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EFFECTIVENESS OF INFORMATION GATHERING OF CRITICAL THINKING SKILLS AND GUIDED DISCOVERY METHOD IN PHYSICS AT SECONDARY LEVEL

DR. NITHYA PREM S.R., Post Doctoral Fellow (ICSSR) Department of Education, University of Kerala, Thiruvananthapuram

Abstract- Critical thinking skills are the process of skillfully conceptualizing, self regulating, clear, rational and evaluating information to arrive at a conclusion. It is disciplined thinking that is open-minded, and evidence supported. The study focuses on developing information gathering the sub skill of Critical thinking skills in physics at secondary level. The study is concerned with finding out the effectiveness of Guided discovery method is effective for developing information gathering the sub skill of Critical thinking skills in physics at secondary level. Samples of 66 students were selected for the study. Findings from this study revealed that there is significant difference between the control and experimental groups with respect to the post test scores for information gathering the sub skill of Critical thinking skills in physics at secondary level. It finds that Guided discovery method is effective for developing information gathering the sub skill of Critical thinking skills in physics at secondary level.

Key words: Guided discovery method, Information gathering, Critical thinking skills

I. INTRODUCTION

Modern educational systems provide science education through actual scientific activities, experimentation and organization of firsthand knowledge obtained through experimentation. Inquiry approaches in teaching science facilitate the acquisition of science process skills by providing adequate opportunity to enrich understanding of science and develop student abilities. When students focus on the processes of inquiry, they develop the ability to ask questions, define problems, investigate the world around them and use their observations to construct reasonable explanations for the problem (Krulik and Rudnick, 1996).

Good thinkers can become good learners and good learners can become good problem-solvers. If our thinking process is in accordance with the scientific method of problem solving, will be able to find out ways to answer our questions about the world. This involves a number of independent variables influencing student learning.

The social movements now shaping the world were not imagined by the best minds of a generation ago.Critical thinking is logical thinking sequences that requires pupils to be reflective, and pay attention to decision-making which lead their values and actions. Critical thinking allows pupils to deduct with more logic, to process intricate information and look at diverse sides of an issue so they can produce more concrete conclusions. Critical thinking is challenging approach to knowledge and gathers wisdom. It incorporates ideas and facts from an empirical position and then questioning new ideas in view of values, attitudes and experiential philosophy.

According to Stupple, E. J. N et.al (2017) The Critical Thinking Toolkit is a substitute measure that examines student beliefs and attitudes about critical thinking. According to Reynolds (2011), The list of core Critical thinking skills includes observation, interpretation, analysis, inference, evaluation, explanation, and meta cognition an individual or group engaged in a strong way of critical thinking gives due consideration to establish for instance. Ennis(2015), Critical thinking is that the intellectually disciplined method of actively and assuredly conceptualizing, applying, analyzing, synthesizing, and/or evaluating data gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

Objective of the study

To find out the effectiveness of guided discovery method in Physics *'Information Gathering',* the sub skill of critical thinking skills among students at secondary level.

sHypothesis

Guided discovery method in Physics is effective for developing *'Information Gathering',* the sub skill of critical thinking skills among students at secondary level.

II. METHODOLOGY

The present study*"*Guided discovery method is effective for developing*'Information Gathering',* the sub skill of critical thinking skills in physics at secondary level*"* was intended as a quasi-experimental study and normative survey was adopted. Pretest-posttest Non Equivalent Group Design was opted for the experimental part of the study. The sample was selected from different secondary schools of Kerala. Stratified random sampling was selected for the study. The experimental study was conducted on a sample of 66 students studying in the secondary schools of Kerala. *Information Gathering',* the sub skill of critical thinking skills Test in Physics at secondary level students of Kerala, developed by the investigator was the tools used for collecting the data essential for the study. *'Information Gathering',* the sub skill of critical thinking skills Test in Physics at Secondary level was executed for the experimental and control group as pre test and post test. Delayed post test was conducted for the experimental group and control group after an interval of two weeks to examine the retention of 'Information Gathering', the sub skill of critical thinking skills in physics at secondary level.

Appropriate statistical techniques viz., computation of mean, percentages, critical ratio, and analysis of covariance (ANCOVA) were employed for data analysis and interpretation of results.

