CHAPTER V

COMPARATIVE EFFECTIVENESS OF THE THREE FORMS OF PLM AND RELATIONSHIP BETWEEN ACHIEVEMENT THROUGH THE STRATEGY AND STUDENT CHARACTERISTICS

Introduction

As stated at the end of chapter IV of the thesis, this section of the report attempts to provide the details regarding the study related to the comparative effectiveness of the three forms of PLM namely Linear, Deviated linear and Branching. It also presents the details of the study pertaining to the relationship between attitude of the students towards the strategy and their achievement through it and the relationship between their intelligence and achievement through the strategy. These aspects of the study deemed necessary because of the non-availability of proper knowledge regarding how these different forms function under situations such as one perceived the present study with pupils of varied calibre. So they are to be brought under testing so that empirical evidence can be obtained regarding their functioning. A knowledge about the functioning of the techniques with emphasis on the impact of certain student characteristics on achievement of the students through the strategy would help the designing and development of flexible

strategies with potential in alternative inputs or components suitable to different personality attributes of individual learner.

However, before entering into the details of these aspects, it would be worthwhile to note certain facts related to the present study so that the various aspects of the study under consideration could be seen in the right perspective. First of all it should be borne in mind that the present study has been conducted in the real classroom situation and therefore, it has to undergo certain restraints especially by those imposed on by the prescribed syllabus and time. Consequently, instead of resorting to self-pacing and providing alternatives within the strategy as every self-instructional strategy ought to, the present study has more or less tried to fit the strategy into the existing system by adhering to group-pacing and the same components uniformly. Despite these limitations, with a view to getting insight into the implications of such strategies as they would lead a great way towards determining the place of such strategies in real classroom situations so as to amalgamate them into the present set up, these aspects of the study have been undertaken.

It is on considerations mentioned above, the present investigation has attempted to study both the comparative effectiveness of the three forms and the relationship of certain student characteristics with their achievement through the strategy. The comparative effectiveness of the three forms

of PLM has been found through (i) a comparison of the students' performance on criterion tests of units of various forms and (ii) students' reaction towards the three forms in terms of ranking. The relationship between student characteristics and achievement has been found through a comparison of the scores on achievement and scores on the variables of intelligence and attitude. The details pertaining to these aspects of the study are provided in what follows.

Sample

The entire group of 28 students of std. IX and the same students in the subsequent year as they were promoted to std. X, of Navrachana High School, Baroda, who underwent the strategy was considered sample for studying the comparative effectiveness of the three forms of PLM as well as for studying the relationship between achievement of the students through the strategy and each of the selected personality attributes of the students.

Tools of Measurement

The following tools were utilized for obtaining data for studying the comparative effectiveness of the three forms of PLM as well as the relationship between student characteristics and achievement of the students through the strategy.

The Criterion Tests : Criterion tests were utilized for studying the comparative effectiveness of the three forms of PLM in terms of achievement. Details regarding the composition of the criterion tests are provided under the title 'Criterion and

Comprehensive Tests' (chapter III) and the final form of the criterion tests are given in the appendix (at the end of their respective units).

Reaction Questionnaire : A reaction questionnaire was prepared by the investigator for collecting data for studying the three forms of PLM in terms of ranking by the students. The questionnaire contained questions related to the various aspects common to all three forms. The validity of the various points raised in the questionnaire pertaining to the three forms were scrutinized by experts and necessary modifications were made as per the suggestions made by the experts. The final form of the questionnaire is given in Appendix III.

Intelligence Test : For measuring the intelligence of the students, the standard Progressive Matrices developed by J.C. Raven have been employed. The tests represent an attempt to measure intellectual functioning within the context of Spearman's concept of 'g' (Bortner, 1965). The tasks or materials consisted of designs which require completion. The student chooses from a number of multiple choice options, the design or design part which fits best. Answer which fits may be (a) complete a pattern, (b) complete an analogy, (c) systematically alter a pattern, (d) introduce systematic permutation or systematically resolve figures into parts.

The Progressive Matrices Tests have been subjected to extensive researches in several countries and with a wide variety of groups. Numerous reliability coefficients quoted by Raven vary from 0.80 to 0.90. Reliability reported by other investigators both in India and abroad using the split half method ranged from 0.70 to 0.90. With older children and adults test-retest reliability varied within approximately the same range as those formed by the split half method.

