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Effect of Problem solving teaching strategy on 8th Grade students' attitude towards Science

Mushtaq Ahmad Malik (Corresponding author)

Vice Principal Islamabad Model School for Boys, Islamabad Pakistan.

mamalik27@yahoo.com

Zubair Ahmad Shah

Senior Subject Specialist (Education) Chak #49 NB, Tehsil and District Sargodha, Pakistan.

zashah101@yahoo.com

Zafar Iqbal

Ph. D. Scholar Department of Education, National University of Modern Languages, Islamabad

Muhammad Rauf

Lecturer, Institute of Education and Research, University of the Peshawar, Pakistan

rauf_ier@hotmail.com

Abstract

The study was conducted to explore, 'The effects of problem solving teaching strategies on 8th grade students' attitudes toward science'. Pre-test, post-test design was selected for this study. Experimental group was exposed to problem solving teaching strategies, while the control group was instructed using traditional teaching methods. The study was conducted with 60 students 30 in each experimental and control group at a public high school at Islamabad the federal capital of Pakistan. A scale regarding attitude towards science learning (A*t*SL) with Cronbach's alpha 0.86 was administered to the students of both experimental and control groups. Data obtained was analyzed using t test. The findings indicated that student in experimental group made positive improvement in attitude towards science learning as compared to students in control group. Hence, it is recommended that science teachers' may incorporate problem solving teaching strategies in their teaching to improve students' attitude towards science. Key words: problem solving, attitude towards science learning *(AtSL)*

1. Introduction

In this century, one can not conceive to live with out scientific gadgets. A handsome knowledge of science is necessary to lead a better life. Like developed countries imparting scientific knowledge is among the major objectives of education in Pakistani curricula especially at elementary level (Govt. of Pakistan, 2006). Achieving objectives of science education completely and fully have never been possible in any country and so is the situation in Pakistan. As Mattern and Schau, (2002) described the situation, "In developed countries, it has been determined that goals of science are never fully realized, that students do not like science lectures and that most have no preference for science". Though scientific concepts are functioning in daily life but these are difficult and complex in nature. In learning these concepts, students' attitude and interests could play a substantial role among pupils studying science (Normah & Salleh, 2006). Students can succeed in science subject if they have attitude towards science (Erdemir, 2009). In science education, "The affective outcomes of instruction are as important as the cognitive outcomes. The affective

domain is characterized by a variety of constructs, such as attitudes, preferences, and interests. But negative attitude toward a given subject leads to a lack of interest and avoidance of the subject" (Nurulazam, Rohandi, & Jusoh, 2010). It means, a positive attitude toward science will leads to a positive commitment to science that will effect students' lifelong interest and learning in science.

According to Salta & Tzougraki, (2004), "Attitude is a tendency to think, feel, and act positively or negatively toward objects in our environment". Attitude organizes thoughts, emotions and behaviors towards a psychological object. Some attitudes are based on people's own experiences, knowledge and skills, and some are gained from other sources (Erdemir, 2009). It can be concluded in words of Craker (2006) that attitudes are learned, not inherited.

The attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure, the learning environment, and teaching method" (Craker, 2006). It can be said that a negative attitude towards a certain subject makes learning or future-learning difficult. As conceived by Nurulazam, Rohandi, & Jusoh, (2010), "A positive attitude toward science leads to a positive commitment to science that influences students' lifelong interest and learning in science". But once the attitudes are formed they are long lasting and difficult to change (Ajzen & Fishbein, 1980).

Almost all researchers agreed that for science education one of the critical problems is the negative attitude towards science (Ramsden, 1998), so to overcome this problem, study of attitude towards science and science learning should be conducted. The importance and role of attitude towards science can be recognized from the researches' findings showing positive relationship of attitude towards science and achievement, and students with more positive attitude towards science has sustainable learning, and also want to continue with those subjects they enjoy (Pell & Jarvis, 2001). Students' attitude towards science at secondary and elementary schools were extensively studied by Frazer and Walberg (1981); Ramsden (1998); Morrell and Lederman (1998); Myers and Fouts (1992) either by quantitative or qualitative method. These researchers provided revealing insight regarding attitude towards science and most of them have reported positive attitude of students towards science (Osborne, Simon, & Collins, 2003).

