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Effect of student teams achievement divisions (STAD) method on problem solving ability in relation to critical thinking

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Abstract
The purpose of the present paper was to investigate the effect of Student Teams Achievement Divisions (STAD) method on Problem Solving Ability in relation to Critical Thinking. A Sample of 180 (90 Experimental group and 90 Control group) students of 11th class was taken from Government Senior secondary Schools of Ludhiana district of Punjab. The experimental group was taught through Student Teams Achievement Divisions Method for a period of 30 sessions at the rate of 60 minutes per day. On the other hand, control group was taught the same concepts with the help of traditional method for the same period of time at the same rate. Mixed Type Group Test of Intelligence by Mehrotra (2008) was used to match the groups. Problem Solving Ability test by Dubey (2008) and Critical Thinking Scale (developed and standardized by the investigator) was used as tools for data collection. 2X2 ANOVA design was used in the study. The results of the study showed that Problem Solving Ability of the experimental group who taught through STAD was significantly higher than as compared to the control group who taught through traditional teaching method. Further, the critical thinking has a significant effect on the problem solving ability of the students. Significant Interaction was also found between treatment and critical thinking on the problem solving ability.

Keywords: Critical Thinking, Problem Solving Ability, Student Teams Achievement Divisions (STAD) Method, Government Senior Secondary School

1. Introduction

Nowadays, society becomes very much complex with the piles of everyday- increasing knowledge and information. It is very difficult for the individuals dealing with ever increasing information or diverse resources of information and adapt themselves in the society and works for the progress and development of the nation. It requires high levels of intellectual and rational skills such as problem solving ability, decision making power, reflection, analysis, arguments, synthesis, evaluation and Critical Thinking. It is Very much necessary that these skills should be inculcated in the students from the very beginning of their schooling. For this purpose Indian school system must be undergo for some major reforms. These reforms should include a shift from the didactic approach to a student centered or more interactive teaching strategies, besides that we also need some reforms in the school curriculum. The school curriculum must be replace its emphasis of acquisition of factual knowledge to emphasis on process oriented curriculum that teach the students how to learn, how to organized the facts, analysis of the information, evaluate the facts and learn how to solve problems. Such reforms should include the concepts like cooperative learning and metacognitive strategies in pre-service as well as service training programs. Those strategies help to improve the whole teaching learning process in the Indian classrooms to encourage students' curiosity, imagination, reasoning, logical thinking, Problem Solving Ability and Critical Thinking, to make them vigorous, dynamic, creative and active learner and as a result make learning more purposeful and meaningful (Gupta and Pasrija, 2012) [6]. So one of the greatest and the inevitable challenges that the modern educators face today is determining the most effective teaching strategies for their students. Understanding and assessing student involvement in learning can help teachers design the most effective curriculum and determine how student's best learn. In addition, instructors must consider which skills will be most practical for students entering a workforce where building relationships and productivity go hand-in-hand. To meet the demand, many educators are using active learning pedagogies, such as cooperative or team-based learning (Menges and Weimer, 1996) [12]. Because those students who learn through an active learning approach not only learn better, but also enjoy much more from the learning experience. According to Payne and Whittaker (2000) [16] one of the most important strategies for activating the students in the learning process is employing the "study groups" in the class and also providing an opportunity for discussion, exchange of views, and question and answer. It seems that making the students active through a cooperative approach will be executed better, for in this way better opportunity will provide for students to discuss and exchange their views with one another and help to develop higher order thinking such as reasoning, logical thinking, Critical Thinking and problem solving ability.