Effectiveness of guided discovery method for developing 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level

Hypothesis mentioned that *"Guided discovery method in Physics is effective for developing 'Information Gathering', the sub skill of critical thinking skills among students at secondary level".* To examine the statistical significance of Hypothesis, the experimental group and control group were compared with respect to their pretest scores, posttest scores and delayed post test scores of 'Information Gathering', the sub skill of critical thinking skills in Physics at the Secondary Level through critical ratio tests of significance and analysis of gain scores, retention test and analysis of covariance. The details of the statistical analysis are given in Tables.

Comparison of the experimental group and control group with respect to the pretest scores, post test scores and delayed post test scores of 'Information Gathering', the sub skill of critical thinking skills in Physics at the secondary Level was done using critical ratio test of significance. The data and results of the two-tailed test of significance for difference between means (Garrett, 1981, pp 213) are given in Table 1.

Table:1.
Critical ratio test of significance for difference between the control and experimental groups with respect to Pretest, Posttest and Delayed Posttest scores of 'Information Gathering', the sub skill of critical thinking skills in Physics at the Secondary Level

'Information Gathering', the sub skill of critical thinking skills in Physics at the secondary level	Control Group			Experimental Group			Critical Ratio	
	N_1	M_1	σ_1	N_2	M_2	σ_2	t	P
Pretest	66	13.06	0.72	66	12.95	0.81	0.83	.01
Post test	66	15.55	0.68	66	18.12	0.66	22.01**	.01
Delayed Posttest	66	14.86	1.66	66	16.95	1.35	7.93**	.01

** Significant at .01 level of significance

The null hypotheses formulated in connection with the comparison of experimental group and control group with respect to the pretest scores, post test scores and delayed post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level are *"there is no significant difference between the control and experimental groups with respect to the pretest scores for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level"*; *"there is no significant difference between the control and experimental groups with respect to the posttest scores for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level"* as well as *"there is no significant difference between the control and experimental groups with respect to the delayed post test scores for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level"*.

Table 1 shows that there is no significant difference between the experimental group and control group with respect to the pretest scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level (CR=0.83; *df*= 130; P<0.01).Whereas significant difference was observed between the experimental group and control group with respect to the posttest scores on 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level (CR = 22.01; *df* = 130; P<0.01). Further, comparison of the experimental and control groups with respect to the delayed post test scores on 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level revealed significant difference (CR = 7.93; *df*= 130; P<0.01).

Comparison of the experimental and control groups with respect to the gain scores of 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level

Gain Score Analysis was performed to examine the difference between the experimental group and control group with respect to the achievement of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The null hypothesis formulated in this context was *"there is no significant difference between the experimental group and control group with respect to the gain score of 'Information Gathering', the sub skill of critical thinking skills in Physics at the secondary level".* Table 2 represents the details of statistical analysis performed with respect to analysis of gain score.

Table 2.

Critical ratio test of significance for difference between the experimental and control groups with respect to the gain scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level

Groups	**N**	**M**	**σ**	**CR**	***df***	**P**
Control	66	2.48	0.93	14.92***	130	0.01
Experimental	66	5.17	1.14			

** Significant at .01 level of significance

The critical ratio test of significance shows that there is significant difference between the control group and experimental group with respect to gain scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level (C.R = 14.92; *df* = 130; P<0.01). From Table 2 it is evident gain in achievement of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level is greater for the experimental group (M_1 = 5.17) than that of the control group (M_2 = 2.48).

Comparison of the experimental and control groups with respect to the Adjusted Post test scores of 'Information Gathering', the sub skill of Critical thinking skills in Physics at the secondary level

Analysis of covariance was conducted on the adjusted post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level to examine the effectiveness of guided discovery method for developing 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The null hypothesis formulated in this context was *"There is no significant*

difference between the experimental group and control group with respect to the adjusted post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level". The data and results of the analysis of covariance are presented in Tables 3.

Table 3.

Analysis of covariance of the Adjusted Post test scores of 'Information Gathering', the sub skill of critical thinking skills in Physics at the secondary level for the experimental and control groups.

