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A STUDY OF ACHIEVEMENT IN CHEMISTRY OF STUDENTS OF XI STANDARD IN RELATION TO PROBLEM SOLVING STRATEGY

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Defining Problem Solving Skills

Problem solving shifts to represent a complex mental activity consisting of a variety of cognitive skills and actions. Problem solving includes higher order thinking skills such as "visualization, association, abstraction, comprehension, manipulation, reasoning, analysis, synthesis, generalization—each needing to be 'managed' and 'coordinated" (Garofalo & Lester, 1985, p. 169). General Problem Solving Models of the 1960's. During the 1960s and 70s, researchers developed general Problem solving models to explain Problem solving processes (Newell & Simon, 1972; Polya, 1957; Bransford & Stein, 1984). The assumption was made that by learning abstract (decontextualized) Problem solving skills, one could transfer these skills to any situation (context). One example of this general problem-solving model is Bransford's IDEAL model:

1) Identify the problem
2) Define the Problem through thinking about it and sorting out the relevant information
3) Explore solutions through looking at alternatives, brainstorming, and checking out different points of view
4) Act on the strategies
5) Look back and evaluate the effects of your activity

This model is similar to many of the general Problem solving models that were common then and that are still used with many general Problem solving courses found in academic and corporate training settings. These are stand-alone courses, which teach problem solving as a "content-free" thinking skill, not integrated with the rest of the curriculum or work environment.

In schools, these models were one source of the "Inquiry" curriculum movement, which in turn led to "new" curricula such as "new math."

Characteristics of difficult problems

As elucidated by Dietrich Dörner and later expanded upon by Joachim Funke, difficult problems have some typical characteristics that can be summarized as follows:

- In transparency (lack of clarity of the situation)
- commencement opacity
- continuation opacity
- Polytely (multiple goals)
- inexpressiveness
- opposition
- transience
- Complexity (large numbers of items, interrelations, and decisions) enumerability
- connectivity (hierarchy relation, communication relation, allocation relation)
- heterogeneity
- Dynamics (time considerations)
- temporal constraints
- temporal sensitivity
- phase effects
- dynamic unpredictability

The resolution of difficult problems requires a direct attack on each of these characteristics that are encountered.

Problem-solving strategies

Divide and conquer: break down large, complex Problem into smaller, solvable problems Hill-climbing strategy, (or - rephrased - gradient descent/ascent, difference reduction) - attempting at every step to move closer to the goal situation. The Problem with this approach is that many challenges require that you seem to move away from the goal state in order to clearly see the solution.

Means end analysis, more effective than hill-climbing, requires the setting of sub goals based on the process of getting from the initial state to the goal state when solving a problem.

- Working backwards
- Trial-and-error
- Brainstorming
- Morphological analysis
- Method of focal objects
- Lateral thinking
- George Pólya gives the following outlines

Research: what others have written about the Problem (and related problems).
Assumption reversals (writes down your assumptions about the problem, and then reverse them all).

Analogy: assess if a similar Problem (possibly in a different field) has been solved before Hypothesis testing: assuming a possible explanation to the Problem and trying to prove the assumption.

Constraint examination: are you assuming a constraint which doesn't really exist Incubation: input the details of a Problem in to your mind, then stop focusing on it. The subconscious mind will continue to work on the problem, and the solution might just "pop up" while you are doing something else Build (or write) one or more abstract models of the Problem Try to prove that the Problem cannot be solved. Where the proof breaks down can be your starting point for resolving it

Get help from friends or online Problem solving community (e.g. 3form) delegation: delegating the Problem to others?

Root Cause Analysis: Finding out basic data and relationship underlying the problem.

Current Problem Solving Models

Cognitive research done in the last 20 years has led to a different model of problem solving. Today we know Problem solving includes a complex set of cognitive, behavioral, and attitudinal components. In 1983, Mayer defined Problem solving as a multiple step process where the Problem solver must find relationships between past experiences (schema) and the Problem at hand and then act upon a solution. Mayer suggested three characteristics of Problem solving:

1) Problem solving is cognitive but is inferred from behavior.
2) Problem solving results in behavior that leads to a solution.
3) Problem solving is a process that involves manipulation of or operations on previous knowledge (Funkhouser and Dennis, 1992).

This model identifies a basic sequence of three cognitive activities in Problem solving:

- Representing the Problem includes calling up the appropriate context knowledge, and identifying the goal and the relevant starting conditions for the problem.
- Solution search includes refining the goal and developing a plan of action to reach the goal.
- Implementing the Solution includes executing the plan of action and evaluating the results.

