EFFECTIVENESS OF INQUIRY METHOD OVER LECTURE-CUM-DEMONSTRATION METHOD IN ACHIEVING EVIRONMENTAL SCIENCE AS CONTENT AMONG HIGH SCHOOL STUDENTS IN PUDUCHERRY, INDIA

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ABSTRACT:

The purpose of this study is to determine the effectiveness of inquiry based learning over lecture cum demonstration method in teaching environmental science as content at 8th grade students in Union Territory of Puducherry, India. Pre test-post test control group and experimental group design was selected to observe the effectiveness of the treatments. Total sample size involved for the study was 69 (including experimental and control group). Descriptive statistics, t-test and ANCOVA were used to analyse the data. From the result obtained, it was concluded that inquiry method proved more effective over lecture cum demonstration method in teaching environmental science as content.

Keywords: *Puducherry, Inquiry method, lecture-cum-demonstration method, environmental science experimental design, descriptive statistics, t-test, ANCOVA.*

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Introduction:

Teaching students with the notion of critical thinking, questioning and problem solving is one of the main aims of current education (Balim, 2009). In order to achieve these it is important not only to design curriculum based on worthy aims but also to give equal importance to interventional effectiveness (Bok, 2006). Researches indicate that students taught through inquiry had a positive effect on enhancing their academic skills (critical thinking, questioning, oral and written communication skills) (Justice et al, 2007). Thus, it is clear that the shift in pedagogy that too inquiry method will prove effective. But Van Gelder (2005) raised question about how difficult it is to help students in acquiring critical thinking, questioning and problem solving. He says that it is as difficult as learning a new language requiring considerable time and effort but still if once acquainted it is sure to prove its efficacy life long (Van Gelder, 2005). According to Matson (2006), the nature and structure of universe is inquired by the process involved in inquiry based teaching. It expects students to take examples from their day to day life and allows them to propose hypotheses, test them in a scientific way and to gain higher level skills (Mathews, 2002). Only this learning exposes the learners about the nature of scientific studies (National Research Council, 2004). This kind of learning is acquired best when they teach students through inquiry method. It is the way people learn when they are isolated and is a natural way that human beings learn about their environment. It kindles a thought process which in turn assures the students in gaining new experiences less strange and more meaning (Richard Suchmann, 1968). A number of programs (which include scientists in Action developed by the Cognition and Technology Group at Vanderbuilt (1992); Linn's Computers as learning partner; Songer's (1993) Kids as Global Scientists; and Brown and Campione's (1994) Community of Learners) have been developed to stress the significance of engaging students in inquiry learning. Many researchers have revealed that inquiry-based learning could be effective for teaching biology (Demastes,1995), Geography (Wolf,1993; Trundle, Atwood, Christopher, Sacker, 2010), Personal Values (Mohanty,1992), Science (Johnson,1991; Green wood,1995; Maxim,1997;Gibson,1998), Mathematics (Cobb,1991; Kramarski, Bracha, Dudai, Vered, 2009) and Physics (Thacker,1994). But there were a few studies that investigate environmental science as content for inquiry in classroom practices. Therefore, this study is an attempt to fill up the gap in this area by investigating the effectiveness of inquiry method in classroom practices using environmental science as subject matter.

In this study, the effect of inquiry training method and lecture method on achievement, which is defined as gaining knowledge, understanding and application of learning, in environmental science among students of secondary school in Puducherry was investigated.

Review:

While reviewing related studies, it was found that Researches done by Schlemker (1970), Smith (1974), Marsh (1975), Wolf (1993), King (1995), Peck (1996), Maximum (1997), on inquiry approach proved effective results over other approaches. Among which studies done by Schlemker (1970), and King (1995) had reported that inquiry based teaching showed a greater fluency in inquiry and critical thinking than in content mastery and information retention whereas Marsh (1975) indicated that the inquiry method is superior to lecture method in terms of recall, transfer and retention of data and in developing specific skills in questioning and concept building. Smith (1974) reported that his inquiry approach proved to be effective in individualized instruction. Wolf's (1993) comparison of two instructional approaches concluded inquiry approach provided more opportunities for students to apply intellectual skills than repository instruction. And in the same way experiments conducted by Massials (1966), Hinrichson and Schaumburg (1975), Cobb (1991), Thacker (1994), and Mohanty (1992) to test the effectiveness of the inquiry method versus lecture-cum-demonstration method indicated that, inquiry method showed greater efficacy over lecture-cum-demonstration method in terms of academic performance in general, and learning mathematics and physics in particular. Germann (1991) found that directed inquiry approach is effective in learning science process skills and scientific problem solving. Rosebery's (1997) study reveals that the inquiry-based approach is very effective for the teacher's professional development.

