CHAPTER VII

SUMMARY, EDUCATIONAL IMPLICATIONS AND SUGGESTIONS

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Introduction

It is recently that the experimental attack on thinking began. The results have not been as fruitful as expected but we now know the type of road that the succeeding research workers on thinking have to traverse. Among the workers, the name of late Professor Jean Piaget is well known over the entire English speaking world. The late Prof. Jean Piaget (1896-1980) who, by his intensive research over the years right until death, wrote a large number of articles, papers, monographs and books and gave the world the famous "Piagetian Theory" epitomized in the "Geneva School" which explains the development of cognition qualitatively from birth till late adolescence. According to him, intelligence develops in four stages : Sensory motor (0-2 years), Pre-logical

(2-7 years), Concrete (7-11 years) and Formal (11-15 years). The first stage begins with the capacity for a few reflexes and ends when language and other symbolic ways of representing the world first appear. In the second stage, the child's thinking is dominated by his perception. In the third stage, though the thinking, to a large extent, resembles adult thought, child, however, fails to think abstractly or hypothetically. In the fourth stage, the thinking is highly sophisticated and it involves : Hypothetico-deductive operations, proportional logic and combinatorial systems. The ultimate equilibrium of intelligence is found in this stage, which develops during adolescence. Adolescence is regarded by Piaget as the most exhilarating and productive time of life. The development of abstract reasoning among adolescents is more urgent today than ever before, to help them tackle complex situations, man is confronted with at present. Abstract thinking is essential for learning as one is required to manipulate ideas and possibilities in the mind.

Though Educators rarely agree as to which content and forms of instruction are the best, there is however, one aspect of teaching where there is a remarkable degree of agreement among the present day educators. They believe that, "Problem Solving" has an important place in the learning. Problem solving is the frame work or the pattern within which thinking and reasoning takes place. It is the ability to think and reason at given levels of complexity. The study of

problem solving behaviour of the pupils having different intellectual abilities, in relation to the problems of different complexities in each discipline is an exciting challenge for educators and psychologists. It has been observed in the various studies that many a times, the comprehension of a problem and the procedures for its solution and testing are dependent on the mental ability such as logical thinking and the experience about the information of the problem. Further, it was observed that the students wrongly answered or were even unable to attack a given problem because of the fact that they start answering without comprehending the problem. The present study was undertaken with a view to investigate the acquisition of problem solving processes during adolescence and to identify adolescent thought with problem solving ability.

Past Work

Hardly any work in this area has been attempted in Nepal. The work in India is also of recent origin. However, works are available in Europe and U.S.A. All these studies that have direct relevance on the present study are those of : Heidbreder, E. (1928); Mumford, S.C.(1937); Kyle, T.(1950); Buswell (1956); Polya, G. (1957); Inhelder, B. and Piaget, J. (1958); Wheeler, D. (1958); Lovell, K. (1961); Mealings (1961); Beard, R.M. (1962); Case, R.D. (1964); Jackson, S. (1965); Burke, R.J., Maier, N.R.E., and Hoffman, L.R. (1966); Yudin,

L.W. (1966); Gunnels, F.G. (1967); Lewis, W.R. (1972); Lunzer, E.A.; Harrison, C. and Davey, M. (1972); Misra, R.M. (1973); Amos, G. (1974); Somerville, S.C. (1974); Karplus, E., Karplus, E. and Paulsen, A. (1975); Rajput, M.D. (1975); Graybill, L.A. (1975); Wonzy, C.D. and Cox, D.C. (1975); Vaidya, N. (1975); Morris, L.L. (1976); Klein, G.A. and Weitzenfeld, J. (1977); Dunlop, D.L. and Frank, F. (1977); Morin, Joseph, G. (1978); Sandhu, T.S. (1980); Mathur, M. (1981), Padmini, M.S. (1982); Jain, S.C. (1982). In the light of the study of above workers, it is difficult in making a single key statement of findings because of the diverse aims and objectives of the various studies undertaken, their models of sampling and the use of tests, tools and techniques. Each study have individual requirements too within its own context. However, the major trends in findings are summarised below which do provide a broad picture of problem solving spectrum.

(i) Adolescent's problem solving ability increases with chronological age and grade.

(ii) The past experience of the information of the problem plays an important role in solution of the problem.

(iii) The opinion is more or less divided on sex differences in problem solving.

(iv) The different school subjects demand varying amounts of formal thought.

(v) The significant relationships of the abstract reasoning tests and Piagetian tasks scores with problem solving

scores indicates that the experience with "reasoning patterns" is most essential for problem solving.

(vi) Normal adolescents operate at the concrete operational level in majority.