Significance of the study

It is a basic skill needed by today's learners. Guided by recent research in Problem solving, changing professional standards, new workplace demands, and recent changes in learning theory, educators and trainers are revising curricula to include integrated learning environments which encourage learners to use higher order thinking skills, and in particular, Problem solving skills. As education has come under criticism from many sectors, educators have looked for ways to reform teaching, learning, and the curriculum. Many have argued that the divorce of content from application has adversely affected our educational system (Hiebert, 1996). Learners often learn facts and rote procedures with few ties to the context and application of knowledge.

Problem solving has become the means to rejoin content and application in a learning environment for basic skills as well as their application in various contexts.

Reasoning occurs when the individual is confronted with a problem. By a problem we understand a situation for which the individual has no ready-made response. The ability to solve problems requires some degree of independence, judgements, originality and creativity. Of course, it may be easy to imitate the solution of a problem when solving a closely similar problem. Yet there is a deep seated human desire for more; for some device, free of limitations that could solve all problems. This desire may remain obscure in many of us, but it becomes manifest in a few false tails and in the writings of a few philosophers

Title of the study

A Study of Achievement in Chemistry of Students of Xii Standard In Relation To Problem Solving Strategy

Definition

Problem solving has been defined as higher-order cognitive process that requires the modulation and control of more routine or fundamental skills (Goldstein & Levin, 1987).

- Problem -solving is the processes involved in the solution of a problem.
- Strategy is a set of operations or rules that govern the individual to solve a problem.

Objectives of the Study

1. To study the effectiveness of problem solving ability upon Chemistry at Higher secondary level.
2. To find out the extent of Achievement in Chemistry of the students of Standard XI.
3. To introduce problem solving strategies among students.

Hypotheses

1. There will be no significant difference in the mean scores for achievement in Chemistry in the pre-test between control group and experimental group.
2. There will be no significant difference in the mean scores in achievement in between the pre-test and Post-test for the control group.
3. There will be no significant difference in the mean scores Achievement in Chemistry between the pre-test and Post-test for the experimental group
4. There will be no significant difference in the mean scores in Achievement in Chemistry for the Post-test between control group and experimental group.
5. Gap closures in experimental groups will be greater than those in control group.

Population and Sample for the Study

The sample for the study consists of 180 students studying in Government Schools, The sample is random sampling.. The following table furnishes the details.

Table 3.2 Distribution of the final sample in the control and experimental groups of the study

Name of the School	Control group	Experimental group	Total
G.H..S.S	30	30	60

Experimental Design

Considering the major objectives of the study and pre conditions of experimental research designs, the investigator has adopted the quasi-experimental design for the present study.

Tools Used in the Study

The investigator has developed or adopted the following tools to generate the data for the present study.

1. CAI-software evaluation Performa.
2. Criterion Referenced Test (CRT)

Criterion Referenced Test

Criterion Referenced Test is defined as a test that has been designed with very restricted content specifications to serve a limited range of highly specific purposes (Aiken, 1998). The aim of the test is to determine where the examinee stands with respect to certain educational objectives.

Method of Experimental Study

Analysis and Interpretation

Hypothesis 1 There will be no significant difference between experimental group and control group in the pre-test performance in Achievement in Chemistry.

Table 4.1 Pre-Test Performance Control Group and Experimental Group

Group	N	Mean	SD	"t" value	Significance
Control	30	35.81	9.13	0.68	NS
Experimental	30	34.17	9.66		

df=58 $t_{(0.05)} = 1.96$ $t_{(0.01)} = 2.58$

Hypothesis 2 There will be no significant difference between pre-test and post test performance for control group in Achievement in Chemistry.

Table 4.2 Pre-Test /Post–Test Performance for Control Group

Type	N	Mean	SD	"t" value	Significance
Pre	30	35.81	9.13	1.40	NS
Post	30	39.16	9.49		

df= 58 $t_{(0.05)} = 1.96$ $t_{(0.01)} = 2.58$

There is no significant difference between pre-test and post test performance for control group in Achievement in Chemistry.

Hypothesis 3: There will be no significant difference between pre-test and post test performance of experimental group in Achievement in Chemistry.

Table 4.3 Pre-Test / Post – Test Performance for Experimental Group

Type	N	Mean	SD	"t" value	Significance
Pre	30	34.17	9.66	4.00	S
Post	30	43.86	9.13		

df=58 $t_{(0.05)} = 1.96$ $t_{(0.01)} = 2.58$

Hypothesis 4 There will be no significant difference between experimental group and control group in the post-test performance in Achievement in Chemistry.