Hence, inquiry method has proved greater efficacy over other approaches in academic performance, the method also proved superior opportunities for students to apply their intellectual skills, science process skills, scientific problem solving and teachers' professional development. But very few studies were done taking 'environmental science' as a content for inquiry and this method of teaching and learning interests only a few Indian researchers thus does not attained popularity in India. The approach focuses on developing the knowledge, the understanding and the application in learning which leads to the positive attitude among students (Miller, 1961; Eridemir, 2009).

Research questions:

The research questions of this study are as follows: Are there any effects of inquiry-based teaching on secondary school students' achievement in environmental science as content? Are there any significant differences after the study between the experimental group and control group in their achievement level in environmental science? (Achievement defined in terms of knowledge, understanding, and application). Are there any intervening effects of covariates in the treatment?

Methodology:

Variables:

In the present study, two variables were used: independent and dependent variables. Independent variable is nothing but treatment variable i.e., teaching methods (Inquiry method for experimental group and lecture method for control group). Dependent variable is achievement in environmental science (i.e., further specified as knowledge, understanding and application level of students in the content taught). Environmental science was taken as content because protection of the environment today is the concern of the people all round the globe. Only if today's youth is made aware and knowledgeable about the environmental disequilibriation, they will be motivated to conserve nature and find solutions to the problems. Moreover, it gives opportunity to promote process skills, solving abilities, and applications of environmental contents. For these reasons it was felt extremely important and perfect to imbue in learners an environmental consciousness.

Design of the study:

In the present study the researcher selected randomized groups, pre-test-post-test design in true experimental design. In this design subjects were assigned to the experimental and control group by random procedures and administered a pre-test to measure the effect of the treatment given to these groups for a stipulated time period. At the end of experiment the Experimental and Control groups were administered the post test to measure the effect of dependent variable. The difference between mean of pre-test and post-test was found for each other and the mean difference scores were compared with the help of an appropriate statistical tool in order to

ascertain whether the experimental treatment produced a significant effect than the control group when taught using inquiry method.

Sampling:

In the present study, all the 69 students belong to class VIII were taken as the sample. The sample comprises 44 girls and 25 boys from secondary school situated in Thirukanoor, state of Puducherry, India. Out of 69, 38 were experimental group and remaining 31 were control group. There were 2 batches-one for experimental group and another for control group. These two batches were from two different classes (grade VIII-A and grade VIII-B). No student was omitted from either of the groups.

Tools used for administration:

To collect data for the study, the researcher made a tool (pre-test and post-test) to measure the achievement in environmental science to test the effect of the treatment. The achievement test consisted of 25 items, among which 15 were intended to test the knowledge level of the students, 5 items were proposed to test the understanding level and remaining 5 items to test the application skill of both the control and experimental groups. Validity of the achievement test was done to determine the extent to which a text measures and what it claims to measure. It was done by a panel of members consists of 6 experts who judged reviewing each item's relevance to the content. Based on the review of related studies and opinion of the experts it was decided to control the intervening effect of intelligence and socio-economic status of the subjects. For this reason the researcher administrated Standard Progressive Matrices-prepared by J.C. Raven (1976) and Socio-Economic Status Index (SESI) (2008) developed by Pro. R.P. Verma, Prof. P. C. Saxena, and Dr. Usha Mishra. The reason why Raven tool was selected is because it is culture-free and non-verbal test which is perfect to administer to anybody belongs to any part of the world. SESI developed by Prof. R.P. Verma, Prof. P. C. Saxena, and Dr. Usha Mishra was selected because authors of this tool are Indians and items prepared by them will be perfect for Indian students.

Experimentation:

The researcher used the following two treatments in the present study: lecture method for control group and inquiry method for experimental group. Pre-test was given to both the experimental group and control group prior to the treatments to collect data on participants' level of performance before the intervention take place. Researcher taught experimental group with the inquiry method of teaching. This experiment was done for the VIII grade division B students of Thirukanoor government high school, Thirukanoor for 5 days taking 40 mins in the second period from March 27 to March 31, 2012. Simultaneously researcher taught with lecture method for control group. They are students of VIII grade division A of the same school. They also were taught for 5 days in the third period for about 40 minutes. Finally after the treatment, post-test was conducted in the same way as pre-test was done.