Attitude Scale : Attitude of the students towards the self instructional strategy has been measured using the attitude scale developed by Menon (1978). The scale was originally developed and standardised for university students. Hence it was slightly modified for making it suitable for eliciting student reactions at school stage. The scale consisted of 22 statements expressing various levels of attitude. It is an eleven point scale showing extreme favourable attitude to extreme unfavourable attitude. The final form of the test administered on the students is given in Appendix IV.

Comprehensive Test : To measure the overall achievement of the students through the strategy, a comprehensive test was designed by the investigator. Details regarding the composition of it are given under 'Criterion and Comprehensive Tests' in chapter III. The final form of the test is given in the appendix (at the end of the instructional material.)

Similarity in Content Difficulty and the Three Forms of PLM

For the purpose of studying the three forms of PLM for their comparative effectiveness, it was essential to maintain the difficulty level of content similar in all three forms. So the content area that was to be taught through the strategy was analysed and the various teaching points were taken down. Then these points were divided into three parts by the investigator so that each of the parts would be equal in terms of difficulty level. The points thus divided were given to three content experts to examine whether they were equal in terms of difficulty level. As per the suggestions made by these experts, certain rearrangement of the points was made so that the material presented through the three forms would be equal in terms of difficulty level. Once this was done, the various points under each section, were developed into instructional material in terms of three forms namely Linear (Units I to IV), Deviated Linear (Units V to VII) and Branching (Units VIII andIX) respectively by incorporating and integrating other techniques along with P.L.M.

Data Collection

The data regarding the various aspects of the study mentioned earlier were collected as presented below :

For collecting data regarding the three forms of PLM in terms of achievement, one criterion test each was administered at the end of every unit. Thus, in all, out of the nine criterion

tests, four were taken with respect to linear form (at the end of units I to IV), three with respect to Deviated linear (at the end of Units V to VII) and two with respect to Branching form (at the end of Units VIII and IX).

The data regarding the students' reactions towards the three forms of PLM in terms of ranking were collected by administering the reaction questionnaire. The questionnaire was administered at the end of the experimentation when all the students had studied through the three forms. Thus, the scale was administered only when all the students were familiar with the three forms for a pretty long time so that they would be in a position to react in a proper manner to the various points raised with regard to PLM.

For measuring the intelligence of the students, Raven's Progressive Matrices had been administered on the students before the actual implementation of the strategy began. In administering the test, proper procedures were followed.

The Attitude Scale was administered on the sample immediately after the completion of Unit VI and then at the end of the final unit. (Unit IX).

To measure the overall performance of the students through the strategy, the comprehensive test was given to the students at the end of the implementation of the strategy.

(a) Comparative Effectiveness of the Three Forms of PLM

As noted earlier, comparative effectiveness of the three forms of PLM has been found (i) in terms of the students' achievement in criterion tests of the three forms and (ii) through the reaction of the students towards the three forms in terms of ranking.

(i) Comparative Effectiveness in Terms of Achievement: For studying the comparative effectiveness of the three forms of PLM, scores on criterion tests of the three forms have been computed separately using the techniques of percentiles, mean and S.D. as they would help in understanding the overall dispersion of scores in a better manner. The mean in each case would tell about the central tendency and S.D. would help in a better manner to explain this. Hence the percentiles, mean and S.D. of the scores of the three forms are presented in the table that follows.

Table V-1 gives the percentiles, mean and S.D. of scores obtained by the students through the three forms of PLM. From the table, it could be noticed that the P_{oo} of scores in all the three forms namely linear, deviated linear and branching are 44.00, 57.33 and 57.00 respectively. The scores show that the P_{oo} of linear is lower in comparison to those of deviated linear and branching. When the percentile distribution of scores is observed, it could be seen that the students have shown better performance through deviated linear and branching than through

Table V-1 : Percentiles, Mean and S.D. of Students' Achievement Scores through the Three Forms of PLM