(vii) Adolescents are not necessarily in a position to test the stated hypotheses who are in a position to state hypotheses.

(viii) Problem solving, Piagetian tasks scores and I.Q. are found to be significantly related to each other.

(ix) It is possible to identify the concrete and formal operational pupils through cluster analysis.

(x) The formal operational children use more sufficient strategies for problem solving.

(xi) Significant relationship exists between the scores of total problem solving ability and each problem score.

Problem Restated

The problem was stated as :

"THE ACQUISITION OF PROBLEM SOLVING PROCESSES DURING ADOLESCENCE"

Aims and Objectives of the Study

The study entitled aims at achieving the following objectives :

1. To determine incidence of achievement in problem solving ability of adolescent pupils on certain predetermined key processes within the individual problems.

2. To determine the behaviour of error on certain predetermined key processes.

3. To determine the relationship between scores on problem solving processes and some outside variables like grade and sex.

4. To study the relationship between the scores of different problems.

5. To identify adolescent scheme of thought on certain predetermined processes of problem solving, using factor analysis.

6. To point out the main educational implications based upon findings of the study.

Hypotheses

The following hypotheses were proposed and tested :

1. Complex problem solving processes arise from simple problem solving processes.

2. Scores on problem solving do not increase with age and grade.

3. There are no significant differences in means from grade to grade.

4. There are no significant sex differences in problem solving.

5. Using constant difference, proportion, insight, summation, applying comparative difference and grasping the essence of the problem are not distinguishing characteristics of Piagetian Thought during adolescence.

Method of Procedure

Sample and Subject

The sample consisted of 400 students (200 boys and 200 girls) drawn randomly, out of a sample of 1200 students, from two urban secondary schools (co-education) of two districts (Kathmandu and Bhaktapur) of Nepal, belonging to 12.1 to 12.11, 13.1 to 13.11, 14.1 to 14.11, 15.1 to 15.11 and 16.1 to 16.11 years age levels studying in grade V, VI, VII, VIII and IX respectively. Each grade represented equal number of boys and girls. Both schools followed the same curriculum prescribed by the Ministry of Education and Culture, His Majesty's Government of Nepal and administered by concerned District Education Committee and District Education Office, H.M.G. of Nepal. The sample students drawn for this study had Nepali as their medium of instruction.

Tasks Used

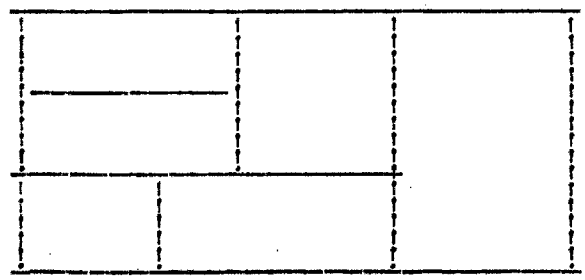
Out of eleven problems, the following seven problems comprising twenty nine processes were finally chosen by the investigator.

Table XIII

S. No.	Statement of the problem and the underlying processes	Code
I.	Problem No.1 : Height Problem	
1.	Process No.1 : What is the height of Mohan?	Pr.1
2.	Process No.2 : What is the height of Sohan?	Pr.2
3.	Process No.3 : What is the height of Shyam?	Pr.3
4.	Process No.4 : How much is Mohan shorter than Shyam?	Pr.4

S. No.	Statement of the problem and the underlying processes	Code
5.	Total score of Problem No.1	P_1
II.	Problem No.2 : Positive Constant Difference Problem	
6.	Process No.5 : 25 ?	Pr.5
7.	Process No.6 : ? 35	Pr.6
8.	Process No.7 : ? 40	Pr.7
9.	Process No.8 : 40 ?	Pr.8
10.	Process No.9 : ? 50	Pr.9
11.	Process No.10: 50 ?	Pr.10
12.	Total score of Problem No.2	P_2
III.	Problem No.3 : Time Problem	
13.	Process No.11: How much time will you take if you go on bicycle five times at more speed than the speed on foot?	Pr.11
14.	Process No.12: How much time will you take, if you go on bicycle from one town to the other and return to the same town?	Pr.12
15.	Total score of Problem No.3	P_3
IV.	Problem No.4 : Rectangle Problem	
16.	Process No.13: What is the total distance when the man goes once round the rectangle?	Pr.13
17.	Process No.14: What is the total distance when the man goes four times round the rectangle?	Pr.14
18.	Process No.15: How much time does he take for going once round the rectangle?	Pr.15
19.	Process No.16: Suppose he rests for a second at the end of each round. How much time does he take for completing just four rounds?	Pr.16
20.	Total score of Problem No.4	P_4