Data collection:

Before the experiment, pre-test was administered to the students belong to both the groups along with J.C. Raven's Standard Progressive Matrices Test for Intelligence and Socio-Economic Status Schedule by R.P. Verma, et al. On the completion of each group's experimentation, post test was administered to each group. Finally the scores obtained were pre-test scores, intelligence test scores, socio-economic status scores, and post-test scores. The scores of pre-test and post-test were used to do descriptive statistics and t-test whereas, post test scores, intelligent test scores and socio-economic status scores were used to do ANCOVA.

Analysis:

Descriptive statistics were done to quantitatively describe the main features of a collection of data. It provides simple summaries like mean, median, and standard deviation, about the sample and the measures.

Table:1 Descriptive statistics for pre- and post test scores

Group	Pre-Test			Post-Test	
	N	Mean	SD	Mean	SD
Exp. Group	38	6.87	2.268	18.13	4.225
Cont. Group	31	8.45	2.378	12.84	4.383

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Above table shows that the experimental group has higher mean (M=18.13), while control group's mean is M=12.84 which indicates that experimental group has done relatively better performance when compared to control group in post test level.

Table:2 Showing the value of 't' for difference between the control group Students (pre-test) and Control group Students (post-test)

Levels compared	No. of Pupils (N)	Mean (M)	Standard Deviation (SD)	t-value	p-value
Post-test	31	12.84	4.383	6.645	0.000
Pre-test	31	8.45	2.378		

Table 2 shows the paired sample t-test conducted to compare control group pre-test and post test scores. The sig. (2-tailed) value is less than .05 (p=0.000) and t-value=6.64 thus it is revealed that there is a statistically significant difference between the pre-test and post-test scores obtained by control group students. This difference is because, even though the control group students are not given any special treatment, they were also exposed to some kind of treatment. Thus, students have performed better in the post test.

Table:3 Showing the value of 't' for difference between the experiment group Students pre-test and post-test

Levels compared	No. of Pupils (N)	Mean (M)	Standard Deviation (SD)	t-value	p-value
Post-test	38	18.13	4.225	20.057	0.000
Pre-test	38	6.87	2.268		

Table 3 shows the paired sample t-test was done to test the difference between the experimental groups' pre-test and post test scores. The sig. (2-tailed) value is less than .05 (p=0.000) and t-value =20.057 thus it is revealed that there is a statistically significant difference between the

pre-test and post-test scores obtained by experimental group students. It means that students in experimental group have performed well in post test which ultimately denotes that inquiry method has worked well.

Table:4 Showing the value of 't' for difference between the Experiment group Students and Control group Students post-tests

Levels compared	No. of Pupils (N)	Mean (M)	Standard Deviation (SD)	t-value	p-value
Experimental Group	38	12.84	4.383	5.091	0.000
Control Group	31	18.13	4.225		

Table 4 shows the independent sample t-test conducted to compare control group post-test and experimental group post-test scores. The sig. (2-tailed) value is less than .05 (p=0.000) and t-value=5.09 thus it is revealed that there is a statistically significant difference between the scores obtained by control group students and experimental group students in their achievement in environmental science (post-test). It shows that inquiry method has proved its efficiency over lecture method in achieving environmental science as content.

Table:5 Results of ANCOVA of post-Test Scores of 8th grade in the control and the experimental groups with respect to their Intelligence

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Covariate (intelligence)	157.432	1	157.432	9.629	0.003
Post tests	400.107	1	400.107	24.471	0.000
Error	1079.104	66	16.350		

The above table shows the summary of ANCOVA used to test the effects of the instructions considering intelligence as covariates. The analysis in which intelligence was taken as a covariate shows the values of F=24.47, p<0.05. This indicates that there was no significant effect

of covariates in the treatment and the outcome result was purely because of the methodology used.

Table:6 Results of ANCOVA of post-Test Scores of 8th grade in the control and the experimental groups with respect to their Socio-economic Status

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Covariate (SES)	0.518	1	0.518	0.028	0.868
Post tests	478.408	1	478.408	25.546	0.000
Error	1236.017	66	18.728		

Table 6 gives the summary of ANCOVA used to test the effects of the instructions considering Socio-economic status as covariates. This analysis shows the values of $F=25.54$, $p<0.05$. From this result, it is statistically proved that there was no significant effect of covariates in the performance and the groups had performed better mainly due of the effect of treatment they undergone and not due to the covariates.

