A CRITICAL STUDY OF EFFECTIVENESS OF PROGRAMME INSTRUCTION (PI) AND COMPUTER ASSISTED INSTRUCTION (CAI) FOR MATHEMATICAL LEARNING DISABILITY OF SECONDARY SCHOOL STUDENTS

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Abstract

Learning is the process of acquiring and retaining knowledge so it may be applied in daily life. It is not a passive process, but many students find learning a difficult and painful process. Learning can become a terrible when there are memory problems, difficulties in following directions, trouble with the visual or auditory perception of information and an inability to perform paper and pencil tasks. Persons with learning disability are average or above average in intelligence. A severe mathematics learning disability and related conceptual disturbances in learning quantitative elements are referred as dyscalculia. It is a disability in which a person has a problem to understand arithmetic's concepts and math concepts. Computer as an aid for teaching has been gaining importance in India during the recent years. Computers have the potential to change the students' performance by promoting active participation, maintaining attention to tasks and enhancing problem solving skills. The use of computers as an aid in learning disabled children education is in its infancy. Research on learning and teaching are on the threshold of providing the kind of knowledge that could lead to real advances in mathematics instruction. Therefore, PI and CAI as a medium to help for meeting the educational needs of mathematical learning disabled should from an important sub-area in the area of intervention researches in learning disabilities. Keeping in view all about the considerations, researcher decided to undertake the study of the effectiveness of PI and CAI as remedial instruction for mathematical learning disabled.

1. INTRODUCTION:

Education, an essential requirement of a good and enlightened life, is a continuous and lifelong process, from 'womb' to 'grave'. Every year, every month, every day, step by step a person learns, feels, desires and is given the opportunity to learn. Education reflects the social pattern of society. It helps in contributing to the progress and development of society, state and thus nation. Schools are thus the essential ingredient of society as they alone are responsible for educating the youth formally. The education planned for these children is termed 'Special Education'. It is individually planned, systematically implemented and carefully evaluated instruction to help exceptional learners achieve the greatest possible personal self-sufficiency and success in present and future environments. In Special Education, as per need or requirement of the children, instructional methods are used and instructional material and packages are designed for students. Thus, in order to provide opportunities to each and everyone for developing and growing to full potential, provision and opportunity of special education is essential. Learning is the process of acquiring and retaining knowledge so it may be applied in life situations. Learning can become a nightmare when there are memory problems, difficulties in following directions, trouble with the visual or auditory perception of information and an inability to perform paper and pencil tasks (i.e. writing composition, note taking, doing written homework, doing mathematical calculation, etc.).

1.1 CONCEPT OF LEARNING DISABILITY:

The term 'learning disability' was first used in 1963 by Prof. Samuel Kirk to describe students having difficulties in schools, who had no other obvious disability. Learning disability is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or numerical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur concomitantly with other handicapping conditions (e.g. sensory impairment, mental retardation, serious emotional disturbances), or with extrinsic influences, (e.g. cultural difference, insufficient or inappropriate instructions etc.).

1.2 MATHEMATICAL LEARNING DISABILITY:

Mathematical learning disability and related conceptual disturbances in learning quantitative elements are commonly referred as dyscalcula/ dyscalculia. It is a disability in which a person has difficult time solving arithmetic problems and grasping math's concepts. It affects mathematical calculations. It is derived from a generic name "mathematics difficulty." Students who have difficulty in visual processing and sequencing or organizing detailed information often have difficulty in remembering specific facts and formulae for completing their mathematical calculations.

1.3 PROGRAMMED INSTRUCTION (PI):

Programmed instruction is a new method based on the old Socratic principle of individual tutoring. A programme is an organized series of simple stages, leading step by step, to the acquisition of a piece of knowledge or to the understanding of a problem. Programmed instruction is a method of self-instruction. It is a carefully designed scheme of work modules or units which enable a child to proceed at his own pace. Different sequences or delivery strategies can be used to meet the save objectives allowing for further adaptation. The small step size reduces the information processing requirements, thereby compensating for some deficiencies. The programme may be of several different forms. It may be a book, may be in the form of tapes or strips of paper, may be series of microfilm slides; it may be auditory material to be used with a tape recorder.

