The mathematical learning theories education essay

Education

There are many theories that attempt to explain how students learn mathematics, but as Campbell (2006) states: Theories are like toothbrushes… everyone has their own and nobody wants to use anyone else's. (Campbell, 2006)There is however, much commonality between theorists, for example Skemp (1964) Ausubel (1968) and Bruner (1966) believe that mathematics is hierarchal in nature; the vast majority of theorists agree that a priori learning plays an vital role in the acquisition of new mathematical learning. Similarly, the use of concrete models to help learners formulate mathematical ideas is advocated by many theorists such as Bruner (1966), Van Hieles (1958), and Dienes (1960). Below is a brief summary of the most renowned mathematical theorist's ideas.

Richard Skemp (1919- 1995)

According to Skemp (1976), students construct schemata to link what they already know with any new learning. As an example, in teaching a student to round a number to the nearest 10, the student needs to use their understanding of place value and their concept of number magnitude to the learning. He suggests that mathematical concepts are hierarchical in nature - a student cannot understand a higher concept until the earlier building blocks which it is dependent on, are understood first. Skemp (1976) defines two types of mathematical learning. Instrumental learning which involves learning processes by rote; this is usually performed by the teacher demonstrating how to solve a particular problem, followed by the students applying this knowledge to very similar problems. Relational learning however, involves understanding the concepts and the reasoning underlying the knowledge rather than just applying rules. Instrumental understanding

produces procedural understanding –the ‘ how’ knowledge, whereas relational understanding produces conceptual understanding – the ‘ how’ and ‘ why’ knowledge. He theorised that both types of learning are important as they both teach the student the rules of mathematics. For example, in calculating the area of a rectangle, students need to know that the area is length multiplied by width – this is instrumental knowledge; being able to see why this rule always works, requires relational understanding. Area = 6 columns of squares all 4 squares high = 24 squares nn_meas_area_03_01

Zoltan Dienes (1916 -)

Diene’s theory (1960) outlines four principles that he believes applies to the learning the mathematics. First is the Dynamic Principle – Learning is an active process that requires opportunities to be provided for students to interact. He states that to be able to understand a concept, there are three essential steps – the play stage, the structure stage and finally the practice stage. The second principle is Constructivity – students need to construct their knowledge before analytical activity. The Mathematical Variability principle states that when knowledge is imparted, all other irrelevant facts should be systematically varied whilst keeping the relevant variables the same. For example, in teaching the definition of what a triangle is, the teacher should change the size, the angles and orientation of the triangle so that the students understand that it is three sides that and three angles that define a triangle. The final Perceptual principle states that different kinds of teaching materials should be used to teach the same concept or idea.

Jerome Bruner (1915 –)

Bruner (1966) is credited for developing the inquiry-based constructivist approach to learning, known as discovery learning, which argues that it is best for learners to discover facts and relationships for themselves. Learning is best achieved through a process of inquiry. Bruner said that anybody can learn anything at any age, provided it is stated in terms they can understand (Bruner, 1960 p. 33). He believes that learning is a cumulative process and therefore requires previous learning to be frequently revisited; Bruner refers to this notation as the spiral curriculum. His learning theory describes three stages of knowing: enactive (action-based), iconic (image-based), and symbolic (language-based). Bruner suggests that when children learn mathematical concepts, they need to go though these stages - from concrete objects to pictorial images and then to abstract symbols (Bruner, 1966 p. 11) . Take for example the concept of addition. A student working at the enactive stage would physically move objects into a single pile in order to find out how many there are. At an iconic level: At a symbolic stage: http://www. gsx. com/Portals/38080/images/cloud. gif http://www. gsx. com/Portals/38080/images/cloud. gifhttp://www. gsx. com/Portals/38080/images/cloud. gif and http://www. gsx. com/Portals/38080/images/cloud. gif http://www. gsx. com/Portals/38080/images/cloud. gif is 3 + 4 = http://www. gsx. com/Portals/38080/images/cloud. gif http://www. gsx. com/Portals/38080/images/cloud. gif

David Ausubel (1918 – 2008)

Ausubel et al. (1968) was a critic of discovery learning as he believed students acquire knowledge by being exposed directly to it rather than through discovery. Ausubel's theory of Assimilation states that it is essential to relate new knowledge to previous learning. Teachers should facilitate learning by organising information so that new ideas are easily related to concepts already learned. The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly" (Ausubel et al., 1968 p. vi)Ausubel believed that it was important for teachers to give a brief overview of the knowledge that students will learn beforehand, he refers to this as giving students the ' big picture'. This then enables learners to link new concepts and vocabulary to existing known ideas. Existing knowledge provides a framework into which the new learning is related.

Robert Gagne (1916 – 2002)

Gagné's ' Conditions of Learning' (1965) outlines five major categories of learning that each require a different type of instruction in order for learning to occur. The five categories are: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. Gagné suggested that learning is most effective when students move from mastery of the smallest conceptual units to the most general concepts. For this to happen, teachers must carry out a learning task analysis – Identify learning skills, analyze learning tasks, then sequence the teaching of the learning skills in a hierarchical order.