TIIE IMPACT OF PSYCHOLOGICAL RESEARCH ON MATHEMATICS EDUCATION IN PRIMARY SCHOOLS

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Abstract

Wheeler (1970) deposed that to see Mathematics as invention rather than discovery and as applicable to virtually any raw material whatever can give us a different sense of its place in education. The revolution in teaching Mathematics will come if and only if these powers are acknowledged as belonging to the child before anyone starts to tcach him Mathematics at all. Bandet (1968) supports what Wheeler said though from a more traditional standpoint, that of "laying the foundations of mathematical thought". From what they seem to say, we can then ask the question "How do children learn Mathematics?". In answering this question, we are making decisions about what Mathematics to teach, when it can be taught and how it should be presented to children especially at the Primary School level. Many Mathematics educators and psychologists have attempted in their various research works to identify and suggest various ways children of Primary School age learn Mathematics and what the teacher can do to encourage and discover mathematical thoughts in them. Mention was made of some of the renowned psychologists in this paper, an attempt was made to look at the relevance of psychology in teaching, learning children's attitude towards Mathematics and children's cognitive styles in learning Mathematics.

Introduction

Th rough out the first half of the 20th Century, psychologists have been active in the development of learning theories. Thorndike's S - R explanation of learning was the dominant theory. Conspicuous in the early statements of this were the laws of readiness, exercise and effect, allhough in later attempts, these laws were considerable modified. The effective teacher of Mathematics encourages creativity by helping pupils discover the basic ideas, laws or principles of Mathematics. The teacher of Mathematics aims for understanding ahead of skills of operation and seeks to give students the stimulation that comes from accepting and realizing worthwhile goals. The attitudes, interest, self-concepts and factors such as anxiety and frustration all of which influence and interact with children's motivation and which they carry to Mathematics lessons affect the way they feel about Mathematics. Young children tend to indicate their feelings of enjoyment, interest and enthusiasm openly. The same goes with their dislikes.

Researches have been done concerning children's attitudes towards Mathematics but most of the findings have difficulty in measuring attitudes when dealing with young children. This is because children's attitude differs from day to day. It is important to know how children feel because it seems reasonable to assume that the way children feel about and react to mathematical content and ideas are related to the quantity and quality of their learning. This will also lead us to know what motivation has to do in making children really feel good about learning Mathematics. Motivation here involves whatever the teacher does to increase children's interest in learning. One hopes that increased interest will lead to increased achievement in children. Various researches have shown how games, materials and techniques that teachers have used successfully have greatly increased interest in children. What teachers say and how they say it has been found to be particularly important. Praise has been found to be a highly effective way to motivate children to learn mathematics. Teacher and Mathematics educators generally believe that children learn more effectively when they are interested in what they learn and that they will achieve better in Mathematics if they like Mathematics. This means we should continually pay attention towards creating, developing, maintaining and reinforcing positive attitudes in children. Most researches carried out by various Mathematics and Mathematics educators have conflicting evidences on whether boys like Mathematics better than girls or vice versa but generally, teachers find tht th attitudes of children in early primary school are positive towards school. A relationship will seem to exist between the teacher's attitude towards Mathematics and his pupils' attitude towards Mathematics and this will go a long way to determine whether the child will learn Mathematics in

future or not. If the moral of the child at the primary school level is dampened by the negative attitude of the teacher, the child may grow with such ideas and will tend to hate Mathematics throughout his lifetime.

The Development And Growth Of Pupil's Thinking With Respect To Mathematics Learning

Children being to acquire mathematical ideas almost from the time they become aware of the world around them. Some psychologists of Gessel Institute in U.S.A. did a research on how children develop and the implications of these for the school. They propose that a thorough analysis of the child's developmental level would aid teachers in providing an individualized programme for each child. Their researches are designed to ascertain developmental factors including the development of mathematical ideas rather than knowledge acquired from school instruction with respect to the child's level of growth, the child as a unique individual and the child in a certain environment.