The review of related literature supports the idea that the use of cooperative learning methods fosters active learning, promotes higher-order thinking and Problem Solving Ability among students. Cooperative learning method Student Teams Achievement Divisions has been widely recommended and used in a variety of ways in teaching of different subjects in foreign countries. As compared to foreign countries very less research work has been done in India Pandey and Kishore

(2002) [15]; Gupta (2004) [7]; Thakur (2006) [21]; Thomas (2007) [22]; Kagathara (2009) [11]; Pushpanjali and Satyaprakasha (2010) [18]; Dahiya M. (2011) [3]; Santosh (2012) [19]; work on cooperative learning, but all these studies are conducted out sides the Panjab. Only one study by Singh (2014) conducted on Panjab secondary school students with cooperative learning method i.e. Jigsaw. No such study has been conducted on the senior secondary school students of Punjab state with student teams achievement divisions cooperative learning method. Thus the proposed study seems fully justified and indispensable as it investigates the effect of (STAD) method of achievement in economics and Problem Solving Ability in relation to Critical Thinking of XI class school students in the state of Punjab. Therefore, the present study was conducted with the following objectives.

2. Objectives of the Study

1. To study the significance of difference in Problem Solving Ability of the groups taught through Student Teams Achievement Divisions method and traditional teaching method.
2. To study the significance of difference in Problem Solving Ability of the groups having high and low Critical Thinking.
3. To study the first order interaction between teaching method and Critical Thinking on Problem Solving Ability.

Hypotheses

$H_0$1: There exists no significant difference in the mean gain scores on the Problem Solving Ability of the groups taught through Student Teams Achievement Divisions method and traditional method.

$H_0$2: There exists no significant difference in the mean gain scores on the Problem Solving Ability of the groups having high and low Critical Thinking.

$H_0$3: There exists no significant interaction between the teaching methods and Critical Thinking on Problem Solving Ability.

Sample

The population of the study was 11th class students studying in P.S.E.B affiliated schools of Ludhiana district of Punjab. Due to the experimental nature of the study, Sample was confined to only two Govt. Senior Secondary Schools, which were selected randomly from the available list through lottery method. The sample comprised of 180 economics students of 11th class for experimentation. So, following the instructions of the school two intact sections of 11th class were taken; randomly one was selected as the experimental group and another as a control group and the same procedure was followed in the second school for the selection of sample.

Measure

In the present study Mixed Type Group Test of Intelligence by Mehrotra (2008) [13], Critical Thinking Scale (developed and standardized by the investigator) and Problem Solving Ability test by Dubey (2008) [4] was employed by the investigator to collect the data.

Procedure

The sample was selected from two Govt. Senior Secondary Schools (affiliated to PSEB) of District Ludhiana. The Random sampling technique was employed to select the sample school. Then the permission was taken from the principals of the school for conducting the experiment. In the first step, the sample was divided into two groups randomly. One group was termed as the experimental group and the other as the control group. Critical Thinking scale and Problem Solving Ability Test were administered to both the groups (N=180 students) as pre-test. Then the experimental group was taught economics through Student Teams Achievement Divisions Method (with modules prepared by researcher) for a period of 30 sessions at the rate of 60 minutes per day. On the other hand, control group was taught the same concepts with the help of traditional method for the same period at the same rate. After completion of the treatment both groups were administered Problem Solving Ability test as post-test.

3. Results and Discussion

Analysis Related with Matching of Groups

The two groups, that is, experimental group and control group were formed randomly. Therefore, matching on the extraneous variables is ensured. To confirm it, experimental group and control group were matched on the variables of problem solving ability, Critical Thinking and intelligence.

Table 1: Showing t-ratio between mean values of the groups taught through Student Teams Achievement Divisions (STAD) Method and Traditional Teaching Method on Problem Solving Ability, Critical Thinking and Intelligence as Pre-Test.

Variable	Student Teams Achievement Divisions Method Group	Traditional Teaching Method Group	t-ratio
Problem Solving Ability	Mean = 5.04 SD = 1.63 N = 90	Mean =5.16 SD = 1.74 N = 90	0.251NS
Critical Thinking	Mean = 118.87 SD = 6.66 N = 90	Mean =118.17 SD = 10.28 N = 90	1.29NS
Intelligence	Mean = 52.85 SD = 3.16 N = 90	Mean = 52.51 SD = 4.67 N = 90	0.593NS

NS Not significant at 0.05 level of significance

It is evident from the table 1 that mean scores of the groups taught through Student Teams Achievement Divisions (STAD) Method and traditional teaching method in Problem Solving Ability are 5.04 and 5.16 respectively and standard

deviations for the same are 1.63 and 1.74 respectively. The value of t-ratio came out to be .251 which is insignificant showing no significant difference in Problem Solving Ability of both the groups.