1.4 COMPUTER ASSISTED INSTRUCTION (CAI):

In the age of "information and computer literacy", computers have found their way into the classroom faster than most of us thought would be possible. Computers have enormous teaching-learning applications due to their large storage capacity, fast operating speed, interactive graphics and audio-visual mode (multi-media applications). The computer, in these cases, is used to present information to the students, receive their responses, analyze the responses and take appropriate action such as offer remedial information, cross-questioning, help in analyzing problems etc. Such use of computers to facilitate teaching and instruction is known as Computer Assisted Instruction (CAI). CAI occurs often without the direct intervention and sometimes even without the presence of the teacher. The role of the computer in CAI is to teach subject through preferably a dialogue, to evaluate student response and provide remedial teaching, to generate instructional material depending on the level of the student, to simulate systems of interest and to store students' records. CAI is the only medium which provides interactive, individualized learning and is pre-eminently, suited for simulations. The graphic and multimedia features of computers enable the student to visualize the models and problems which besides providing a clearer understanding, enhances the intuitive thinking of the student.

1.5 OBJECTIVES OF THE STUDY:

The study was conducted with the following major objectives:

1. To assess the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability.
2. To compare the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability among boys students.
3. To compare the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability among girls' students.
4. To compare the effectiveness of Traditional method in remediation of mathematical learning disability for learning disabled girls and boys.
5. To compare the effectiveness of PI in remediation of mathematical learning disability for learning disabled girls and boys.
6. To compare the effectiveness of CAI in remediation of mathematical learning disability for learning disabled girls and boys.

1.6 HYPOTHESIS OF THE STUDY:

As the present study was exploratory in nature, following null hypotheses were formulated:

1. There is no significant difference in the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability.
2. There is Significant variation does not occur between the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability among boys students.
3. The difference in variation is not significant between the effectiveness of PI, CAI and Traditional method in remediation of mathematical learning disability among girls' students.
4. There is no significant difference between the effectiveness of Traditional method in remediation of mathematical learning disability for learning disabled girls and boys.
5. There is no significant difference between the effectiveness of PI in remediation of mathematical learning disability for learning disabled girls and boys.
6. There is no significant difference between the effectiveness of CAI in remediation of mathematical learning disability for learning disabled girls and boys.

1.7 RESEARCH METHODS OF THE STUDY

The type of research method to choose is determined by the nature of the study and the aims to be achieved. The current study is quantitative in character and experimental in nature. The purpose of this study was to determine the relative effectiveness of traditional teaching methods, programmed instruction, and computer assisted instruction in the remediation of mathematical learning disabilities.

True experimental designs employ comparison groups and random assignments of subjects to conditions. The study was conducted using a single component multiple treatment approach. When we have one independent variable design then we use single factor research design. This design implemented because the study aimed to find out effectiveness in resolving a single aspect of mathematical learning disability of teaching methods;

- Traditional methods,
- Programmed instruction,
- Computer Assisted instruction (Multiple treatments)

Three groups were formed by random technique, one control and other two experimental, and the control group was taught using traditional method whereas the experimental groups were taught using PI and CAI.

1.8 VARIABLES – INDEPENDENT AND DEPENDENT
The following two types of variables were taken for the study:

A) INDEPENDENT VARIABLES
The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. Controlled variables of the study, namely, age, grade, place of instruction and level of intelligence have been studied. Other independent variables in the study are:

a) Method of Teaching
It is a treatment variable and therefore three methods of teaching i.e. Traditional Method, Programmed Instruction, and Computer Assisted Instruction were taken for the study. Here, Traditional Method means question answer method, rigorous practice, and repetition (drill and practice) and other practices which are commonly used in classroom settings in the schools of our country i.e. controlled method. Programmed Instruction method is an instruction program where the subject matter is broke down into small bits of information, arranged in a series of simple statements which involves active participation of the students. Computer Assisted Instruction is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place.

b) Gender
Being an attribute variable, it, too, cannot be altered. Gender had been thus used as a criteria variable under this study.

B) DEPENDENT VARIABLES
The dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces, removes or changes independent variables.
The dependent variable in this study was mathematical learning disability.
1. Number Concept
2. Arithmetic Process (operations)
3. Arithmetic Reasoning

1.9 POPULATION AND SAMPLE
As the learning material (PI and CAI Package) were prepared in English for class VIIth students, the study's population comprised all class of VIIth students in English medium schools in Moradabad who had learning difficulties in mathematics. In order to achieve the study's aims and test the hypothesis, schools in Moradabad were choosen at random among those that follow the CBSE, ICSE or U.P. Board. The research study included twelve English-medium schools with class VIIth students. Table 1.1 indicates the total number of students enrolled in VIIth class in the schools choosen for the study.