Acquiring attitudes especially towards science is possible with student-centered education (Dede, 2006). In this regard, detection of students' attitudes can have a contribution to make interests and curiosity lively and increase the success of students. Studies have revealed that teaching methods influence on students' attitudes towards science (Adesoji, 2008; Gok and Sılay, 2008; Erdemir, 2009). On the other hand attitudes, whether positive or negative, affect learning in science. Teaching methods in science education influences attitudes and also predict achievement (Siegel, & Ranney, 2003; Erdemir, 2009). However, a positive attitude toward science can be developed through hands-on activities and other methods of instruction that excite students and encourage them to learn like problem solving teaching strategies. Gök, & Sılay (2010) were of the view that "One of the fundamental achievements of education is to enable students to use their knowledge in problem solving".

Problem-solving involves knowing what to do in the situation of not knowing what to do. Problem-solving is a process which covers a wide range of mental abilities. Students should realize what and why they are doing, and know the strengths of these strategies, in order to understand the strategies completely and be able to select appropriate ones (Telli, Brok, Tekkaya, & Cakiroglu, (2009). In the words of Erdemir, (2009), "Problem-solving also involves a student's willingness to accept challenges. Accepting a challenge in this context means that the student is willing to find appropriate methods to solve a problem". Normah and Salleh (2006) discovered that students who can successfully solve a problem possess good reading skills, have the ability to compare and contrast various cases, can identify important aspects of a problem, can estimate and create analogies and attempt trying various strategies. It can be concluded in the words of Hetherington and Parke (1999), "Problem solving involves a higher level of information processing than the other functions and mobilizes perception, attention and memory in a concerted effort to reach a higher gaol".

Woolfolk (2004) describes problem solving process with two arguments; general problem solving related to general areas and domain specific problem solving unique to some specific area such as maths or science etc. People, with respect to the situation and level of their expertise, move between general and domain specific approaches. On acquiring more domain knowledge, the general strategies are used less and problem solving becomes more domain specific. Portolés and López (2008) concluded that problem solving is a situational and context bound process that depends on the deep structures of knowledge and experience".

Many surveys indicate that most of students are not able enough in acquiring knowledge independently and in the application of this knowledge to solve everyday life problems (Csapo &Korom, 1998 in Molnar, 2003). In the process of teaching problem solving is suitable approach to involve students in higher order thinking operations like analysis, synthesis and evaluation (Kyurshunov, 2005). Erdemir, (2009) indicated "Many researchers argue that teaching methods have a great impact on students' attitude to learn a subject". That's why it is opted to find out the effects of problem solving teaching on students' attitude towards science learning because students will not be able to learn science concepts properly with out having suitable level of attitude towards science. Sherman, Richardson & Yard, (2009) suggested a problem solving strategy to use in classroom setting, described in detail as follows:

1. Establishing a context for interest incorporating problem solving in lessons.
2. Teaching a variety of heuristics e.g. organizing data in tables make drawings or diagrams, working back toward solutions may be helpful in solving the problems. The similar solutions can be applied to new problems.
3. Starting with simple problems make it easy for students to solve the next problem quickly as their confidence is raised.
4. Reward students for small successful steps as small words of praise again and again and giving positive comments are like rewards for students. On the other hand during the problem solving process suggestions or hints can also help the students.
5. Record of used tactics for problem solving in a journal way may be compiled with the help of students.
6. Provide sufficient time to solve problem
7. Guide the students in simplifying numbers given in the problem.
8. Help students to reduce reading difficulties

This strategy helps the teacher to develop attitude towards science among the students. Gok and Sılay (2008) worked on the effects of directive and non-directive problem-solving on attitudes and achievement of students in a developmental science course; the result was that attitude becomes more positive after instruction.

Pakistan, being a developing country, has always focused on science education in every educational policy. Science subject is compulsory only till 8th grade, while from 9th grade, enrollment in science subjects is not compulsory. Unfortunately educational researchers focused less on science education and only a few research studies are available that explore the attitude towards science and effect of problem solving teaching on Pakistani students. This study is aimed to explore effect of problem solving teaching strategy on students' attitudes towards science leanings in Pakistani perspective because Machina and Gokhley (2009) were of the view that "maintaining the levels of positive attitude towards science in early years is easier than transforming the negative attitude to positive attitude in the following years".