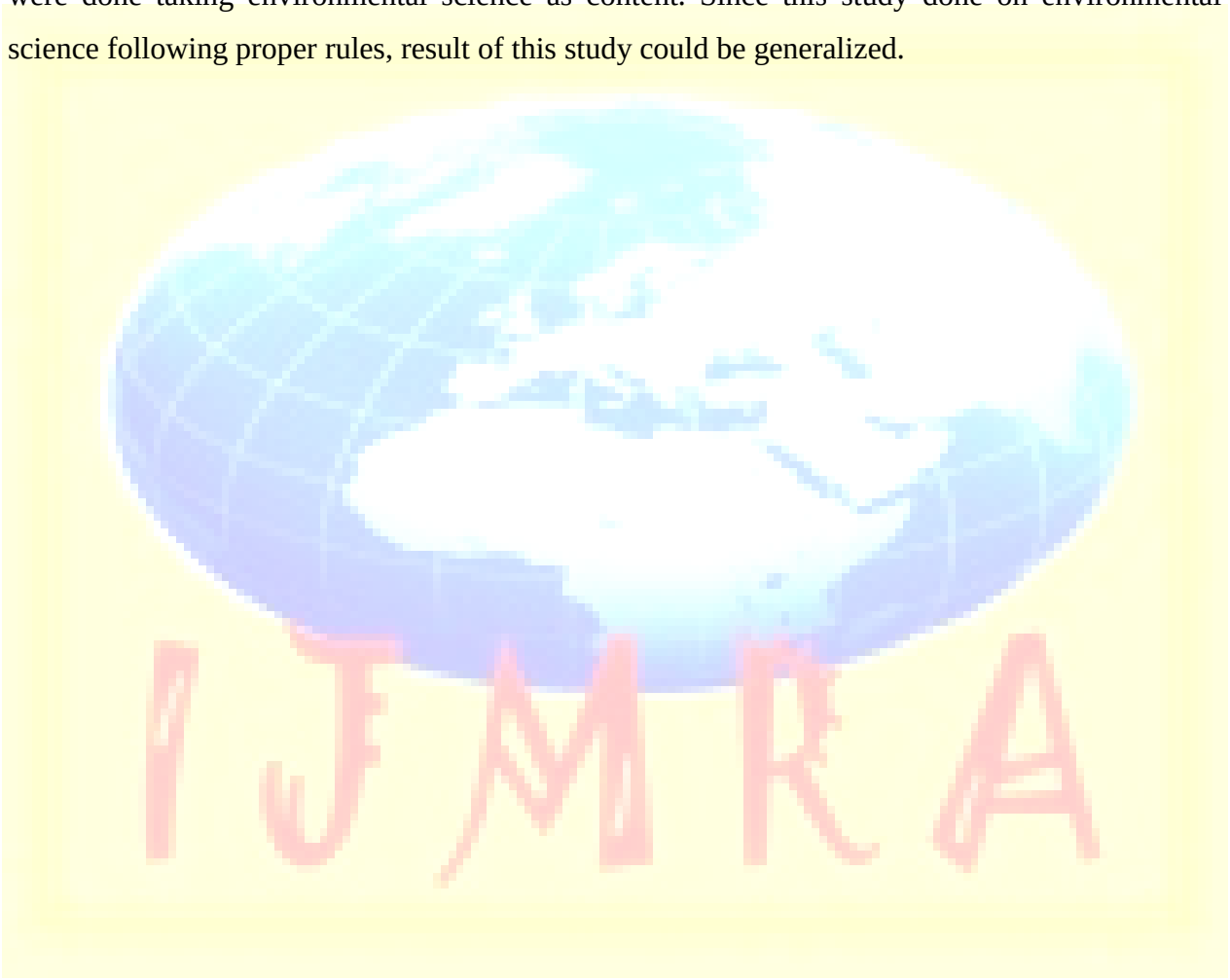
Discussion:

The result of this study is that students taught through inquiry method showed better performance when compared to students taught through lecture method which is in agreement with the results obtained by the researchers Ivany (1969) and Strike (1975), Myer (1975) Voss (1982), and Doty and katyal (1985). Ivany (1969) and Collin (1969) reported that inquiry training model is effective only when exposed with strong, arousing genuine puzzlement.

The result of the present study is contrary with Bloom(1971), Block (1971), Hood and Syag (1982), Clark et al (1983), Yadav (1984), Patadia (1987), and Ashok K. Kalia (2005). Among whom Bloom (1976) and Ashok K. Kalia (2005) reported that the period of treatment might have been insufficient to bring changes. The inquiry method of teaching does not have much significant impact on the achievement of the learners in their study.

The result of this study is that students taught through inquiry method acquired better means when compared to students taught through lecture method. This difference in means is due to the effect of the treatment given which implies that the inquiry method of teaching is more effective not only in achieving the content but also in acquiring positive attitude towards environment.

Even though there are studies supporting and opposing inquiry method, very few studies were done taking environmental science as content. Since this study done on environmental science following proper rules, result of this study could be generalized.



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