Table 4.4 Post-Test Performance Control Group and Experimental Group

Group	N	Mean	SD	"t" value	Significance
Control	30	39.16	9.49	2.79	S
Experimental	30	43.86	9.13		

df=58 $t_{(0.05)} = 1.96$ $t_{(0.01)} = 2.58$

Interpretation

This is an experimental study with pretest post test equivalent group design. Entry behaviour test was conducted to separate control and experimental group to assess the prerequisite knowledge Both the groups are identical and this indicates the nature of identicalness in tune with the pre-test mean scores of both groups. All the pre-test 't' value for control and experimental reveal no significant difference among control and experimental groups. This establishes their identical nature and no significant achievement in their pre-requisite knowledge.

The means of pre-test scores and post-test scores of control as well as experimental groups differ significantly (0.01 level) with the post test mean being greater than the pretest mean. The implication of that is that the level of acquiring of the basic skills in Chemistry has increased due to traditional method in control group and **Programmed Learning Method** in experimental group.

The post test scores of control and experimental group differ significantly. The means score of experimental group is greater than of control group.

Instrumentation

For the purpose of evaluating pupil's performance in this study the following tools were developed and validated.

1. Problem solving strategies
2. Achievement Test in grammar

The content and the items of the above tools were subject to validation. Experts established the content validity. Item validity was made employing discriminative and difficulty indices. Reliability of the test was established by rational equivalent method.

Findings

There was significant difference between experimental group and control group in the pre-test performance in Achievement in Chemistry.

There was significant difference between pre-test and post test performance for control group in Achievement in Chemistry.

There was significant difference between pre-test and post test performance of experimental group in Achievement in Chemistry.

There was significant difference between experimental group and control group in the post-test performance in Achievement in Chemistry.

Gap closure in the experimental group was greater than that of the control group.

Suggestions

Principles for Teaching Problem Solving

This new understanding of Problem solving leads to a number of important principles for teaching Problem solving. Instructors can apply these principles in classroom. They form the basis of Problem -solving instruction in the PLATO system. Here is a summary of these principles:

1) For any "real-world" job or work skill, identify both the declarative and procedural knowledge components. Give each appropriate instructional emphasis.
2) First introduce a Problem solving context, then either alternate between teaching declarative and procedural knowledge, or integrate the two.
3) When teaching declarative knowledge, emphasize mental models appropriate to the Problem solving to come, by explaining knowledge structures and asking learners to predict what will happen or explain why something happened.
4) Emphasize moderately- and ill-structured Problem solving when far transfer is a goal of instruction.
5) Teach Problem solving skills in the context in which they will be used. Use authentic problems in explanations, practice and assessments, with scenario-based simulations, games and projects. Do not teach Problem solving as an independent, abstract, decontextualized skill.
6) Use direct (deductive) teaching strategies for declarative knowledge and well structured Problem solving.
7) Use inductive teaching strategies to encourage synthesis of mental models and for moderately and ill-structured Problem solving.
8) Within a Problem exercise, help the learners understand (or define) the goal, then help them to break it down into intermediate goals.
9) Use the errors learners make in Problem solving as evidence of is conceptions, not just carelessness or random guessing. If possible, determine the probable misconception and correct it.

10) Ask questions and make suggestions about strategy to encourage learners to reflect on the Problem solving strategies they use. Do this either before or after the learner takes action. (This is sometimes called cognitive coaching).
11) Give practice of similar Problem solving strategies across multiple contexts to encourage Generalization
12) Ask questions which encourage the learner to encourage the learner to grasp the generalizable part of the skill, across many similar problems in different contexts.
13) Use contexts, problems and teaching styles which will build interest, motivation, confidence, persistence and knowledge about self, and reduce anxiey.
14) Plan a series of lessons which grow in sophistication from novice-level to expert-level understanding of the knowledge structures used.
15) When teaching well-structured Problem solving, allow learners to retrieve it (e.g., from a reference card). If the procedure is frequently used, encourage memorization of the procedure and practice until it is automatic.
16) When teaching moderately-structured Problem solving, encourage the learners to use their declarative (context) knowledge to invent a strategy which suits the context and the problem. Allow many "right" strategies to reach the solution, and compare them for efficiency and effectiveness.
17) When teaching ill-structured Problem solving, encourage the learners to use their declarative (context) knowledge to define the goal (properties of an acceptable solution), then invent a solution. Allow many "right" strategies and solutions, and compare them for efficiency and effectiveness.