1.1 Statement of the Problem

Positive attitude towards science and science learning not only has strong positive relationship with achievement but also help students to make his career in science. In developing positive attitude, teaching methods are more effective than any thing else. The study aimed to find out the effect of problem solving teaching on students' attitude towards science learning.

It was hypothesized that "There is no significant difference among the gain score of the students of experimental and control group on attitude towards science learning scale".

2. Method

The study was experimental in nature and pre-test post-test design was found suitable. From the accessible population of 150 students 60 students were selected randomly. These students were arranged in descending order on the basis of their previous exam scores. Then two groups each of 30 students were formulated selecting students alternatively from the list. One group was taken randomly as control group and the other was taken as experimental group. Both the groups were administered attitude towards science learning scale as pre-test. Then the experimental group was treated with problem solving strategy in the subject of general science and the other group was taught traditionally. To teach the experimental group through problem solving strategy, lesson plans for each unit were developed according to problem solving teaching method. Exemplary lesson plans are given in the appendix. Larger units were divided into two or three parts, as per the 40 minutes duration of class period. Different problematic situations were developed for students to solve in the class or for home work keeping in view the requirement of content and level of students. Afterwards solutions were discussed in the class.

This experiment was carried out for approximately 06 months. The long duration treatment was given for the better change in attitude of the students. At the end of the experiment, both experimental and control groups were again administered attitude towards science learning scale as post-test.

2.1 Research Instrument

Attitude towards science learning scale was used for this study. Much research has attempted to measure attitudes at different grade levels in schools especially towards science and science learning (Weinburgh (1995); Remin, Raymonan, Susan and Hanexia (1998); TOSRA by Frazer (1982); Krogh & Thomsen (2005); Salta & Tzougraki (2004); and Parkinso, Hendley, Tanner and Stables (1998)). Research instruments reported in these papers were developed in their own perspectives to measure attitude qualitatively or quantitatively. Blalock et al (2008) were of the view that most of the research instruments measuring attitude towards science during 1935-2005 lack adequate psychometric properties.

So an attitude towards science learning in national language was developed and pilot tested. Exploratory Factor Analysis was used to identify subscales within the instrument and the internal consistency of each scale (Cronbach alpha value) was found. Following the trial, a set of 23 statements (18 positive and 5 negative statements) were selected. They seemed to fall into 4 subscales detail is given in table 1.

2.2 Data Analysis

Data were analyzed after taking gain score of the students subtracting pre-test score from post-test scores using SPSS software. The t-test was applied to find out the difference between the mean scores on the gain scores.

3. Results

There was significant difference between the mean gain scores of the experimental group and control group and the hypothesis that “there is no significant difference between the mean gain scores of the students of experimental and control groups” was rejected as the t-value is 2.278 which is significant at $\alpha = 0.05$. The mean gain score of students of experimental group (4.3) is higher than the mean gain score of students of control group (2.33). The difference between the means shows that attitude of students of experimental group who were treated with problem solving teaching strategy improved more than the attitude of students of control group (Table 2).

4. Conclusion and Discussion

The results of the study showed that attitude of students of experimental group treated with problem solving teaching strategy improved more than students of control group who were taught through

traditional methods. It means that the problem solving teaching strategy is better teaching strategy to enhance the students' attitude towards science learning. The findings of the studies Adesoji (2008), Akınoğlu and Tandoğan (2007), and Akay and Boz (2008) also favour the findings of this study as they also concluded that students in the experimental group developed more positive attitude towards science subjects after the treatment of problem solving teaching. On the basis of the results of this study and others it is recommended that the science teachers may incorporate the problem solving teaching strategy during teaching science to improve the attitude of the students towards science learning so that students may be able to work better in the field of science.

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Table 1: Psychometric Properties of the Attitude Scale

Factor*	**Statement Number in the scale**	**Cronbach Alpha**	**Example of item**
1- Enthusiasm in science learning	1,3,6,7,8,11,12, *5,10*	0.75	I can focus on the science topics during the class.
2- Feeling pleasure	2,9,13,15,24	0.73	I really enjoy science lessons.
3- Teacher interaction	14,17,18,20,21	0.65	Whenever I need to know any thing about science, I consult my teacher
4- Disliking science subject	16,19,22,23	0.63	Science lessons are boring to me.
Cronbach alpha for the whole scale		0.86	

* Rotation method – Varimax with Kaiser Normalization

* Rotation converged in 8 iterations.