Test	Mean		Source	Sum of squares	df	Mean Square	F	P
	Exp	Con						
Pretest (X)	12.95	13.06	Between groups	0.37	1	0.37	0.63	0.01
			Within groups	76.62	130	7.93		
			Total	76.99	131			
Post test (Y)	18.12	15.55	Between groups	218.94	1	218.94	479.21	0.01
			Within groups	59.39	130	0.46		
			Total	278.33	131			
Sum of Co deviates SSxy			Between groups	9.02				
			Within groups	2.82				
			Total	11.83				
Adjusted Post test(Y.X)	18.29	15.73	Between groups	217.22	1	217.22	472.22	0.01
			Within groups	59.29	129	0.48		
			Total	276.51	130			

Table 3 shows that the F_x ratio calculated for the pre test scores for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level (F_x = 0.63) is less than table values (F = 3.92 ; P<0.01 and F = 6.84; P <0.05). From the calculated value for F_x it is evident that there is no significant difference between the experimental group and control group with respect to the pre test scores for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. F_y ratio computed for the post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level (F_y=479.21), is greater than the statistical table value (F=3.92; P<0.01), which makes it evident that the experimental group and control group differ significantly with respect to the post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The analysis of covariance computed from the adjusted post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level shows that the calculated F ratio ($F_{Y.X}$= 472.22) is significantly greater than the table value (F=3.92; P<0.01). Further, from the adjusted post test means it is evident that the experimental group ($M_{Y.X}$=18.29) differ significantly from control group ($M_{Y.X}$= 15.73) with respect to the 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The results of ANCOVA presented in Table 3 converges to the finding that the Guided discovery method for developing the 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level is effective than the traditional method currently being practiced in the secondary schools of Kerala. Hence, the Hypothesis *"Guided discovery method is effective in developing 'Information Gathering', the sub skill of critical thinking skills in Physics at the secondary level"* stands valid.

Comparison of the experimental and control group with respect to the retention of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level.

Delayed posttest analysis was done to compare the experimental and control groups with respect to the retention of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The null hypothesis *"there is no significant difference between the experimental group and control group with respect to the retention of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level"* was examined through critical ratio test of significance. The details of statistical analysis are presented in Table 4.

Table 4.

Critical ratio test of significance for difference between the experimental and control group with respect to the retention of 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level.

Groups	N	M	σ	CR	*df*	P
Control	66	1.35	0.71	1.04**	130	0.01
Experimental	66	1.50	0.94			

** Significant at .01 level of significance

The critical ratio test of significance reveals that there is significant difference between the control and experimental groups with respect to the retention of 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level (C.R = 1.04; *df* = 130; P<0.01). The mean scores of delayed post test for the experimental and control groups presented in Table 4 makes it evident that the experimental group (M_1 = 1.50) has better retention of 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level than the control group (M_2 = 1.35).

III. FINDINGS EMERGED FROM SECTION

1. There is no significant difference between the control and experimental groups with respect to the pretest scores (CR = 0.83; *df* = 130; P<0.01) for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level.

2. There is significant difference between the control and experimental groups with respect to the posttest scores (CR = 22.01; *df* = 130; P<0.01) for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level.

3. There is significant difference between the control group and experimental group with respect to gain scores (C.R = 14.92; *df* = 130; P<0.01) of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level. The gain in achievement of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level is greater for the experimental group (M_1 = 5.17) than that of the control group (M_2 = 2.48).

4. There is significant difference between the experimental group and control group with respect to the adjusted post test scores of 'Information Gathering', the sub skill of Critical thinking skills in physics at the secondary level (($F_{Y.X}$ =472.22; *df* = 130; P<0.01). The experimental group ($M_{Y.X}$ = 18.12) is significantly better than the control group ($M_{Y.X}$ = 15.55) with respect to the adjusted post test scores of 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level.

5. There is significant difference between the control and experimental groups with respect to the delayed post test scores (CR = 7.93; *df*=130; P<0.01) for 'Information Gathering', the sub skill of critical thinking skills in physics at the secondary level.

6. There is significant difference between the control and experimental groups with respect to the retention of 'Information Gathering', the sub skill of critical thinking Skills in physics at the secondary level (C.R = 1.04; *df* = 130; P<0.01). The experimental group (M_1=1.50) has better retention of 'Information Gathering', the sub skill of critical thinking Skills in physics at the secondary level than the control group (M_2 = 1.35).

IV. CONCLUSION

Problem solving is most thoughtful and creative. It involves critical thinking for testing the truthfulness of hypothesis. Proper education will help a child to be a good critical thinker and an excellent problem solver in his future life. Also what one earns from his school life need to be nurtured throughout his life. Thus to conclude, let our students be flexible and original in their thinking process. Teaching Guided discovery method to pupils in every field facilitates organization of ideas, enlargement of different thought skills, and building consistent thought models.

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