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OVERVIEW ON MATHEMATICS LEARNING THEORY

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ABSTRACT

Mathematical learning theory is an attempt to quantitatively describe and explain behaviour. Several psychologists have sought to create such ideas. From 1930 to 1950, learning theories were quite prominent and influential in psychology, but they faded dramatically during the next two decades as the information-processing approach to cognition based on a computer metaphor took hold. The creation of a speciality known as mathematical learning theory provided the framework for a comeback of learning theory in the field of cognitive psychology early in the decade.

Keywords: **learning theory, variety, remarkable, described, communicate**

MATHEMATICS LEARNING THEORY

Research literature shows that there are a variety of different general learning theories that are applied to mathematics learning. Mathematics is often described as a hierarchical subject, where later learning depends on understanding of earlier concepts (Chambers 2008). Skemp (1987) asserts that "the amount which a bright child can memorise is remarkable, and the appearance of learning mathematics may be maintained until a level is reached at which only true conceptual learning is adequate to the situation. At this stage the learner tries to master the new tasks by the only means known - memorising the rule

for each kind of problem. That task being now impossible, even the outward appearance of progress ceases, and, with accompanying distress, another pupil falls by the wayside" (Skemp 1987). Skemp (1987) also asserts that "mathematics is the most abstract, and so the most powerful of all theoretical systems" where "more abstract means more removed from experience of the outside world". Skemp believes that "mathematics cannot be learnt directly from the everyday environment, but only indirectly from other mathematicians". He says that mathematics learning is "very dependent on good teaching" and that "to know mathematics is one thing and to be able to teach it - to communicate it to those at a lower conceptual level - is quite another; and I believe it is the latter which is most lacking at the moment" (Skemp 1987).

Most mathematics learning theories refer to Jean Piaget whose work established constructivism as a leading theory in mathematics learning (Chambers 2008; Ernest 2011; Jaworski 2002; Zimmerman and Schunk 2003). Constructivism is founded on Piaget's belief that learning is an active process whereby new knowledge is accommodated into previously understood knowledge. Piaget (1896-1980) identified four stages of learning through which people progress from birth to adulthood, these are: sensor-motor (up to 2 years); preoperational (2 to 7 years); concrete operational (7 to 11 years) and formal operational (11 years and older). Teaching involves using methods that are appropriate to a child's stage of development and children move through these levels in the defined order; they cannot skip a stage. Constructivism is based on the theory that thinking is an internalized activity and that new knowledge is constructed based on experiences. When a child encounters a learning experience, mental structures or schemas are constructed to represent perceptions of what they experience. New experiences result in new schemas or the reinforcement or modification of existing schemas. Assimilation is the process where new knowledge is fitted into existing schemas and accommodation is the process of adapting schemas to fit new perceptions (Chambers 2008; Ernest 2011; Jaworski 2002; Zimmerman and Schunk 2003).

Developing specific mathematical forms of discourse that can be internalised by individual students is an important part of effective mathematics teaching (Pietsch 2009). In India there is little evidence of group work, individualised work, whole class discussion or reflection in mathematics classrooms (Lyons et al. 2003). Classroom discussion, dialogue and collaboration are critical components of social

constructivist theory of mathematics learning. Dialogical classrooms, while challenging teachers, allow students to ask questions and consider different perspectives, create rich learning environments. Collaborative learning, where a group of students work together dealing with different perspectives and a common goal, encourages interaction between students. The peer tutoring element of collaborative learning benefits both students who are tutoring as they are encouraged to clarify their own thinking and those who are being tutored as they can address their areas of misunderstandings. Collaborative learning opportunities encourage students to verbalise their ideas and challenge other students (Pietsch 2009).

There are numerous mathematics classroom teaching practice views and the majority of these recommend a shift away from isolated facts and memorisation of procedures and a move towards conceptual understanding and problem solving (Chambers 2008; Jaworski 2002; Pietsch 2009; Schoenfeld 1994; Watson and Mason 2008). The National Council of Teachers of Mathematics (NCTM) in the U.S. is probably the most active initiative aimed at reforming school mathematics teaching. The NCTM released standards for school mathematics in 1989; these were subsequently updated and rereleased in 2000 and they are called "Principles and Standards for School Mathematics". The NCTM's Principles and Standards for School Mathematics highlight students' need to learn mathematics with understanding by actively building new knowledge from existing knowledge and experience. The council also highlights the need to focus on "important mathematics" that will prepare students for continued study and for solving problems in a variety of school, home and work settings (National Council of Teachers of Mathematics 2000). The NCTM present six principles and ten standards to guide teachers who seek to improve mathematics education in their classrooms and schools. The six principles for school mathematics address overarching themes of: Equity ("excellence in mathematics education requires equity-high expectations and strong support for all students");

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