Piaget's theory depicts intelligence as an active organizing process whereby the child attempts to structure his world and give meaning to it. Piaget's operational level consists of two stages. The first is concrete operational stage. At this level, ideas must be abstracted from experiences in the physical world such as by actions performed on objects. Young children explore and manipulate objects in order to learn about them. At 11 to 12 years of age, children reach the second level of operational thought, at which they can reason and consider ideas at the abstract level without having to rely on their experience in the physical world. This level of thought is called formal operational stage and is characterized by hypothetical - deductive, since it is based on a deductive reasoning process from any arbitrarily chosen hypothesis or premise.

Piaget has identified four important factors involved in the development of intellectual ability. They are:

(1) Maturation;
(2) encounters with the physical environment;
(3) social experience including both interaction with the instruction by adults and peers; and
(4) a process he calls equilibration, by which the child incorporates new knowledge.

Piaget has also identified certain stages of development and established approximate chronological age boundaries for each stage. He has ascertained that a child's development is invariant in terms of sequencing. By this Piaget is saying that the child passes from one stage to another in much the same order as all other children. He maintains that a major shift in the nature of children's thinking occurs at about age 7. At this point, the child becomes less prone to distractions than he was earlier, he can manipulate ideas more readily, he is aware of contradictions and can correct himself when he makes mistakes. This means that the period of early childhood marks the transition from thought that is perceptual and subjectively oriented to thought that is conceptual, objective and systematic. The child develops increasing trust in reasoning rather than reacting almost entirely on the basis of what he perceives. Piaget was interested in determining how children develop spontaneously and interact with their environment but without planned changes in that environment. He was of the opinion that the child develops mathematical concepts not only from instructions but also independently and spontaneously from his own experiences. Other psychologists have shown that a child's experience can be altered through training though the training has not changed the overall developmental level of the child. He believes that the child must grasp the principle of conservation before he can develop a reliable concept of cardinal number. He ***found out*** that ***the development of*** this ***concept takes place at about*** 7 ***to*** 8 ***years.*** In ***studying*** children's concepts of numbers, Piaget first investigated the way in which children arrive at the invariance of wholes and conservation of quality and then the problem of one to one correspondence leading to cardinal and ordinal meanings of numbers. Secondly, Piaget studied the way in which children combine classes of numbers adaptively and multiplicatively.

Piaget and lnhe!der(1971) investigated how the child comes to classify and order within the class; the capacity to group and order environment in a logical way. They found out that these ideas are what children acquire slowly in the first few years of their development and they demonstrate these difficulties both in arriving at criteria for grouping and also recognizing the structural properties these criteria possess. Their findings were similar to Vygostsby(1962). Lovell (1961) also experimented on children's concept of numbers, material, spaces and time and were to be closely

related to Piaget's and Inhelder's findings. Piaget point out that by studying children's development vvc are able to understand how human knowledge works particularly scientific and Mathematical knowledge, lie also point out that the three mother structures of Mathematics - algebraic structures, relation of order and topological structures, originate from children's thinking. Piaget also stated that the child must first construct simple collections of materials before he is able to manipulate objects and classes within hierarchical systems. From Piaget's view, it appears that a child's Mathematical achievement may be aided by instruction that is based on an assessment of his developmental level and that includes content that helps him to focus on relevant aspects of such factors as conservation, seriation and classification. Piaget's findings on how learning should be geared towards the ***improvement*** of the ***child's improvement*** will be discussed later ***in*** this paper.

Skemp(1961) elaborated on what Piaget did for the study of children's number awareness to their mathematical thinking. He began by assuming that concept and operation are the basic ingredients of mathematical thought and distinguished between concept formation and the use of operation on one side and their manipulation on the other side. The manipulative skill in children. Skemp called reflective activity. He devised tests of concept formation, which consists of shapes, patterns and two-dimensional geometrical figures with his pupils of age 14-15 years. He correlated the scores in the different tests with performance by the pupils on a GCE Mathematics test. He found out that reflective activity is as essential for Mathematics as classifying activity is for Arithmetic. His results showed a clearly more significant correlation between Mathematics and the reflective scores than between Mathematics and the scores on the formation and use of concepts. He regarded reflective activity as the essential feature of Mathematics learning and thinking in children.

