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Laboratory Method and Development of Scientific Process Skills

Dr. Prasenjit Pal

Research Scholar, Department of Education, Rabindra Bharati University, Kolkata, West Bengal (India)

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***Corresponding Author**
Email: prasenjit.pal75[at]gmail.com

ABSTRACT

The role of laboratory method in the development of scientific process skills cannot be underestimated. Here we incorporated observation, classifying, experimenting and predicting in expressing scientific process skills. The subjects of the study were 350 students (200 boys and 150 girls) of class VI of 6 different schools of Malda district selected randomly. The subjects were assigned to two groups. The experimental group was taught by laboratory method and control group was taught by conventional method. Simultaneously a group of 26 teachers were selected randomly from those schools for observing the two groups of students. An opinionnaire was given to them. The responses of the teachers were used to know the relative effectiveness of the laboratory method and conventional method. To know the relative effectiveness researcher uses χ^2 test. The analysis conducted produces significant result. The result shows that laboratory method is proved as more effective method in the development of scientific process skills.

1. Introduction

Science education is a must in today's word which heavily relies upon the progress of science and technologies. It is argued that such education should be imparted from the primary school level. Science education essentially involves scientific skills. Scientific skills are classified into basic science process skills and integrated science process skills like. Observation, classification, communication, thinking, measuring, inferring and predicting are kinds of basic science process skills. Graphing, hypothesizing, interpreting data, models formulating, experimenting are integrated science process skills. Educationist believes that basic science process skills should be nurtured best from the elementary school level. But the traditional class room has not much scope to develop those skills. Laboratory gives the opportunities to the students to improve these skills. The effect of demonstration in laboratory in the development of scientific process skills have been observed by **Nwosu and Okeke**. The results revealed that student taught by laboratory method performed significantly better than those taught through conventional methods. The present study also tried to find out the relative effectiveness of laboratory method and conventional method in the development of science process skills. Here we incorporated observation, classifying, experimenting and predicting in expressing scientific process skills.

2. Objectives of the study

This study is aimed to explore the relative effectiveness of laboratory method and conventional method of teaching science at upper primary school level in the scientific process skills like observation, classifying, experimenting and predicting.

3. Research question

1. Does the use of laboratory in science teaching develop scientific process skill like observation among the primary school students?
2. Does the use of laboratory in science teaching develop scientific process skill like classification among the primary school students?
3. Does the use of laboratory in science teaching develop scientific process skill like experimentation among the primary school students?
4. Does the use of laboratory in science teaching develop scientific process skill like prediction among the primary school students?

4. Hypothesis

H_{01} : There is no significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like observation.

H_{02} : There is no significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like classification.

H_{03} : There is no significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like experimentation.

H_{04} : There is no significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like prediction.

5. Operational definition of the terms

1. **Conventional method of teaching science**- The methods of teaching employed by the teachers in class room other than inquiry based teaching, activity based teaching and laboratory based teaching is considered as conventional method of teaching.
2. **Laboratory method of teaching science**- Laboratory method is a way of using systematically the science processes skills and methods of thinking through inquiry, activity and exploration.

3. **Observation-** It refers to collection of information from primary sources through sense experience.
4. **Classification**- it refers to categorization of event on the basis of certain rules or principle.
5. **Experimentation-** An **experiment** is a process carried out to accept, reject or validate a hypothesis. It determines the relationship between independent and dependent variable while controlling the extraneous variables.
6. **Prediction-** Prediction is an intelligent guess. Two groups randomized matched subject post-test true experimental design was used in the present study. In this method subjects were assigned to two groups through technique of matching with respect to extraneous variables. Then experimental group were taught by laboratory method and control group were taught by conventional method. After that a post test or achievement test of science was administered on both the groups. Simultaneously a group of 26 teachers were selected randomly from those schools for observing the two groups of students. An opinionnaire was given to them. The responses of the teachers were then subjected to some statistical analysis to know the relative effectiveness of the laboratory method and conventional method.

6. Population of the study

The target population of present research is all the students of class VI of West Bengal studying in upper primary level of education. The accessible population of present research is all the students of class VI of Malda districts of West Bengal studying in upper primary level of education.