Type of PLM	P_{00}	P_{10}	P_{20}	P_{25}	P_{30}	P_{40}	P_{50}	P_{60}	P_{70}	P_{75}	P_{80}	P_{90}	Mean	S.D.
Linear (I-IV)	44.00	58.50	62.10	63.50	64.90	66.88	68.63	70.38	72.67	73.80	75.00	81.00	69.25	7.75
Deviated Linear (V-VII)	57.33	62.75	68.50	73.00	75.70	77.10	78.50	79.90	82.50	84.30	86.17	91.50	78.18	10.13
Branching (VIII & IX)	57.00	66.06	68.06	69.00	70.06	74.17	77.50	80.30	83.10	84.50	86.17	91.00	77.65	9.58

linear. This fact could be explained with reference to the median value (P.50) also. While the median value is 68.63 in respect of linear, it is 78.50 and 77.50 with respect to deviated linear and branching respectively. When the average performance of the upper 40 percent students come around 80 percent or above with respect to deviated linear and branching, it comes to 10 percent only in the case of linear. This shows that the scores in deviated linear and branching run almost parallel to each other. The distribution of scores especially after P_{50} obviously shows this fact.

In the case of mean scores also, the deviated linear and branching have reached around 78 percent on the total scores whereas in the case of linear the mean score is 69 percent only. From this aspect also, the scores of deviated linear and branching give a better picture of achievement than linear.

Further comparison has been carried out to test whether there is significant difference among the mean scores of the three forms. For this purpose the null hypothesis 'There is no significant difference among the mean scores of linear, deviated linear and branching at .01 level of significance' has been framed and the same was tested by applying the technique of Analysis of Variance. The results of this analysis are given in the table V.2.

Table V-2 : Table of ANOVA of the Aggregate Scores of Linear, Deviated Linear and Branching

Source of Variation	Sum of Squares	df	Ms	F
Between Sets	102.17	2	51.08	7.90
Within Sets	523.53	81	6.46	
Total	625.70	83		

It is observed from table V-2 that the 'F' ratio 7.90 is significant at .01 level as it is greater than 3.11, the value required for being significant at .01 level. This shows that the null hypothesis of no significant difference among the mean scores is rejected.

As discussed in the research hypothesis (ref. chapter III), all the three forms of PLM employ sound principles of learning. All of them give enough scope for student participation. Hence it was supposed that there would be no significant difference in the mean scores of units taught through the three forms. However, this assumption was found rejected as significant difference was found among the mean scores of the three forms. Therefore, the investigator made further attempts to study where the real differences lie. The following null hypotheses were framed for testing purpose :

(i) There is no significant difference between the performance of students with respect to their mean scores of linear and deviated linear at .01 level of significance.

(ii) There is no significant difference between the performance of students with respect to mean scores of linear and branching at .01 level of significance, and

(iii) There is no significant difference in the performance of the students with respect of their mean scores of deviated linear and branching.

The above pairs of mean combinations were tested through the application of Tukey test. The result is given in table V-3.

Table V-3 : Tukey Test on the Aggregate Mean Scores of Linear Deviated Linear and Branching.

Mean	Mean Difference	Difference Significant at .01 level
M_1 - 17.21	$M_1 - M_2 = 2.36$	Significant
M_2 - 19.57	$M_2 - M_3 = 2.32$	Significant
M_3 - 19.53	$M_3 - M_1 = 0.04$	Not significant

Table V-3 presents the result of the Tukey Test. The Tukey value in the case of the first and second pairs of mean combination are found to be 2.36 and 2.32 respectively. Hence they are significant at .01 level as they are greater than 2.006 the value

required for being significant. Therefore, the null hypotheses of no difference between the mean scores of linear and deviated linear and linear and branching are rejected. This shows that the achievement of the students through deviated linear and branching is better than that of linear. However the difference between the mean scores of deviated linear and branching being ,04, the null hypothesis of no difference between the mean scores of deviated linear and of branching is not rejected.

The result in general shows that the mean scores of deviated linear and branching are similar in nature while that of linear is found lower.

(iii) Comparative Effectiveness in Terms of Ranking

For studying the comparative effectiveness of the three forms of PLM in terms of ranks, the scores on the reactions scale were added up and for testing purpose the following null hypothesis was framed :

> 'There is no significant difference among the percentages of students showing their preferences for the various forms of PLM and the same was tested through the chi-square Technique of Equal Probability. The result is in Table V-4.'

