CHAPTER II

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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 are documented below which have direct relevance for the problem under study.

Important Related Research Studies

Heidbreder E. (1928) in his title of study "Problem Solving in Children and Adults" found that reactions and sensitivity to problems increased from subjective attitude, to a more objective attitude. Whereas the general pattern of the solution became more explicit and definite, new rigidity set in with increasing age.

In the study 'Factors Involved in Problem Solving with Special Reference to the Problem of Insight' Mumford, S.C. (1937) noticed that if the thinking is regarded as a mental skill based upon innate capacity, their training, experience and practice influence thinking. Similarly school subjects also promote problem solving if properly approached.

In 1950, Kyle, T. studied "An Investigation of Thought Processes of a Group of 14-year olds During the Solving of a Scientific Problem" and found the following three indications :

(i) Able pupils do not solve problem in stages. In fact, they jump from stage to stage.

(ii) A problem becomes real for a person only when he has some rudimentary foresight of tentative solution.

(iii) A 'doing group' went further towards a solution than a 'thinking group'.

Buswell (1956) investigated patterns of thinking in solving problems. His study indicated : (i) The subjects experience difficulty in expressing concepts verbally which they had in fact acquired, (ii) They do not estimate the answers before they start solving problems; (iii) Their failure to distinguish between the relevant and irrelevant aspects of the problem attracts all sorts responses. Variety rather than similarity in the sequence of thinking was the most striking and outstanding characteristics even when common and uniform patterns of thinking were seen during the entire act of problem solving.

Polya, G. (1957), in his investigation "How to Solve it" found that the problem solving performance may be improved by making the children conscious of their thinking. 'Questions' and 'directions', apparently much like the

heuristic questions and suggestions to stimulate students for analyzing their own thinking are helpful in problem solving.

Inhelder, B. and Piaget, J. (1958) in their study "The Growth of Logical Thinking : From Childhood to Adolescence" concluded that (i) Concrete operational subjects can describe the results of their experiments but fail to hold other factors constant, (ii) Formal operational subjects attempt to prove something through control experiments, (iii) Considering experimentation elsewhere, they hypothesized setting and testing behaviour does not become highly rampat.

Wheeler, D. (1958) in his "Studies in the Development of Reasoning in School Children" found that Contradicts Piaget, he concluded that elementary schemata are very much there even among young children. It is their subsequent development which describes the difference in performance between the young.

Lovell, K. (1961) confirms Piaget in principle in his investigation "A Follow-up Study of Inhelder and Piaget's 'The Growth of Logical Thinking'. It was found that the pupil's of low academic ability fail to develop formal operations even past their mid-adolescence.

Mealings (1961) investigated some aspects of problem solving in science. He concluded the following : (i) Problem solving in science is more related to intelligence

than to chronological age, (ii) There appears to be a minimum mental age of 13 years before a child can reason formally about a problem, (iii) Children should not be expected to solve abstract problems below the mental age of 16 plus, (iv) There is a time lag between the emperical solution and formal solution.

Beard, R.N. (1962), in his study of children's reasoning found that the level of logical thinking among adolescent varied extensively between schools. He noticed vast individual differences in levels of thinking among adolescent pupils studying in different schools. Previous classroom experience appeared to play an important part in the ability to control variables.

In 1962 Case, R.D. and Collinson J.M. observed in their study 'The Development of Formal Thinking in Comprehension' that scores on formal thought varied even when the children were matched on CA and MA but were drawn from different cultural background.

Vaidya, N. (1964) in his title "A Study of Problem Solving in Science Among Certain Groups of Adolescent Children", using questionnaire approach (N = 60) as well as interview approach (N = 31), found adolescent boys of two schools in central London, (i) solving a given problem over a wide I.Q. range not only within a given age group but also across the various age groups, (ii) Though adolescent pupils

are in a position to state hypotheses most of them are not in a position to test them, (iii) They do not, contrary to Piaget, exhaust all possibilities.

Jackson, S. (1965) investigating in the growth of logical thinking in Normal and Sub-normal children found that about half of the 15-year olds do atain the formal operational stage.

Burke, R.J., Maier, N.R.F., and Hoffman, L.R.(1966) while investigating the functions of hints in individual problem solving, it was concluded that (i) hints stop the ongoing direction of thinking, (ii) hints serve as a stimulant for the correct direction or the solution, (iii) hints are absorbed or modified by the ongoing direction, (iv) hints can set up false direction, or (v) hints remain in the background as a point of orientation whenever unsuccessful directions are abondoned.