7. Samples

The researcher selected 6 schools randomly from the schools of Malda Districts. The random selection of 6 schools was done by using lottery method. 350 students of Class VI including 200 boys and 150 girls were selected randomly from the students of Class VI studying in those schools using random number table. Then 350 subjects were assigned to two groups containing 175 subjects in each group through technique of matching with respect to achievement scores obtained in previous examination. Then 175 subjects of experimental group were taught by laboratory method and 175 subjects of control group were taught by conventional method using different lesson transcript on same unit. After that a post test or achievement test was administered on both the groups. Simultaneously a group of 26 teachers were selected randomly from those schools for observing the two groups of students. An opinionnaire was given to them. The responses of the teachers were then subjected to some statistical analysis to know the relative effectiveness of the laboratory method and conventional method.

8. Tools

Four tools were used in the study. Researcher used different lesson plan for different group but on the same unit. All the tools were constructed and standardized by researcher. The achievement test prepared by the researcher consisted 25 items with a reliability coefficients of .93 and high face validity, content and item validity, internal and external validity. An opinionnaire or Likert type attitude scale consisting 26 items (13 items for opinion of control class and 13 items for opinion of experimental class) were prepared and standardized by researcher. Among 26 items 24 items are positive statements and 2 items are negative statements. The subjects were asked to give their responses in maximum extent (MAX), a moderate extent (MOD), Unknown (U), little extent (LIT), No (N) scale. The scale has a reliability coefficient of .98 and high levels of validity. The tools are as follows

1. Lesson transcript for control group.
2. Lesson transcript for experimental group.
3. Achievement test for the students
4. Opinionnaire for the observing teacher.

9. Data Analysis

A group of 26 teachers were selected randomly from those schools for observing the two groups of students. They were oriented and trained properly for this activity. An opinionnaire or attitude scale developed by the researcher was given to them. The responses of the teachers were then subjected to some statistical analysis. The data obtained from administration of the opinionnaire were tabulated for presentation, analysis and interpretation. The researcher analyzed the data obtained on the variables with the help of chi-square test.

The response of the observing teacher on their opinion for control group and experimental group regarding the development of scientific process skill like observation are summarized in the following table.

Table - 1

Opinion for control group and experimental group regarding the development of scientific process skill like observation

			Responses			
			MAX	MOD	U/LIT/NO	Total
Group	Control	Count	3	8	15	26
		Expected Count	14.0	4.0	8.0	26.0
		% within Group	11.5%	30.8%	57.7%	100.0%
	Experimental	Count	25	0	1	26
		Expected Count	14.0	4.0	8.0	26.0
		% within Group	96.2%	.0%	3.8%	100.0%

Total	Count	28	8	16	52
	Expected Count	28.0	8.0	16.0	52.0
	% within Group	53.8%	15.4%	30.8%	100.0%

It is evident from the percentages data that only 11.5% observing teacher thoughts that conventional method develops scientific process skill like observation to a maximum extent and 96.2% observing teacher thoughts that laboratory method develops scientific process skill like observation to a maximum extent. Therefore there exist difference in opinion on control group and experimental group regarding the development of scientific process skill like observation. To know whether this difference is significant the researcher conducted a chi square test. This is shown in the following table-

Table -2
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.536[a]	2	.000
N of Valid Cases	52		

The result obtained from the chi-square test could be summarized in API format as $\chi 2$ (2, N=52) = 37.536. The critical Chi-Square value at .05 level of significance is $\chi 2c$ (2, N=52) = 5.991. As $\chi 2 > \chi 2c$ the null hypothesis is rejected and it can be inferred that there is significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like observation. Experimental group is more likely to develop scientific process skill like observation then control group (96.2% to 11.5%).

The response of the observing teacher on their opinion for control group and experimental group regarding the development of scientific process skill like classification are summarized in the following table.

It is evident from the percentages data that only 30.8% observing teacher thoughts that conventional method develops scientific process skill like classification to a maximum extent and 76.9% observing teacher thoughts that laboratory method develops scientific process skill like classification to a maximum extent. Therefore there exist difference in opinion on control group and experimental group regarding the development of scientific process skill like classification.