Table 1.1 :Population of childrens of class VIIth in selected school in Moradabad

S.No	Name of School	No. of Students		Total
		Boys	Girls	
1	Kendriya Vidalaya, Railway Harthala Colony	55	41	96
2	G K Wallems School	68	50	118
3	Ramsaran Das School	25	45	70
4	Kisan Saraswati Shishu Mandir	62	60	122

5	Prathmik Vidhyalaya, Manghopura	120	80	200
6	Maharaja Agrasen Public School	138	66	204
7	Sanjay Devi Bal Vidya Mandir	68	44	112
8	Gokul Singh Memorial Public School	244	105	349
9	Ramchand Sharma Inter College	69	49	118
10	Kanya Shiksha Prasar Junior High School	98	52	150
11	Ram Bharose Junior High School	16	20	36
12	Prathmik Vidhyalaya, Manhoharpur	44	26	70
	Total	**1007**	**638**	**1645**

In the next step, after selecting 1645 childrens, Behavioural Checklist for Screening the Learning Disabled (BCSLD) were provided by the class teacher of class VIIth of these schools to find out the children expected to be learning disabled. On the basis of the result, provided by teachers by applying BCSLD for each of these children, the researcher selected a primary sample of 297 childrens suspected to be learning disabled as shown in table 1.2.

Table 1.2 : Students suspected to be learning disabled

| S.No | Name of School | No. of Students | | Total |
		Boys	Girls	
1	Kendriya Vidalaya, Railway Harthala Colony	15	9	24
2	G K Wallems School	18	8	22
3	Ramsaran Das School	18	12	30
4	Kisan Saraswati Shishu Mandir	19	13	32
5	Prathmik Vidhyalaya, Manghopura	12	12	24
6	Maharaja Agrasen Public School	9	13	22
7	Sanjay Devi Bal Vidya Mandir	9	9	18
8	Gokul Singh Memorial Public School	19	14	33
9	Ramchand Sharma Inter College	11	14	25
10	Kanya Shiksha Prasar Junior High School	14	13	27
11	Ram Bharose Junior High School	9	10	19
12	Prathmik Vidhyalaya, Manhoharpur	10	11	21
	Total	**159**	**138**	**297**

The Diagnostic test of Learning Disability (DTLD) was administered to these 297 students in the second phase to identify those who would be classified as actual learning disabled. On the basis of the result of

the diagnostic test, 185 students, found to be actually learning disabled, were selected in the secondary sample. (Table 1.3)

Table 1.3 : Populations of Students categorized as actual learning disabled.

S.No	Name of School	No. of Students		Total
		Boys	Girls	
1	Kendriya Vidalaya, Railway Harthala Colony	9	6	15
2	G K Wallems School	9	7	16
3	Ramsaran Das School	11	7	18
4	Kisan Saraswati Shishu Mandir	10	5	15
5	Prathmik Vidhyalaya, Manghopura	10	11	21
6	Maharaja Agrasen Public School	8	5	13
7	Sanjay Devi Bal Vidya Mandir	8	5	13
8	Gokul Singh Memorial Public School	11	8	19
9	Ramchand Sharma Inter College	8	6	14
10	Kanya Shiksha Prasar Junior High School	8	7	15
11	Ram Bharose Junior High School	4	6	10
12	Prathmik Vidhyalaya, Manhoharpur	8	8	16
	Total	**104**	**81**	**185**

Raven's test of Colored Progressive Matrices (CPM) was used to assess the intellectually ability of these 185 children and intellectually average and above average students (falling in grade III or above the test) were identified (Table 1.4) and given the Grade Level Assessment Device (GLAD) to determine their mathematical learning ability. In this test, all students with a score of $P_{40}(52)$ or lower were choosen as an actual sample. Among 96 students, 54 were boys and remaining 32 were girls. (Table 1.5)

Table 1.4 : Distribution of VIIth grade Intellectually-Average Learning Disabled Children (School wise & Gender wise)

S.No	Name of School	No. of Students		Total
		Boys	Girls	
1	Kendriya Vidalaya, Railway Harthala Colony	3	5	8
2	G K Wallems School	3	6	9
3	Ramsaran Das School	5	8	13
4	Kisan Saraswati Shishu Mandir	3	4	7
5	Prathmik Vidhyalaya, Manghopura	6	7	13

6	Maharaja Agrasen Public School	3	5	8
7	Sanjay Devi Bal Vidya Mandir	5	5	10
8	Gokul Singh Memorial Public School	9	7	16
9	Ramchand Sharma Inter College	4	3	7
10	Kanya Shiksha Prasar Junior High School	2	6	8
11	Ram Bharose Junior High School	3	3	6
12	Prathmik Vidhyalaya, Manhoharpur	5	5	10
	Total	**64**	**51**	**115**