Table 2

Showing mean score standard deviation and t-value for experimental and control groups

Groups	N	Mean gain score	Std. Deviation	Std. Error Mean	t	*df*	Sig.
Control Group	30	2.33	12.3	2.25	2.278	58	0.026*
Experimental Group	30	4.3	10.14	1.85			

Significant at $p < 0.05$

Appendix

PROBLEM SOLVING LESSON PLAN

GENERAL SCIENCE (8TH GRADE)

UNIT 3

1. **Lesson Plan Title** Liquid Pressure
2. **Subject** Science
3. **Grade Level** 8th
4. **Teaching Method** Problem Solving

The lesson will be completed with in two periods each of 35 minutes

5. **General Objectives**

After the lesson the students will be able to:

i. Develop problem solving ability and higher order thinking
ii. Solve different scientific problems / situations
iii. Evaluate the solution of any problem
iv. Reason about the correct solution of a problem.

6. Specific Objectives

Students will be able to:

i. Describe the term 'pressure in liquids'
ii. Explain the phenomena of 'pressure at varying depth'.
iii. State the properties of 'liquid pressure'.

7. Required Materials

i. A tin with holes at different heights
ii. A tin with holes at equal depth level.
iii. A U-shape tube with a valve in the middle and two funnels

8. Step-By-Step Procedure

a. Brain Storming (10 minutes)

Teacher will ask the following questions to make students think about the problem and lesson i.e.

i. You might have read behind the heavy vehicles (trucks etc) "pressure breaks, keep distance" why it is written?
ii. Which is heavier and why, an empty bucket or bucket full of water?
iii. If you take out a cup of water from bucket full of water. No hole occurs in water, why?

b. Presentation of the problem (05 minutes)

Teacher will put the following problem before the students regarding liquid pressure.

c. Problem:

Ashfaq went to his friend, there he used wash room. He noticed that water coming from the tap was with good pressure. He thought why water pressure of tap in my house is not good? How can you explain him this phenomena.

d. Appropriate context knowledge (20 minutes)

After noting down the different solutions (reasons) given by the students, teacher will announce that today's topic is 'Liquid Pressure' and discuss the contents with the students (given on the page no 85-86 of the science textbook) which include following topics:

a. Pressure in liquids
b. Pressure in liquids varies with depth.
c. Water keeps its own surface level.
d. Liquid exerts pressure in all directions.

Teacher will help the students to understand the concepts. Teacher will encourage the students to ask questions to understand the text.

Time for the following steps 'e' to 'i' is 15 minutes

e. Identifying the goal

After fifteen minuets, the teacher will ask the students that what the problem which they are to solve is.

f. Relevant starting conditions for the problem

Following activities given in the content will be arranged for the students to understand the liquid pressure, its properties and find the solution of the problem.

a. Activity about "pressure varies with depth".
b. Activity about "water keeps its own level".
c. Activity about "liquids exert pressure in all directions".

g. Solution search

Solution search will include the discussion among the students to analyze the appropriateness of every solution presented by the students in which the whole class will take part and one solution will be taken as the best solution based on the content knowledge.

h. Developing a plan of action to reach the goal

Teacher will ask the students to state the liquid pressure and its properties in their own words.

i. Implementing the Solution

In this step, teacher will ask the students to analyze the selected solution and check its suitability.

j. Evaluate the result (10 minutes)

At the end, the teacher will ask the students to consider, whether the solution upon which they agreed is correct.

Time for the steps 8 and 9 is 10 minutes

8. Assessment Based On Objectives

For assessment of the students' comprehension teacher will ask the questions like:

i. Why liquid exerts pressure?
ii. What are the properties of liquid pressure?

iii. Explain through an activity that water exerts equal pressure in all directions.

9. Home work

For the extension purpose, and for the possible connections to other subjects**,** teacher will assign the home work to the students. Write an example in your notebooks from your daily life other than given in the textbook, that water exerts pressure in all directions. (You can discuss with your parents and relatives about this).