S. No.	Statement of the problem and the underlying processes		Code
V.	Problem No.5 :	Hotel Problem	
21.	Process No.17:	How much in all did they spend on Roties?	Pr.17
22.	Process No.18:	How much in all did they spend on vegetable plates?	Pr.18
23.	Process No.19:	How much in all did they spend on milk?	Pr.19
24.	Process No.20:	How much in all did they spend on tea?	Pr.20
25.	Process No.21:	How much did they spend per head?	Pr.21
26.	Process No.22:	How much did they spend in all?	Pr.22
27.	Process No.23:	How much additional money was demanded by the hotel manager?	Pr.23
28.	Total score of Problem No.5		P_5
VI.	Problem No.6 :	Questions Inviting Wrong Answer Problem	
29.	Process No.24:	A blind man with one eye can see up to a distance of 100 ft. How far can he see with two eyes?	Pr.24
30.	Process No.25:	It takes 10 minutes for a boy to reach his school. How much time will it take for ten boys if they start for the school at the same time?	Pr.25
31.	Process No.26:	A stick is 10 cm.long. It is cut by a cm. per minute. In how much time will it be cut into 1 cm. pieces?	Pr.26
32.	Process No.27:	Suppose a donkey has two horns. How many horns in all have eight donkeys?	Pr.27
33.	Process No.28:	A cow is standing beside a tree. A cord of 50 cm. is tied around her neck. Tell how far can she go for eating the grass?	Pr.28
34.	Total score of Problem No.6		P_6

S. No.	Statement of the problem and the underlying processes	Code
VII.	Problem No.7 : Counting Maximally Rectangles Problem	
35.	Process No.29: 	Pr.29
36.	Total score of all problems	P_L

The scheme of thought used for the problems are mentioned in the following table :

Table XIV

S.No.	Problems	Scheme of Thought
1.	Height Problem	- Using constant difference
2.	Positive constant Difference Problem	- Using constant difference
3.	Time Problem	- Using proportion
4.	Rectangle Problem	- a) Using constant difference b) Using summation c) Using proportion
5.	Hotel Problem	- a) Using summation b) Using proportion
6.	Questions Inviting Wrong Answer Problem	- *Failure to grasp the essence of the problem
7.	Counting Maximally Rectangle Problem	- Insight

* Reversible scoring for grasping the essence of the problem.

Administration of the Questionnaire

The questionnaire was administered to the sample in their respective classes. Instructions were read out loudly by the investigator along with the examples, and the subjects were asked to follow what is read in their questionnaire. They were asked to raise their hands if they had any difficulty to proceed. There was no time limit. Students were allowed to think as long as they required. To complete all the questionnaire, the time taken by students of grade V to IX ranged between 40 minutes and 1 hour 50 minutes. Generally less time was taken by higher grade students in comparison to lower grades.

Research Design and Analysis

In all, there were 38 variables whose data were computed from Statistical Package for the Social Sciences - 'Version 5.01 Computer' at Council for Social Development, 53 Lodi Estate, New Delhi-110003.

The Statistics computed were mean, standard deviation and 't' value sexwise and gradewise for all the variables for the whole sample as well as for sub samples to test the various hypotheses stated earlier. Similarly factor analysis (by principal component method-varimax rotation) was used to study the mathematical structure of the scheme of thought of problems.

Delimitation

The sample drawn was pupils of grade V to IX from two city schools of two districts of Nepal having Nepali medium and of average socio-economic group ranging within the age limits of 12^{+} to 16^{+} years.

Main Findings

The subsidiary findings being numerous, the main findings of the study indicated :

1. Mean scores on individual processes of thinking within any problem show an increasing trend with age and grade.

2. There is dip in means, within the over-all growth in some of the grades in the total score of problem No.2 (Positive constant difference problem : Using constant difference). Hump effect is suspected.

3. Mean scores on individual processes of thinking within any problem sexwise also show an increasing trend with age and grade.

4. Mean scores on all problems show an increasing trend with age and grade for the entire sample. This shows that the problems chosen for investigation are really speaking, development.

5. The performance, however, remains quite heterogeneous throughout the grade, not only for the individual problems but also across the problems as well grade-wise as well as for the entire sample.

6. On height problem (using constant difference) 52.8%, on positive constant difference problem (using positive constant difference), 91.5%, on time problem (using proportion) 36.1% of the total number of students (total sample) from grade V to IX attempted correctly.

7. Whereas on rectangle problem (using constant difference, summation and proportion) 9.2% on hotel problem (using summation and proportion) 46.5% on questions inviting wrong answer problem (failure to grasp the essence of the problem) 36.6% and on Counting maximally rectangle problem (Insight, partially to fully) 13.0% of the total number of subjects from grade V to IX attempted correctly.

