



Development of Strategies for Teaching School Science by Using Heuristic Method

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Abstract

This paper is based on the UGC (University Grants Commission, India) Minor Research Project submitted in 2008. The main purpose of this project was to develop strategies for teaching school science by using heuristic method. Initially a suitable topic from Science textbook was identified and a rough strategy was prepared based on H.E. Armstrong's (1888-1928) approach of heuristic teaching. It was implemented on a purposive sample of 15 VII standard students and 15 VIII standard students (in two separate batches) who are having deviation I.Q. more than 129 in Group Test of Intelligence for Children by Dr. R.K.Tondon and are high achievers in Science i.e. more than 75% marks in previous examination. Those students were selected from a renowned coaching class in Kolhapur city (India) so that the students from (at least five) different high schools could be selected at a single place. During the implementation of the rough strategy the performance of the students was observed by teacher trainees in 1:1 ratio. After the qualitative analysis of the observations made and discussions with the experts in the field two new strategies were developed and implemented on two new batches of students, one of VII standard students and the second of VIII standard students selected on the same criteria as in the implementation of rough strategy. Those two batches of the students were selected from a single high school in Kolhapur city so that effectiveness of the strategies in a normal school environment could be generalised. Again the performance of the students was observed by the same teacher trainees in 1:1 ratio. From the analysis of the observations it was found that strategies are effective for teaching school science by using heuristic method.

1. Introduction

Heuristic method of teaching science was proposed by H. E. Armstrong (1888-1928) Professor of Chemistry in the Central Technical College, City of Guilds of London Institute. In the words of Prof. Armstrong, 'heuristic Method is a method of teaching which involves our placing the students as far as possible in the attitude of a discoverer'. It has been pointed out that object of Heuristic method is to make pupil more accurate and truthful observant, thoughtful and independent problem solver and confident decision maker. Heuristic Method intends to train the pupil in scientific enquiry and develop skills of observation, analysis and interpretation and to develop the scientific temper of mind.

Polya(1975) in his book 'How to solve it?' presents a four part heuristics for solving problems. In the model developed by Palincsar and Brown (1984) the teacher demonstrates or models a cognitive process explaining at the same time what he or she is doing and why he or she is doing it. The Discovery learning project at the College of Natural Science University of Texas at Austin(1999) is predicated on the belief that all students have creative ability which can be further developed utilizing the techniques of inquiry based learning. This project promotes the use of inquiry based methods of teaching and learning. Guided Discovery learning encourages participation of the class members. It is based on the supposition that people learn more through 'hearing and doing' together than through simply hearing [8].

2. Procedure of the development of strategies

The main purpose of this study was to develop strategies for teaching school science by using heuristic method. The strategies were developed in following steps.

2.1 Step I: Identification of the Topics

The investigator identified two topics, one from the text book of VIII standard and one from the text book of IX standard.



2.2 Step II : Preparation of Rough Strategy

The investigator prepared rough strategy based on H.E. Armstrong's approach of heuristic teaching..

2.3 Step III : Implementation of the Rough Strategy

The investigator implemented the prepared strategy on 15 students from VII standard and 15 students from VIII standard in separate batches. Those students were selected on the following criteria i) They are having Deviation I. Q. above 129 on the Group Test of Intelligence for Children prepared and standardized by Dr. R. K. Tondon ii) They are high achievers in science i. e. achieving above 75% marks as reported by their science teacher. Those students were selected from a renowned coaching class in Kolhapur city (India) so that the students from (at least five) different high schools could be selected at a single place. One observer (B. Sc. Degree holder studying in B. Ed. Course) was kept near one student and he had to note observations of student's performance in a given observation schedule.

2.4 Step IV : Analysis and Discussions

The investigator then analyzed qualitatively, the observations made by the observers. It was found that there are some problems to the students in heuristic learning. The observations and findings were discussed with the observers and experts in the field of science education.

2.5 Step V : Modification in the Strategy

Based on the analysis of the observations made and discussions with the experts in the field two new strategies were developed.

2.6 Step VI : Implementation of the Modified Strategy

The modified strategies were implemented on two new batches of students, one of VII standard students and the second of VIII standard students selected on the same criteria as in the implementation of rough strategy. Those two batches of the students were selected from a single high school in Kolhapur city so that effectiveness of the strategies in a normal school environment could be generalized .Same observers (as in step[III]) noted the observations of student's performance while the strategy was being implemented.It was found that the strategies used were effective

2.7 Step VII : Analysis, Discussion and Preparation of the Final Draft

Based on the analysis of the observations made by the observers in step VI and discussions with them, final draft of two strategies for teaching school science by using heuristic method were developed.