Table 1.5 :   Population of Students found to be mathematical learning disabled

S.No	Name of School	No. of Students Boys	Girls	Total
1	Kendriya Vidalaya, Railway Harthala Colony	4	2	6
2	G K Wallems School	5	3	8
3	Ramsaran Das School	7	4	11
4	Kisan Saraswati Shishu Mandir	4	2	6
5	Prathmik Vidhyalaya, Manghopura	6	6	12
6	Maharaja Agrasen Public School	4	2	6
7	Sanjay Devi Bal Vidya Mandir	5	2	10
8	Gokul Singh Memorial Public School	5	7	16
9	Ramchand Sharma Inter College	3	4	7
10	Kanya Shiksha Prasar Junior High School	4	2	6
11	Ram Bharose Junior High School	3	3	6
12	Prathmik Vidhyalaya, Manhoharpur	4	5	9
	Total	**54**	**42**	**96**

1.10 TOOLS EMPLOYED

In this part, you will find a list:

a)   Behavioral Checklist for Screening the Learning Disabled (BCSLD) by Swaroop and Mehta

b)   Diagnostic Test of Learning Disability (DTLD) developed by Swaroop and Mehta

c)   Raven's Coloured Progressive Matrices (Sets A, Ab and B)

d)   Grade Level Assessment Device (GLAD) Developed by Jayanthi Narayan.

e)   Programmed Instruction & CAI Package, developed by researcher in guidance of supervisor.

1.10.1 BEHAVIOURAL CHECKLIST FOR SCREENING THE LEARNING DISABLED (BCSLD)

The Behavioural Checklist is a screening tool that promotes the use of other diagnostic tools for the assessing and determining a child's learning disability. The teacher must fill in 30 items, both positive and negative, on the checklist. It includes eight categories, each of which represents a lack in certain ability,

and provides insight into the mental make-up of the child, seeking to explain why he or she is underachieving. It was tested on 1000 children aged 8 to11 years old.

All aspects of learning, including the ability to assimilate visual and auditory information, memory, understanding, reasoning, psychomotor abilities, self- image and motivation, are attempted to be integrated in the behavioural approach. All these factors are important in a child's learning process. The interplay of these eventually leads to the child's academic success. The eight areas covered by BCSLD are as follows:

1.   Deficiency in Visual Processing
2.   Deficiency in Auditory Processing
3.   Deficiency in the Cognitive Domains (thinking, reasoning, comprehension)
4.   Deficiency in Language
5.   Deficiency in Memory
6.   Preservation – Tendencies
7.   Deficiency in motor coordination
8.   Disorders in the Affective domain

1.10.2 DIAGNOSTIC TEST OF LEARNING DISABILITY (DTLD)

Swarrop and Mehta (1983) developed and standardized the Diagnostic Test of Learning Disability (DTLD) to detect children with learning disabilities in English medium schools aged 8-11 years. Because learning disabilities can affect a wide range of talents, DTLD has divided learning impairment into ten sections, each representing a basic psychological process. A learning problem would result from a shortfall in any of the domains, or a combination of areas. Despite the fact that the areas have been categorized independently, they cannot be divided into discrete groupings because some overlap is unavoidable. The DTLD can be given to an individual or a group of people.

1.10.3 RAVEN'S COLOURED PROGRESSIVE MATRICES (CPM)

Raven (1990) created and standardized the Coloured Progressive Matrices (CPM) to test intellectual capacity. The three sets A, Ab and B of twelve items that make up the CPM are designed to measure the main cognitive processes that children under the age of 12 are capable of. The test has been given as 36 coloured illustrations printed in a book (Book Form) or as boards and movable pieces (Board Form) to make the problems to be addressed as evident as possible with as little spoken explanation as feasible. Manipulation of the material is not required for success, all that is required for a person to indicate the desired figure to be entered in the problem. When coloured backgrounds are utilized, the book and board formats of the test produce nearly identical results for the majority of regular applications.

1.10.4 GRADE LEVEL ASSESSMENT DEVICE FOR CHILDREN WITH LEARNING PROBLEMS IN SCHOOL (GLAD)

Jayanthi Narayan (1997) created this instrument to assess the primary school students learning difficulties. The device was designed with the regular curricular content's of India's first through fourth grades in mind, including things drawn from the existing curricular. There are two formats of GLAD available:

Format I have test booklets in the form of worksheets for Grades I through IV. Worksheets in Hindi, English and Maths were distributed to each class. Tasks involving verbal and written responses to queries are among the items. The instructions are written at the top of each worksheet. Each subject, namely Hind, English and Maths, includes a scoring sheet at the end. Format I helps in the quantitative assessment of a child's performance at the class level.

