model are: Call and exploration, proposing solutions and interpretations, implementation, which is a phase or stage of action",

According Yager (Yager, 1991, 52-57) the constructivism model of learning aims to teach learners a new knowledge by building on their own, and supports self-learning through the development of processes of learning and research, with teaching this model through: (activation), exploration, discovery, innovation, proposal, interpretations and solutions, finally the action, learning model is a teaching models based on the constructivism theory, making the learner at the center of the educational process, and stresses on the interaction between the teacher and the learner, the cooperation of the educated among them inside the classroom, moving the process of teaching and learning according to this model in four Successive phases: advocacy, exploration, discovery, innovation, proposing explanations and solutions, and action(the application).

Perkins, (Perkins 1991:18-27) and Maximus (2003, 57) a number of practicalities that underpin the model constructivism learning, including: planning by the teacher to invite learners to participate effectively in the implementation of solving activity a specific problem or discuss a particular phenomenon, this stage comes at the beginning of learning new steps– Rely on concepts and perceptions and ideas of learners to discuss what raises themquestions and find solutions to face them with a problem, while enabling them in the course of learning to discuss and test their ideas and suggestions, even if it is just because of the error is normal in the learning process, The teacher constructivism accept learners errors then perform discussion to be able to discover and correct their mistakes on their own, bring the right concepts and ideas somewhere they might have wrong concepts and ideas. Planning by the teacher to invite learners to participate effectively in the implementation of solving activity a specific problem or discuss a particular phenomenon, this stage comes at the beginning of learning new steps. Rely on concepts and perceptions and ideas of learners to discuss what raises them questions and find solutions to face them with a problem, while enabling them in the course of learning to discuss and test their ideas and suggestions, even if it is just because of the error is normal in the learning process, The teacher constructivism accept learners errors then perform discussion to be able to discover and correct their mistakes on their own, bring the right concepts and ideas somewhere they might have wrong concepts and ideas.

Activities/phases in constructivism ApproachTHE 5 E's

The 5E"s is an instructional model based on the constructivist approach to learning, which says that learners buildor construct their own ideas. The 5E"s can be used with students of all ages,

including adult. Each of the 5E‟s describes a phase of learning and each phase begin with the letter "E" which are Engage, Explore, Explain, Elaborate and Evaluate. The 5E‟s allow students and teachers to experience common activities to use and build on prior knowledge and experience, to construct meaning and to continually assess their understanding of a concept.

(i) Engage: This phase of 5E‟s start the process. An engage activity should do the following:

Make connection between past and present learning experience. Anticipate activities and focus students‟ thinking on the learning outcomes of current activities. Students should become mentally engaged in the concept, process or skill to be learned.

(ii) Explore: This phase provide student with a common base of experience. They identify and develop concepts, processes and skills during this phase; students actively explore their environment or manipulate materials.

(iii) Explain: This phase of 5E‟s helps students explain the concepts they have been exploring. They have opportunities to verbalize their conceptual and understanding or to demonstrate new skills or behaviors. This phase also provides opportunities for teachers to introduce formal terms, definitions and explanations for concepts, process, skills or behavior.

(iv) Elaborate: This phase of 5E‟s extend students‟ conceptual understanding and allow them to practice skills and behaviors. Through new experiences, the learners develop deeper and broader understanding of major concepts, obtain more information about areas of interest and refine their skills.

(v) Evaluate: This phase of the 5E‟s encourages learners to assess their understanding and abilities and lets teachers evaluate student‟s understanding of key concepts and skill development.

Constructivism As Pedagogy

The view of constructivism as a psychological theory tells us much about how students learn mathematics. Using this information, many teachers have begun to think about exactly how they conduct their mathematics classrooms. The standard model for mathematics teaching has long been the lecture, as exemplified in Krantz (1999, p. 12), where he says, "Lectures have been used to good effect for more than 3000 years." While no one will probably deny that they have seen some very effective lectures in their educational experience, the modern thought is that a good majority of lectures tend to be rather ineffective, especially in the mathematics classroom. As Dubinsky (1999) points out, how do we really know what the classroom style of Newton was like? There seems to be no historical documentation pointing to the exact teaching style of these great mathematicians. The use of constructivism in the mathematics classroom has many variations. The one thing that these variations have in common, however, is the central role of the student in the learning process.

Previous Studies

A great deal of research has been conducted surrounding the idea of traditional more constructivist approach to education is apparent in much of the research literature. The motivation and engagement of students in the learning process has been shown to increase with the use of active learning strategies. The development and implementation of such diverse strategies have both positive and negative affects for the teacher and student.

According to Crawford and Witte (1999) the best word to describe a constructivist classroom is energy. The active engagement of students in the learning process is essential. Obtaining this type of engagement requires a much different classroom from the authoritative and teacher-centered traditional classrooms in which the teacher stands at the front of the room directing the content that is delivered to the students (Polya, 2002). Brooks and Brooks (1999) discuss the need to rethink this traditional classroom and the notion that students will learn on demand and that they will learn the same material at the same pace

According to Rosenthal (1995), "most mathematicians agree that the best way to learn mathematics is by actively doing mathematics; by discussing it with others; and by synthesizing major ideas" (p. 108) which is typically not seen in a mathematics classroom. The use of lecturing as the traditional teaching method is not always the most successful approach according to O'Sullivan and Copper (2003). Leonard (2000) highlighted that lectures guarantee that a particular amount of material is covered but does not guarantee that the students have fully understood the material. Leaming cannot take place just by reading or listening to lectures (Polya, 2002). In the context of Kieren's (1969) article "activity learning is taken to mean school learning settings in which the learner develops mathematical concepts through active participation" (p. 509). This may involve the manipulation of physical materials, games or experiments with physical objects

Crawford and Witte (1999) discuss the contextual teaching strategies that should be used when developing an active learning strategy. Theses strategies focus on the fundamental principle of constructivism - teaching and learning in context. The contextual teaching strategies include relating, experiencing, applying, cooperating, and transferring.