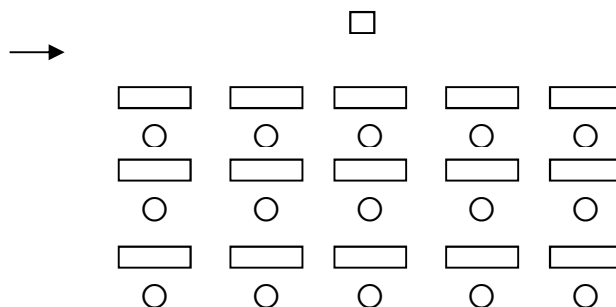
3. Final Draft of the Strategies

Strategy No.1: Independent Performance Strategy for Teaching School Science by using Heuristic Method

Seating Arrangement

□ Teacher ○ Student

Number of Students: Not more than 15





Phase I: Introduction

Time: 10 minutes

Teacher's Activity

He explains the process of heuristic teaching and learning. He tries to create the confidence in the students that they can solve the problem independently. He provides answer papers to the students, states the problem and tells the students to note down the problem in the answer paper.

Student's Activity

He listens carefully and notes down the statement of the problem on the answer paper.

Phase II: Skill Development

Time: As per the requirement

Teacher's Activity

He identifies and develops the skills required for performing the experiment or activity. (provided that related concepts have been taught previously)

For example in case of the problem - 'To find out the relation between the volume of water (or any liquid) displaced by a body fully immersed in it and volume of the body.'

The skills required on the part of the student are -

1. Measuring the volume of the metal cube.

Sub Skills

(i) Measuring the length of the cube (ii) Measuring the breadth of the cube (iii) Measuring the thickness of the cube (iv) Calculating the volume of the cube

2. Filling the overflow vessel with water up to the spout.

3. Immersing the metal cube in the water.

4. Measuring the volume of water with the help of the measuring cylinder.

Student's Activity

He develops the required skills in himself under the guidance of the teacher.

Phase III: Restating the Problem

Time: 2-3 minutes

Teacher's Activity

He restates the problem, clears doubts if any.

Student's Activity

He listens carefully.

Phase IV: Students formulate the steps of the experiment/activity independently

Time: As per the requirement

Teacher's Activity

He asks the students to formulate the steps of the experiment/activity by their own, tries to build confidence in the students that after having the required skills they definitely can find out the solution to the problem.

Student's Activity

He formulates independently the steps of the experiment/activity to be performed for problem solving.

Phase V: Teacher checks the steps formulated by the student

Time: As per the requirement

Teacher's Activity

He checks the steps formulated by the students. If they are correct, he allows the student to perform the experiment/activity. If there are minor mistakes, teacher can correct them and go to the next phase. (However, if there are major mistakes, the strategy No. 2 should be used here onwards i.e. at this phase there should be a shift from strategy No. 1 to Strategy No. 2 Phase IV, which involves use of instruction cards.)



Phase VI: Students perform the experiment/activity by their own and solve the problem independently

Time: As per the requirement

Teacher's Activity

He asks the students to perform the experiment/activity independently according to the steps formulated by them in Phase IV. He supervises the class.

Student's Activity

Student performs the experiment or activity by their own and try to find out the solution independently.

Phase VII: Teacher tells the solution and discuss

Time: As per the requirement

Teacher's Activity

He tells solution and discusses the practical aspect of the problem. He asks students doubts if any, takes feedback, checks whether all the students could find the solution. He explains the need and techniques to be adopted for accuracy in observation, action, calculation and interpretation while performing scientific experiments. He helps in solving the problem to those students who could not perform successfully. Individual guidance is provided.

Student's Activity

He listens carefully, asks doubts, and shares experiences.

Strategy No.2: Instruction Cards Strategy for Teaching School Science by using Heuristic Method

Seating Arrangement - Same as in Strategy No. 1

Phase I: Introduction - Same as in Phase I of Strategy No. 1

Phase II: Skill Development - Same as in Phase II of Strategy No. 1

Phase III: Restating the Problem - Same as in Phase III of Strategy No. 1

Phase IV: Providing the Instruction Cards to the students

Time: 10 minutes

Teacher's Activity

He provides the instruction cards to the students on which the steps of the experiment/activity are printed serially. Students have to read these cards one by one and perform the experiment. He explains the use of the cards in solving the problem.

Student's Activity

Student listens and tries to understand the use of instruction cards.

Phase V: Students perform experiment/activity by using Instruction Cards and solve the problem independently

Time : As per the requirement

Teacher's Activity

He asks students to perform the experiment/activity by using instruction cards. He supervises the student's activity, does not interfere, provides minimum help wherever necessary.

Student's Activity

He performs experiment/activity by using instruction cards and solves the problem, he asks his doubts to teacher, takes minimum help wherever necessary.

Phase VI: Teacher tells the solution and discuss

Time: As per the requirement

Same as in Phase IV of Strategy No. 1



4. Concluding Remarks

Thus investigator could successfully develop two strategies i. e. 'Independent Performance Strategy' and 'Instruction Card Strategy.' These two strategies can be used for the students studying in V to XII standards. The teachers may identify the topics from the textbooks and also from other sources and organize heuristic teaching once in a week or they can organize one-day or two-days workshops. Such workshops may be organized once in a month.

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