Both Piaget and Skemp showed that earlier concrete, physical experience must be developed before one can move to the second experience that of logico-Mathematics, which points out that unless there is experience in existence, any attempt to describe its properties will be fruitless. To the teacher this means that unless the child has experience through his physical environment on a particular concept can he (teacher) start describing such concepts to the understanding of the child. Where the child lacks such experiences, the teacher can use concrete visual objects to demonstrate what he wants the child to learn.

Dienes (1959) attempted to determine the psycho-dynamics of the process of concept formation and to discover in what ways the ability to form abstract concepts connected with other aspects of personality. He devised two tasks with 10 year children from whom he was able to trace and score how the children formed mathematical concepts. The first task involved arriving at concepts of elements of a group, product of elements, identical and different elements and transformation of one identity to another. The second task involved the inequality of integers in a binary choice system. His finding was that concept formation by different individuals depends on their insights, which refers to the discovery of essential structures. Dienes was able to separate formal analytical from constructive judgements and that girls were more constructive while boys were more analytical. He also found that the connection between intellectual ability and emotional drive was more in the case of boys.

The implication of Dienes' findings to the teacher in the classroom is that the teacher should model the properties of the actions and operations as well as build up these actions, operations and concepts in a concrete way in his teaching young children.

Brunner (1961) was concerned with improving the quality of the Mathematical thinking of pupils and insists that Mathematical processes should be discovered through concrete experiments in the earlier stages of learning.

Benjamin Bloom recommends a complete reorganization of the classroom to attack learning tasks. In his own experiment, his students are allowed to vary the amount of time spent learning rather than the level of achievement, the reverse in common practice. Bloom calls for uniformly high levels of achievement, a constant and individualized amount of time to reach this achievement.

Gagne's (1961) research was based on programmed instructions in which lower concept or lower order set is required to be mastered before the next one could be achieved. Gagne and Brown (1961) in their teaching of conceptual learning devised three types of learning programme where:

(a) the rule was stated first and then a linear programme brought about identification and application of the rule;
(b) the rule had to be discovered by the learner from instances and
(c) a programme of guided discovery was used in which instances were worked with guidance for particular cases and the learner extended the rule to other cases.

They both found out that guided discovery was the best example. To the teacher Gagne's finding relate mostly to what the teacher should do in the classroom to ensure efficient learning process in children. The teacher should be able to guide children in the classroom after given them tasks to do. This can be during a task like problem solving where children need help.

Implications Of Psychological Research Of Mathematics Education To Teaching

From Piaget's, Skemp's, Dienes? Gagne's, and various other psychologist's findings, it seems the importance of developmental stages in children is immense and this greatly helps the teacher in his teaching. The teacher who is aware of children's age, perceptual and reasoning ability will known how to plan his lesson'in order to meet the growing demand of the child. For example children of age 3-6 years cannot be expected to have reached the concrete operational stage where they are able to conserve numbers and understand ideas such as more or less than or addition and subtraction. Unfortunately some teachers think that can teach children of 6 years the concept of numbers, measurement and logic. Children will not understand these concepts. Though there are exceptional children who are brought up in a 'rich' environment where their conceptual ability before they enter primary school is high. Even then the teacher must provide many experiences with manipulative materials to illustrate these ideas or concepts so that the child can grow with such ideas in his environment and can also provoke the desired logical process necessary for such concepts like conservation and invariance. The operational stage of development of children starts at about I 1 to 13 years. It is this stage the child can develop the concept of inclusion. The teacher noticing this concept will then start to teach addition in an effective manner through the use of concrete manipulative materials and examples.

As the child develops from say 5 to 7 years he should be taught with concrete materials and less work with mathematical symbols such as +, and -f As the child begins to have the idea of space and measurement, the teacher should give activities like drawing maps of various things or shapes so as to develop these concepts in them. Moreso their understanding of such concepts (spaces and measurement) may have been constructed in their mind at certain stages of development after many experiences with the physical world. The teacher can do a lot to build on these ideas already in children at this stage by locating them and structure his lesson in such a way as to bring out and explore these concepts to more sophisticated concepts. The teacher in planning his lesson should make provision for group activity, which encourages questions, and the interchange of ideas and emphasis should be place on co-operation rather than competition among the groups of children.

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