Table -3
Opinion for control group and experimental group regarding the development of scientific process skill like classification

			Responses			
			MAX	MOD	U/LIT/NO	Total
Group	Control	Count	8	6	12	26
		Expected Count	14.0	5.0	7.0	26.0
		% within Group	30.8%	23.1%	46.2%	100.0%
	Experimental	Count	20	4	2	26
		Expected Count	14.0	5.0	7.0	26.0
		% within Group	76.9%	15.4%	7.7%	100.0%
Total		Count	28	10	14	52
		Expected Count	28.0	10.0	14.0	52.0
		% within Group	53.8%	19.2%	26.9%	100.0%

To know whether this difference is significant the researcher conducted a chi square test. This is shown in the following table-

Table -4
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.686[a]	2	.002
N of Valid Cases	52		

The result obtained from the chi-square test could be summarized in API format as χ^2 (2, N=52) = 12.686. The critical Chi-Square value at .05 level of significance is χ^2_c (2, N=52) = 5.991. As $\chi^2 > \chi^2_c$ the null hypothesis is rejected and it can be

inferred that there is significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like classification. Experimental group is more likely to develop scientific process skill like classification then control group (96.2% to 11.5%).

The response of the observing teacher on their opinion for control group and experimental group regarding the development of scientific process skill like experimentation are summarized in the following table.

Table -5
Opinion for control group and experimental group regarding the development of scientific process skill like experimentation

			Responses			
			MAX	MOD	U/LIT/NO	Total
Group	Control	Count	4	8	14	26
		Expected Count	13.5	4.5	8.0	26.0
		% within Group	15.4%	30.8%	53.8%	100.0%
	Experimental	Count	23	1	2	26
		Expected Count	13.5	4.5	8.0	26.0
		% within Group	88.5%	3.8%	7.7%	100.0%
Total		Count	27	9	16	52
		Expected Count	27.0	9.0	16.0	52.0
		% within Group	51.9%	17.3%	30.8%	100.0%

It is evident from the percentages data that only 15.4% observing teacher thoughts that conventional method develops scientific process skill like experimentation to a maximum extent and 88.5% observing teacher thoughts that laboratory method develops scientific process skill like experimentation to a maximum extent. Therefore there exist difference in opinion on control group and experimental group regarding the development of scientific process skill like experimentation. To know whether this difference is significant the researcher conducted a chi square test. This is shown in the following table-

Table – 6
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.815[a]	2	.000
N of Valid Cases	52		

The result obtained from the chi-square test could be summarized in API format as χ^2 (2, N=52) = 27.815. The critical Chi-Square value at .05 level of significance is χ^2_c (2, N=52) = 5.991. As $\chi^2 > \chi^2_c$ the null hypothesis is rejected and it can be inferred that there is significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like experimentation. Experimental group is more likely to develop scientific process skill like experimentation then control group (88.5% to 15.4%).

The response of the observing teacher on their opinion for control group and experimental group regarding the development of scientific process skill like prediction are summarized in the following table.

It is evident from the percentages data that only 7.7% observing teacher thoughts that conventional method develops scientific process skill like prediction to a maximum extent and 88.5% observing teacher thoughts that laboratory method develops scientific process skill like prediction to a maximum extent. Therefore there exist difference in opinion on control group and experimental group regarding the development of scientific process skill like prediction.

Table - 7
Opinion for control group and experimental group regarding the development of scientific process skill like prediction

			Responses			
			MAX	MOD	U/LIT/NO	Total
Group	Control	Count	2	9	15	26
		Expected Count	12.5	5.5	8.0	26.0
		% within Group	7.7%	34.6%	57.7%	100.0%
	Experimental	Count	23	2	1	26
		Expected Count	12.5	5.5	8.0	26.0
		% within Group	88.5%	7.7%	3.8%	100.0%
Total		Count	25	11	16	52
		Expected Count	25.0	11.0	16.0	52.0
		% within Group	48.1%	21.2%	30.8%	100.0%

To know whether this difference is significant the researcher conducted a chi square test. This is shown in the following table-

Table -8
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.345[a]	2	.000
N of Valid Cases	52		

The result obtained from the chi-square test could be summarized in API format as χ^2 (2, N=52) = 34.345. The critical Chi-Square value at .05 level of significance is χ^2_c (2, N=52) = 5.991. As $\chi^2 > \chi^2_c$ the null hypothesis is rejected and it can be inferred that there is significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like prediction. Experimental group is more likely to develop scientific process skill like prediction then control group (88.5% to 7.7%).

10. Conclusion

The result of the present work shows that there is significant relationship between the opinion of teachers on control group and experimental group regarding the development of scientific process skill like observation, classification, experimentation and prediction.

The opinion of the observing teachers revealed that experimental group seemed to develop scientific process skill like observation, classification, experimentation and prediction among the students at maximum extent then control group. As the experimental group is taught by laboratory method and control group by conventional method it can be concluded that laboratory method is more effective than conventional method in the development of observation skill among the students.

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