From table V-4, it could be noted that out of the 8 items, in 7 items branching form of PLM has helped more students in achieving the instructional objectives than the other two methods. Hence in all these cases, the null hypothesis of no difference among the percentages of students showing their preference for

Table V-4 : Table of Rating the Three Forms of PLM in Terms of Ranks

Sr. No.	Items	Linear I Rank	Deviated Linear I Rank	Branching I Rank	Chi-square Value	Significant
	Which method has helped you :					
(1)	- to understand the content matters thoroughly ?	28.6	14.3	57.1	28.51	**
(2)	- to understand the principles and oncepts ?	14.3	28.6	57.1	28.51	**
(3)	- to apply the different principles learnt ?	7.2	28.6	64.2	50.007	**
(4)	- to clarify the principles and concepts discussed ?	28.6	32.1	39.3	1.79	NS
(5)	- to arouse your interests in the subject ?	10.6	25.0	64.4	46.58	**
(6)	- to sustain your attention interest throughout the unit?	7.2	10.6	82.2	107.73	**
(7)	- to read your own further?	14.4	32.1	53.5	23.02	**
(8)	- to remember the concepts even after the class ?	28.6	21.4	50.0	13.29	**

** Means significant at .01 level
NS Means not significant

the various forms of PLM is rejected. However, in the case of item 4, the percentages of ranks given to the various methods do not differ much. So in the case, the null hypothesis of no difference is not rejected. This shows that in all items except item 4, branching form of PLM has helped most of the students in achieving the instructional objectives laid down.

The result in the table again shows that deviated linear has secured second position in the percentage of students who gave first rank. Out of the 8 items, in five items (2, 3, 5, 6 and 7), students gave priority to deviated linear over linear. Only in two items (1 and 8) linear has got second position. In the remaining one item, the percentages of students do not show significant difference. This shows that all the three forms of PLM are equally good as far as this particular point is concerned.

In short, in the pupils' rating of the different forms of PLM in terms of ranks, Branching form stands first, Deviated Linear second and Linear third.

(b) Relationship Between Achievement through the Strategy and Student Characteristics of Intelligence and Attitude

As noted earlier, in the case of each of the personality attributes namely attitude and intelligence as well as achievement of the students through the strategy, data were collected and analysed with a view to finding the relationship between achievement and attitude and achievement and intelligence.

In what follows an attempt is made to provide the details regarding this aspect of the study.

(i) Attitude of the Student towards the Multimedia Strategy : In order to measure the attitude of the students towards the multimedia instructional strategy, the score on the first and second administration of the scale have been taken into consideration. These scores were compared through the technique of mean and S.D. The result is presented in table V-5.

Table V-5 : Table of Critical Ratio
(Table on Attitude)

M_1 = 4.69	σ_1 = 0.84	df = 27	
M_2 = 5.10	σ_2 = 1.02	C.R.= 46	Not Significant

The table shows that the mean scores of the first and second administration of attitude scale are 4.69 and 5.10 respectively. The tool being an 11 point scale showing extreme favourable to extreme unfavourable attitude, the above mean scores show favourable attitude of the students towards the multimedia self instructional strategy. Further it was assumed that there is no significant difference between the mean scores of the first and second administration of the attitude scale and the same was tested through the technique of 't' test. The result of the comparison as table V-5 shows, does not exhibit

significant difference as the critical ratio is 0.46. Hence the null hypothesis that there is no significant difference between the mean scores of the first and second administration of the scale is not rejected. The result, therefore, shows that the attitude of the students towards the strategy is favourably stable.

(ii) Attitude and Achievement : As noted earlier, to find the relationship between attitude of the students towards the strategy and their achievement through it, the scores on the comprehensive test and those on the second (final) administration of the attitude were taken. In order to find the correlation between the two, the following null hypothesis has been framed: 'There is no significant correlation between achievement of the students through the strategy and their attitude towards it' and the same was tested through the application of the Product Moment of Coefficient of Correlation technique.

The result showed that the correlation between the two variables was .003 which is not significant at all. So the null hypothesis of no significant correlation between achievement and attitude at .01 level of significance is not rejected. The result shows that although the students have favourable attitude towards the multimedia strategy, their attitude has no significant relationship with their achievement through the strategy.