The ability to relate mathematical ideas to the context of a student's life experiences are important. Educators in the United States are not the only ones faced with being responsible for educating children. Research conducted in the United Kingdom shows that the notionof active learning is widespread.

Findings from this particular literature discuss the nature of active learning (Kyriacou, 1992). Mathematical activities must be chosen carefully so that they fully engage the students' higher mental capacities. Diverse learning activities such as computer-assisted learning, role play exercises, work experience, group discussions, collaborative problem-solving and extended project work are other forms of active learning (Kyriacou, 1992). Choosing the appropriate level of an activity is important in challenging a student. Smith (1999) explains that each learning activity chosen or constructed must demand mental involvement

Constructivist approach to Mathematics Education

The Constructivist Approach to Mathematics Teaching and the Active Learning Strategies used to Enhance Student Understanding Many different methods of teaching are used by mathematics educators around the world. One of these methods is constructivism. Constructivism is by no means an innovative teaching method since it dates back to the time of Socrates. For many years the constructivist approach to teaching has appeared in textbooks, curriculum frameworks and literature. The essence of constructivism has been captured through the development of active learning, also known as learning by doing, learning by experience, learning through action, student-centered learning, peer collaboration and cooperative learning. The following quote expresses what some mathematics educators might identify as a perfect educational system:

Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction .The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding ... Alone or in groups and with access to technology, theywork productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it. (National Council of Teachers of Mathematics, 2000, p. 3)

This quote supports the idea of constructivism and the use of active learning strategies in the classroom. Mathematics has an important role in the real word, and the reality of mathematics curriculum and traditional teaching methods cannot achieve those sparkling goals adopted by educational institutions. Experts and interested in mathematics and methods of teaching and learning tried to make proposals and solutions to methods of teaching mathematics and mathematics curriculum problems, among those proposals workout and use different strategies and models of modern teaching based on modern theories of learning, In the classroom, the constructivist view of learning can point towards a number of different teaching practices.

In the most general sense, it usually means encouraging students to use active techniques

(experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher makes sure understands the students' pre-existing conceptions, and guides the activity to address them and then build on them. Constructivist teachers encourage students to constantly assess how the activity is helping them gain understanding. By questioning themselves and their strategies, students in the constructivist classroom ideally become "expert learners." This has given them ever-broadening tools to keep learning. With a well-planned classroom environment, the students learn how to learn. The constructivist teacher provides tools such as problem- solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, pool and convey their knowledge in a collaborative learning environment. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Always guided by the teacher, students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook.

Constructivist learning benefits, students learn more, and enjoy learning more when they are actively involved, rather than passive listeners, Education works best when it concentrates on thinking and understanding, rather than on rote memorization. And concentrates on learning how to think and understand. In constructivist classrooms students create organizing principles that they can take with them to other learning settings, and gives students ownership of what they learn, since learning is based on students' questions and explorations, and often the students have a hand in designing the assessments as well. Constructivist assessment engages the students' initiatives and personal investments in their journals, research reports, physical models, and artistic representations. Engaging the creative instincts develops students' abilities to express knowledge through a variety of ways. The students are also more likely to retain and transfer the new knowledge to real life, By grounding learning activities in an authentic, realworld context, as well as it stimulates and engages students to learn how to question things and to apply their natural curiosity to the world, and, Constructivism promotes social and, Communication skills by creating a classroom environment that emphasizes collaboration and exchange of ideas. Students must learn how to articulate their ideas clearly as well as to collaborate on tasks effectively by sharing in group projects.

Students must therefore exchange ideas and so must learn to "negotiate" with others and to evaluate their contributions in a socially acceptable manner. This is essential to success in the real world, since they will always be exposed to a variety of experiences in which they will have to cooperate and navigate among the ideas of others.

Concerns of Constructivism/Active Learning

There are many concerns that educators have when it comes to designing and implementing learning activities. "Mathematical activities alone are not enough to achieve learning by themselves; they need to be carried out with a consideration of aspects of presentation, the nature of the pupil's mental activity, the need to ensure pupil reflection and the achievement of socialization of the learning" (Smith, 1999, p. 110).

Conclusion

In this article it has been moved towards understanding what the constructivist approach is, the epistemological basis the approach relies on, and how knowledge within the constructivist understanding is acquired. Later, the necessary theorists and practitioners of constructivism including Dewey, Piaget and Montessori as well as their perspectives and most striking thoughts and practices were examined. In the production of knowledge within the constructivist approach, the building of a person's knowledge is emphasized. The knowledge that people have is related to their social and cultural content, as well as the media's recommended stage of life and life situations. In this way, knowledge is relative, temporary and dependent upon observation. Moreover, cognitive knowledge cannot be learned receptively but is a mixture of personal experience, emotions and intuition. Constructivist theory necessitates a considerable change to general education practices.

The focus of education needs to be shifted from placing content in students' knowledge building. If the focus of studying could be turned from filling one's mind to producing knowledge products, students wouldn't need to concentrate on memorization and cramming for examinations. In classroom instruction there is a need of integration of formal, theoretical, practical and self-regulative knowledge. However, in a traditional type of curriculum these different types of knowledge have been treated separately. One of the most important challenges to pedagogy is developing curricula and teaching methods so that true integration of formal, theoretical knowledge and more informal, practical, and self-regulative knowledge may be achieved. The emphasis is on students' learning process and on their meaning making as much as (or even more than) on the final product.

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