8. Largest number of errors were confined on problem No. 4 rectangle problem whereas least number of errors on positive constant difference problem.

9. The mean score increases from grade V to VI and VIII to IX and their 't' values obtained are 4.56 and 2.67 respectively. Both of them are highly significant at .01 level. Mean score also increases from grade VI to VII and VII to VIII and their obtained 't' values are 0.4 and 1.33 which are not significant.

10. For all the boys and girls (N = 400), 't' value is 4.46 which is highly significant at .01 level. It shows that there is a sex difference on the total score of all the problems.

11. The mathematical structure of the variables selected for the present study using Axis method indicated the existence of the nine factors having eigen values greater than one. Using Scree test the last three factors were eliminated. The first six factors were

interpreted psychologically. The six factors are :

(i) Using Constant Difference (Positive)
(ii) Using Summation
(iii) Applying Flexible or Comparative Difference
(iv) Insight
(v) Proportional Reasoning
(vi) Grasping the Essence of the Problem

Educational Implications

It is very strange that a very highly abstract system of thought resulted in too few educational implications. Piagetian talked very little of his work from the view point of education of children and training of teachers. His total talk in fact comes out to be one-tenth percentage (1/10%) of his entire work. Even here he did not take any definite position except saying that children should be active in their own learning. Teaching means creative situations in which basic concepts can be discovered. It was left to the other workers to see sense in his work from the educational angle. It is a matter of surprise when one sees so many workers engaged in building up educational ideas in different parts of the world particularly speaking Switzerland, U.K., U.S.A., Canada. Works in Africa is also coming up.

It is not possible to point out specific educational implication arising out of the study. The reasons are first, it was not the aim of the study, secondly, the educational implication of Piaget's work are even now at the stage of conjecture. However, if diverse ideas are consolidated, the

following picture emerges.

1. He emphasizes the importance of activity in the growth of intelligence.

2. He explores in depth the growth of the child's thinking in relation to certain universals in the contents of human experiences such as the nature of the objects, space, time, motion, chance, causality, moral responsibility and social awareness.

3. He purposes that certain underlying pervasive logico-mathematical structures are found repeatedly in these diverse areas : Loes (Respect for the individual artisan), Paris (Pleasure of discussion), Athens (The Socratic method) and Eldorado (Both the teacher and the pupil participate in the processes of concept formation, application and discovery).

Within the context of this study, three educational implications appear :

1. It is possible to educate and train adolescent pupils through appropriate methodology in raising appropriate questions on problem sensitivity problem.

2. Through appropriate training, it should be possible to raise pupil's levels of thinking to higher levels as well.

3. It is the job of schools to promote efficient thinking among its pupils. Specifically speaking, it is possible to design short learning loops based upon scientific problems and concepts for pupils of average and below average ability.

The results obtained and the interpretation drawn in the present study may be utilised for the improvement of teaching. In the present study, the Piaget's theory was used as a basis for identifying and assessing student's ability to perform the specific logical operations inherent in understanding and problem solving. Such information should be of value to the teacher in diagnosing a student's learning difficulty and in providing assistance aimed at a specific kind of problem.

The other educational implications of the study may be described as follows :

(i) For effective classroom instructions, curriculum and the methods of teaching should be planned in such a way so that the structure of content is in accordance with the level of intellectual development of the students.

(ii) There are more chances of success in the problem solving if one follows the logical steps for problem solving.

(iii) For improving the problem solving ability among the different groups adolescents, they definitely need training in problem solving strategies.

(iv) Boys and girls should be segregated in the classroom on the basis of sex as there exists a definite evidence regarding the superiority of the boys over the girls. Girls should be given more freedom and recognition, so that they may avail equal opportunities required for the development of the problem solving ability.

Additional Problems for Further Research

The research on problem solving behaviour is a very complex phenomenon as the intellectual abilities influencing problem solving are not directly observable entities. Thus, the conclusion drawn remain purely hypothetical. Even then they give way for understanding of the trend of behaviour in problem-solving. No study is complete in itself. It raises further queries regarding the issues involved in the investigation. The present study also raises some issues. The following research studies may be undertaken for deeper understanding of the problem and reaching to an acceptable outcome.

(i) This study may be replicated on different populations the different grade students of other districts of Nepal.

(ii) To point out the reasons for failure in problem-solving. The possibility of the existence of 'hump effect' may be investigated.

(iii) A study may be conducted to see whether it is possible to enhance problem solving ability through training programmes. Experimental studies may be taken up to evaluate the effectiveness of such training programmes.

(iv) Sex-wise, separately for boys and girls, the factorial structures of all the variables can be analysed and interpreted psychologically.

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