Yudin, L.W. (1966) in the study 'Formal Thought in Adolescence as a Function of Intelligent' concluded that even adolescent pupils of average intelligence, contrary to Piaget, show concrete thinking behaviour as defined by Piaget. Added age is an important factor in the development of formal thought.

Gunnels, F.G. (1967) in a study of the development in logical judgement in science of successful and unsuccessful problem solvers in grades four through nine found that use of formal reasoning in problem solving of science is dependent

on age, mental age, and grade. Stage concept in thought develops sequentially is confirmed.

Lewis, W.R. (1972) in an investigation of the influence of age, sex and school size upon the development of formal operational thought noticed that formal thinking is highly dependent on age rather than any other variable.

In a study of the four card problem and the generality of formal reasoning Lunzer, E.A., Harrison, C. and Davey, M. (1972) found that whereas familiarity with the problem influences performance, the incidence of formal operations is quite low in the general population.

Misra, R.M. (1973) investigated the role of hypotheses in problem solving among grade X students. His study indicated that there is no sex difference between the top group and the bottom group on the number of hypotheses emitted by them. It was also found that problems were solved over a wide I.Q.

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Amos, G. (1974) studied 'Problem Solving Processes of Creative and Non-creative Students'. Three problems one concrete and two abstract were administered to two groups of low and high creative college students. The overall comparisons of the matrices showed significant difference between the high creative and the low creative for each of the three problems.

Somerville, S.C. (1974) administered Inhelder and Piaget's (1958) pendulum problem on a sample of 236 ten to

fourteen year olds individually. The author concludes that the development of formal thought is strongly dependent on age rather than sex and even the type of school.

Karplus, E., Karplus, E. and Paulsen, A. (1975) gave both proportional reasoning problems and controlling variables problems to 13- and 15- year olds in seven countries. About three fourths of the subjects definitely fail to develop formal thought on problems relating to proportional reasoning and control of variables. The scores on the two problems were not found related to each other over the entire population. These findings parallel those of Lovell (1961) for schools within England.

Rajput, M.D. (1975), in his investigation "A Study of the Scheme of Proportion Among Certain Groups of Adolescent Pupils" found (i) no significant sex difference were noticed on the scheme of proportion, (ii) fluctuations in performance were noticed from lower grade to the higher grades of course with dominating increasing trend with age.

Graybill, L.A. (1975) studied "Sex Differences in Problem Solving Ability" and indicated sex differences favouring boys in formal thinking were noticed.

Wonzy, C.D. and Cox, D.C. (1975) in his study, "The Effect of Task Differences on the Assessment of formal Operational Thiking" found that age definitely interacted with the number of variables. A problem becomes more difficult for the adolescent pupils to solve if more variables

are injected into it.

Vaidya, N. (1975) studied, "The Growth of Logical Thinking in Science During Adolescence" on a sample of 100 boys and 100 girls studying in grades VI to X matched on intelligence and socio-economic-status. Seventeen different problems were administered on them for solving. The main findings of this study are : (i) Average performance on each problem increases with grade except for occasional fluctuations. In most of the cases boys are favoured rather than girls in mean performance. However, as they move into higher grades, they try hard to equalise their performance; (ii) Both within and across the various grades, a given problem is solved successfully (or failed) over a wide I.Q. range; (iii) A given problem is solved in stages; (iv) While engage in problem solving, pupils commit a large number of errors; (v) The complex problem solving processes arise from simple thinking processes; (vi) Contrary to Piaget's view, adolescent pupils are affected by the content of the problem than the nature of the problem; (vii) Adolescent pupils are not in a position, contrary to Piaget, to test hypotheses, whereas they are in a position to set up hypotheses which shows that their minds have not yet become experimental; (viii) The top group differed from the bottom group on all five measures of adjustment, understanding of the problem and all the seventeen schemes of thought.

Morris, L.L.(1976) in a study of "An Information Processing Examination of skill Assembly in Problem Solving and Development Using Wertheiner's Area of a Parallelogram Problem", a series of progressively directive prompts were employed for students who did not immediately solve the problem. Five solvers solved the problem without prompting. Seven assisted solvers needed feedback about the initial incorrectness of solution attempts, but did not require a prompt designed to suggest transformation of the figure. Twelve prompted solvers were unable to solve without transformation prompts. Once prompted, however, all students solved the problem and also a similar immediate retention task.

Klein, G.A. and Weitzenfeld, J. (1977), in their study "General Description of Human Problem Solving", problem solving is defined as two simultaneous processes : The generation and evaluation of alternatives that will accomplish what is needed, and the reidentification of what is needed on the basis of the experience of generating and evaluating the alternatives. It is concluded that this approach integrates inferential activities, long term memory, and the management of a limited capacity operational memory into a general account of problem solving.