(iii) Intelligence and Achievement : In order to find the correlation between the variables of intelligence of the students

and their achievement through the strategy, the scores on the intelligence test and their scores on the comprehensive test were taken into consideration. For testing purpose the null hypothesis that 'There is no significant correlation between the achievement of the students through the strategy and their intelligence,' was framed and the same was tested through the application of Product Moment Coefficient of Correlation technique.

When the above technique was applied the obtained value was .69 which is significant at .01 level. This shows that there is highly positive correlation between the variables of achievement and intelligence. Hence the null hypothesis of no correlation between the two variables is rejected.

As the correlation between the two variables was found significant, further null hypothesis was framed with a view to testing whether there was significant difference among the means of the scores of the students of different levels of intelligence. So the null hypothesis 'There is no significant difference among the mean scores of high, middle and low intelligence groups at .01 level of significance' was framed and was tested through the technique of Analysis of Variance. The result is presented in the table given below :

Table V-6 : ANOVA Table of Intelligence and Achievement

Source of Variance	Sum of Square	df	Ms	F
Between Means	988.97	2	494.49	4.335
Within Means	2852.03	25	114.08	
Total	3841.00	27	-	

The table above shows that the 'F' ratio, 4.335 is significant at .05 level. Hence the hypothesis of no significant difference among the mean scores of high, middle and low intelligence group is rejected. The result shows that there is significant difference in the mean performance scores of the differente pairs of intelligence groups.

The result showed that there was significant difference among the different intelligence groups in their mean scores of performance. In order to locate where the actual differences lie, further null hypotheses were framed for testing purpose. They are :

(i) There is no significant difference between the mean performance scores of the high intelligence group and those of the middle intelligence group of students.

(ii) There is no significant difference between the mean performance scores of the high intelligence group of students and those of the low intelligence group of students.

(iii) There is no significant difference between the mean performance scores of the middle intelligence group of students and those of low intelligence group of students.

The above mean combinations were tested through 't' test. The result is presented in table V-7.

Table V-7 : Mean, Standard Error of Difference Between Means and 't' Values of Mean Differences of Achievement Scores of Students of Different Intelligence Levels.

Mean Pairs	No.of Students	Mean	Std.Error of diff. Bet. Means	't' value	Significance
High Intelligence	14	83.43	4.485	2.726	.05 level
Middle Intelligence	10	71.20			
High Intelligence	14	83.43	4.970	2.199	.05 level
Low Intelligence	4	72.50			
Middle Intelligence	10	71.20	4.497	0.173	Not Significant
Low Intelligence	4	72.50			

Table V-7 shows the 't' value of the mean differences of the achievement scores of students of different intelligence levels. The first section of the table gives the achievement mean scores of high and middle intelligence groups of students. The 't' value is found to be 2.726 which is significant at .05 level. Hence the null hypothesis of no significant difference between the achievement scores of high and middle intelligence groups of students is rejected.

Table V-7 shows the 't' value of the mean differences of the achievement scores of students of different intelligence levels. The first section of the table gives the achievement mean scores of high and middle intelligence groups of students. The 't' value is found to be 2.726 which is significant at .05 level. Hence the null hypothesis of no significant difference between the achievement scores of high and middle intelligence groups of students is rejected.

The second section of the table shows the achievement mean scores of students of high and low intelligence groups. The 't' value 2.199 is found significant at .05 level. Hence the null hypothesis of no significant difference between the achievement scores of high and low intelligence groups is rejected.

The third part of the table shows the achievement mean scores of students of middle and low intelligence levels. The 't' value found here is 0.173 which is not all significant. Hence the null hypothesis that there is no significant difference between the achievement scores of the middle and low intelligence groups of students is not rejected.

In short the result shows that there is correlation between intelligence of the students and their achievement through the instructional strategy. This correlation is specifically significant between the mean achievement scores of high and middle and high and low intelligence groups of

students. However, no significant relationship was found between the mean performance scores of the middle and those of the low intelligence group of students.