It is also evident from the table 1 that the mean scores of the groups taught through Student Teams Achievement Divisions (STAD) Method and traditional teaching method in Critical Thinking are 118.87 and 118.17 respectively and standard deviations for the same are 6.66 and 10.28 respectively. The value of t-ratio came out to be 1.29 which is insignificant showing no significant difference in Critical Thinking of both the groups.

Further table 1 also reveals that the mean scores of the groups taught through Student Teams Achievement Divisions (STAD) Method and traditional teaching method in intelligence are 52.85 and 52.16 respectively, and standard deviations for the same are 3.16 and 4.67 respectively. The value of t-ratio came out to be .593 which is insignificant showing no significant difference in intelligence of both the groups.

From the above discussion, it can be concluded that there are no significant difference in the groups taught through Student Teams Achievement Divisions (STAD) Method and traditional teaching method on the variables of Problem solving ability, Critical Thinking and intelligence. Hence, both the groups can be treated as equivalent groups.

2x2 analysis of variance related with gain scores on the Problem Solving Ability in relation to teaching strategy and Critical Thinking was carried out. The summary of the results is given in the table 2.

Table 2: Summary of 2 X 2 Analysis of Variance on Gain Scores on the Problem Solving Ability in Relation to Teaching Strategy and Critical Thinking

Source of Variation	SS	d_f	MSS	F-Value
Main Effects				
A: Teaching Strategy	324.00	1	324.00	102.59**
B: Critical Thinking	57.76	1	57.76	18.29**
First Order Interaction				
A X B (Teaching Strategy x Critical Thinking)	16.00	1	16.00	5.07*
Within Group (Error)	303.20	96	3.16	
Total	700.96	99		

**Significant at 0.01 level of Confidence * Significant at 0.05 level of Confidence.

F_{table} (1, 96) at 0.01 and 0.05 level of significance is 6.87 and 3.93 respectively.

Main Effect A

Main effect of Teaching Strategy (Student Teams Achievement Divisions Method and Traditional Teaching Method) on the variable of Problem Solving Ability

It is evident from the table 2 that the F-ratio for the difference between mean gain scores on the Problem Solving Ability of the groups taught through Student Teams Achievement Division Method and Traditional Teaching Method came out to be 102.59 which is significant at the 0.01 level of confidence. It means that both the groups were significantly different on the gain scores on the variable of problem solving ability. Hence, the null hypothesis Ho 1 stating that there exists no significant difference in the mean gain scores on the Problem Solving Ability of groups taught through Student Teams Achievement Divisions Method and Traditional Method is rejected. Further, the means of the group who taught through Student Teams Achievement Division Method (Mean=6.32) was significantly higher than the group who taught through traditional teaching method (Mean =2.72) on the variable Problem Solving Ability. It may be inferred that the mean gain scores of groups taught through Student Teams Achievement Divisions Method and Traditional Teaching Method may not be considered equal and are different beyond the contribution of chance. Thus, it may be concluded that the STAD cooperative learning method was significantly better than the traditional method of teaching.

The above result has been found to be supported by Heller, Keith and Anderson (1992) [8] in their study, they were found that better problem solutions emerged through cooperation than were achieved by individuals working alone. Similarly Barham (2002) [2] proved that there was a positive impact of applying such strategies in enhancing mathematical achievement and promoting problem solving skills compared with the impact made by traditional teaching strategies. Aluko and Olorundare (2007) [1] found that there was a significant difference in the performance of chemistry students exposed to cooperative instructional Strategy, individualistic instructional strategy and conventional teaching method. Supardi and Zukarnain (2015) [20] found that there is a difference in terms of students' ability of mathematics communication to whom were given cooperative learning model type STAD with type TPS.