Dunlop, D.L. and Frank, F. (1977), in their investigation "A Comparison of Student Performance and Actual Performance in Problem Solving Tasks within a Piagetian

Setting", 116 science students between the ages of 15 and 22 were administered on 18-item abstract preference survey and three different problems. There was a similarity in performances of males and females. On 'fossils' and 'electrical circuit' problems, the shift of preference was from a concrete mode to an abstract mode. On the 'balance' problem the shift of preference was from abstract to concrete.

Morin, Joseph, G. (1978) studied 'The Relationship between Students' Intellectual Development and Their Ability to Solve Problems Requiring Formal Thinking Abilities". Fifty two high school science children, were administered a paper and pencil 'Piagetian tasks' type instrument and the subjects were classified in early concrete, concrete, early formal and formal level. Two chemical concentration problems which were based on the formal thinking abilities were administered. Overall results indicated that formal subjects performed better on the concentration tests than early formal subjects, early formal subjects performed better than concrete subjects and concrete subjects performed better than the early concrete subjects.

Sandhu, T.S. (1980) in a doctoral study, on the "Factorial Study of Adolescent Thought" investigated adolescent thinking processes and found (i) Performance on Piaget type tasks increases with age; (ii) Boys perform either equal or better than girls on the tasks at respective age levels; (iii) Significant correlation exists between intelligence and

the adolescent thought and between academic achievement and adolescent thought.

Mathur, M. (1981) investigated the 'Growth of Experimental Mind During Adolescence' on a sample of 120 students of class VI through class XI of D.M.P.H. School, Regional College of Education, Ajmer. She found that with occassional fluctuations on certain tasks, performance on Piaget type tasks show an increasing trend with grade. It was also found that the capacity to grasp the essence of the problem increases with grade.

Padmini, M.S. (1982) investigated in a doctoral study, on the "The Growth of Exclusion of Variables During Adolescence". She found (i) In all grades adolescent pupils are in a position to state and test hypotheses. However, with occasional fluctuations, the mean performance increases with grades; (ii) Many adolescents are still found to operate at the concrete level; (iii) The fourteen year olds are the successful problem solvers in majority and the majority of the unsuccessful problem solvers are the ten year olds.

Jain, S.C. (1982) in a doctoral study on "A Study of the Problem Solving Behaviour in Physics Among Certain Groups of Adolescent Pupils" investigated adolescent problem solving behaviour in physics and found (i) out of 180 students only 36 percent are at formal level, 46 percent are at post-concrete level and 18 percent are still at concrete level; (ii) After

providing hints, a large number of initially non-problem solver students solve most of the problems; (iii) Among the three groups differing in creativity, no significant difference for problem solving ability scores was observed; (iv) Significant relationship exists between the scores of total problem solving ability and the each problem score; (v) Among the groups differing in I.Q., creativity and level of intellectual development, no sex differences were noticed.

There are other studies as well which have indirect bearing on this problem because they investigate different aspects of formal reasoning.

Summary of the Findings

There are many factors which actually intervene the nature of the problem solving processes during adolescence : the nature of the adolescent, the nature of the problem, socio-economic status and attitude towards the problem solving.

In the light of what has been said above, it is difficult in making a single key statement of findings because of the diverse aims and objectives of the various studies undertaken, their modes 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.

1. Adolescent's problem solving ability increases with chronological age and grade.

2. The past experience of the information of the problem plays an important role in solution of the problem.

3. The opinion is more or less divided on sex differences in problem solving.

4. The different school subjects demand varying amounts of formal thought.

5. 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.

6. Normal adolescents operate at the concrete operational level in majority.

7. Adolescents are not necessarily in a position to test the stated hypotheses who are in a position to state hypotheses.

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

9. It is possible to identify the concrete and formal operational pupils through cluster analysis.

10. The formal operational children use more sufficient strategies for problem solving.

11. Significant relationship exists between the scores of total problem solving ability and the each problem score.

Distinguishing Features of the Present Study

The following are the distinguishing features of the present study.

1. It attempts to investigate scheme of thought through the acquisition of problem solving processes during adolescence.

2. In Nepalese context, no study along these lines has been undertaken.

3. It draws a large size of sample (N = 400) for obtaining meaningful results.

4. It draws a gradewise homogenous sample of the same age group 12^{+} - 16^{+} years of different classes.

5. The data are subjected to highly advanced mathematical analysis called factor analysis which attempts not only to test the mathematical structures of the tasks used but also to test an hypothesis whether the various problem solving processes logically derived problem really belong to the same or similar problems or not.