Discussion

The result presented in the first part of the chapter provides a general picture about the comparative effectiveness of the three forms of PLM not only in terms of the achievement of the students through the three forms of PLM but also in terms of their reaction towards the three forms by way of ranks. It has been noted that the achievement of the students in deviated linear and branching forms is similar in nature as the scores on criterion tests of both the forms run almost parallel to each other while that of linear form was found inferior. In the pupils rating of the different forms of PLM in terms of ranks, the branching form stands first, deviated linear second and linear third. The result in short shows that both in terms of achievement through the material and reaction towards it, linear form of PLM stands comparatively inferior.

This, however, is not to underestimate the potentialities of linear form of PLM. When looked upon it as a method of instruction, it has done its task to a considerable extent as can be noted from the results. Only when its effectiveness is compared with those of deviated linear and branching, it stands inferior. This does not imply that linear form has no efficiency or potentiality. As a medium of instruction it has exhibited

considerable efficiency and this fact cannot be denied.

PLM, in whatever form it is presented, is based on sound principles of learning and all forms are student centred and provide ample opportunity for student participation. The content matter in each form also is properly sequenced. If so what would possibly be the real reasons behind the comparatively lower performance of the students through linear and comparatively weak reaction towards it ? Could the reasons be found in the style or format in which the content matter in each form is presented ? Perhaps the reasons could be found here than anywhere else.

In linear the content matter is presented in small bits and is followed by a question at the end. The learner has to go through each bit of information presented in each frame in its sequence. In contrast to these, the frames both in deviated linear and branching forms are comparatively much bigger. In deviated linear the content matter is presented in such a way that the learner is not interrupted every now and again through questions that require responses until the whole concept that it presently deals is completed. Then the learner is asked a number of questions pertaining to the concept discussed in the frame. Unlike this, in branching form the learner is given a chance to choose alternative answers to the question posed at the end of the frame. Here his ability to recognize is important. Each reply would lead the learner into a different route. The correct response leads him into a new body of material while an incorrect

response leads him to a corrective branch, then back again to the main body of the programme. Thus, the branching form has the capacity for explaining why a response is either correct or incorrect. All these show that in all the three forms the extent of the content matter presented in each frame, the style of posing the question and the mode of responding them differ significantly. Perhaps, as already noted, the linear form with its innumerable little frames, fragment of information, continuous interruption through questions that require response, excess of repetition, might have failed to win the approval of the learner both in their performance on criterion tests as well as in their reactions towards it. In the same way the learners might have found the deviated linear and branching forms with their comparatively bigger frames and with questions requiring greater calibre from the part of the learner for responding, more challenging than the linear form. Perhaps one could find reasons in these for the comparatively inferior stand of the linear form.

The second half of the chapter presented the relationship between learner characteristics of attitude and intelligence and their achievement through the strategy. It has been seen that the students have favourable attitude towards the strategy. However, the relationship between attitude and achievement was not at all significantly important. It may be recollected in this connection that mere favourable attitude alone would not bring out better performance. Perhaps qualities such as patience, concentration, readiness to work hard and facilities of physical environment, etc.

would contribute towards the performance of students. The absence of any of these might adversely affect the performance.

Again, it was noticed that there is significant correlation between intelligence of the students and their performance through the strategy. This correlation is specifically significant between the mean performances of high and middle intelligence groups and between high and low intelligence levels. However, no significant relationship was found between the mean performance scores of the students of middle and low intelligence levels. In spite of the logical sequence of the content matter to be learnt, and the inbuilt capacity of the material for practice and drill, the students belonging to middle and low intelligence levels were not able to score as well as the students of high intelligence level. Perhaps the reason for this could be traced back to the lack of self-pacing in going through the material or to the absence of alternative components within the strategy as to permit the individual learner to select the method or technique that suits him best. Had these deficiencies been eliminated, perhaps this disparity among the different intelligence levels could have been minimised to a considerable extent.

In addition to what is already discussed, it seems worthwhile to putforward certain remarks pertaining to the characteristics of the learners and their achievement. The sample, as the scores on the intelligence test show; happened to be an intelligent one as most of the students belonged either to high or middle

intelligence levels. When looked from this point of view, the group was more or less homogeneous. This need not be the same with the students of the same level elsewhere. Often students with more of heterogeneous nature are found. Hence the outcome of this study may not be taken as indisputable. Further studies, therefore, may be made to rectify such issues as the ones raised int this chapter.