Main Effect B

Main effect of Critical Thinking (High and Low) on the variable of Problem Solving Ability

It is also evident from the table 2 that the F-ratio for the difference between mean gain scores on the Problem Solving Ability of the groups having high and low Critical Thinking came out to be 18.29 which is significant at the 0.01 level of confidence. It means that both the groups were significantly different on the gain scores on the variable of problem solving ability. Hence, the null hypothesis Ho 2 stating that there exists no significant difference in the mean gain scores on the problem solving ability of groups having high critical thinking and low critical thinking is rejected. Further, the means of the group who has high level critical thinking (Mean=5.28) was significantly higher than the group who has low level critical thinking (Mean=3.76) on the variable problem solving ability. It may be inferred that the mean gain scores of the groups having high critical thinking and low critical thinking may not be considered equal and are different beyond the contribution of chance. Thus, it may be concluded that the critical thinking has a significant effect on

the problem solving ability of the students.

The above result has been found to be supported by Johnstone (2006) [9] found that the students' problem-solving ability improved over time, which suggests that the Critical Thinking exercises were effective. Friedel, Rhoades, Irani, Gallo and Fuhrman (2008) [5] found correlations were significant, but low and indicated that Critical Thinking and problem-solving may be more independent than previously thought. Khoo, Abdul and Naser (2011) found a significant difference between AE level ($F(2, 65) = 8.534$, $p < .05$) and TE ($F(2,223) = 4.320$, $p < .05$) at the level of critical thinking mean score. Similarly Özyurt (2015) [14] also found a significant relationship between the critical thinking dispositions and the problem solving skills of students.

Interaction Effect (A X B)

First order interaction effect of Teaching Strategy and Critical Thinking on the variable of Problem Solving Ability

Further table 2 reveals that the F-ratio for the difference in mean gain scores on the Problem Solving Ability of students due to interaction between Teaching Strategy and Critical Thinking Levels came out to be 5.07 which is significant at 0.05 level of confidence. The results show that different groups scored different mean gain scores on the Problem Solving Ability for two types of instructional treatments and Critical Thinking. It means that gain scores due to interaction of treatment strategy yielded different mean gain scores for students with High critical thinking and low critical thinking. Hence, the null hypothesis Ho 3 stating that there exists no significant interaction between teaching method and critical thinking on the variable of problem solving ability is rejected.

4. Discussion

In the present study the group of students who exposed to Student Teams Achievement Division cooperative learning Method were found to be enhance their Problem Solving Ability in comparison to those students who are exposed to the traditional teaching method. Critical thinking has a significant effect on the problem solving ability of the students. Significant Interaction was also found between treatment and Critical Thinking on the problem solving ability. Thus the results of the study highlight the positive effect of STAD cooperative learning method on the Problem Solving Ability of the students and critical thinking also has a significant relationship with problem solving ability.

This may be due to the fact that Student Teams Achievement Division cooperative learning method provides enough opportunities for all the learners with different abilities to cooperate, participate, and interact with each other in classroom situations and thus motivated them to take part actively in the learning activity. This gave them a chance to work together, express their thoughts, listen others point view on a particular problem, discuss the ideas with others and find out the alternative ways of solving problems. Therefore, Student Teams Achievement Division Method is a method of active learning where students are engaged in some activity, interact with each other and work for the achievement of the common goal. In tradition method students have been expected to learn how to solve problems by looking at the way teacher solve the problem on the blackboard. Instead, in this method (STAD) the learners are actively involved in the learning, tackles problems in groups, express their point of with freedom, try to understand the concept in-depth and construct their own knowledge which further help the students to enhance their higher order cognitive skills such as, logical reasoning, inference, reasoning, analysis and problem solving ability.

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