There are three section and a summary sheet in Format II. The child's background information including personal and socioeconomic background, family history and school history, is recorded in Section I. Section II contains items that assist teachers in detecting sensory and motor deficits in children. The Summary page provides a concise genral picture of the child, whereas Section III contains observations about the child's processing issues.

1.10.5 PROGRAMMED INSTRUCTION PACKAGE
The researcher created the PI package with the goal of providing assistance to the study's sample students with mathematical learning disabilities. By showing the package to twelve Teacher-Educators, we were able to ensure that it was face validity.

1.10.6 CAI PACKAGE
The CAI package was created by the researcher with the goal of educating students with mathematics learning disabilities who were chosen for the study to improve their performance in those areas. By showing the package to twelve Teacher-Educators, face validity was ensured.

1.11 PROCEDURE OF EXPERIMENTATION
The procedure adopted in the study can broadly be classified into two parts.
   a) First Part
      The study began with the selection of sample subjects from the population. This section was previously covered in this chapter under the heading Population and Sample.
   b) The second part of the study dealt with conduction of the experiment. On the basis of their CPM scores, 96 sample participants (54 boys, 42 girls) were sorted into three groups A, B and C, each consists 32 (18 boys, 14 girls).One of these groups, Group A was designated as the Control Group, while groups B and C were designated as the experimental groups. The experimental groups B and C were taught using the CAI and PI packages, respectively, whereas the control group A was taught using the Traditional Method. The experiment took place at the Troop Institute of Computer Course in Moradabad over a period of fifteen weeks, with three spells per week. The students in control group A visited Troop Institute twice a week, from 03 to 06 p.m. on Mondays and Thursdays, and the researcher attempted to provide traditional remedies in their areas of mathematical learning disability individually and collectively. The students in experimental group B came to Troop Institute twice a week, from 3 to 6 p.m. on Wednesdays and Saturdays, and were taught using the CAI programme by the researcher. The students in experimental group C likewise came to Troop Institute twice a week, on Tuesdays and Fridays at the same time, and the researcher asked them to learn using the PI programme. After the experiment was completed, the researcher administered the GLAD to the children in all three groups A, B and C.

1.12 ANALYSIS OF DATA
The effect of remediation and double and triple interactional effects were investigated in Phase 1 using a 2 x 3 factorial experimental with a randomized group design. In the next three phases, raw scores were analyzed to find out the effectiveness of the Traditional Method, PI Method and CAI Method, respectively in remediation of learning disability. Phases V to VII dealt with comparing the relative effectiveness of Traditional and Programmed Instruction Method, Traditional and Computer Assisted Instruction Method and Programmed Instruction Method and Computer Assisted Instruction Method in remediation of learning disability respectively. In all the phases, scores were analyzed to determine the effectiveness of

teaching methods on overall remediation, their effect on improving learning disability and gender differences in remediation.

Phase – I Summary of ANNOVA for 2 x 3 factorial experiments with unequal n's

Table 1.6

Source of Variation	SS	Df	MS	F
A (Method of Teaching)	6938.66	2	3469.33	36.08*
B (Sex)	32.60	1	32.60	0.34
AB	57.81	2	28.91	0.30
Within treatment (error)	8653	90	96.14	-

In table 1.6, the results of the computation have been summarized in accordance with 2 x 3 factorial designs with unequal n's in treatment cells. The F-ratio's for Factor A (Method of Teaching) denotes Traditional Method, CAI and PI, Factor B (Sex) denotes male and female and AB interation were obtained. They came out to be 36.08, 0.34 and 0.30 respectively. It was calculated that the observed df of 36.08 for main effect far exceeds the critical value of 4.84 at x = 0.01 for x and 90 degree of freedom.

For male effect of B and interaction effect AB, the observed x of 0.34 and 0.30, respectively were less than the critical value of F at x = 0.01 or even at x = 0.05 which shows that the main effect and interaction effects were not significant.

Now it can be observed that the main effect of A has been determined to be significant that is method of teaching (traditional, PI and CAI) produce a significant effect on sex, but sex produces no effect on the method of teaching and also that there is no evidence of an interaction between the two factors – it can be inferred that the differences in teaching methods are the same for both male and female.

Phase – II Remediation of Mathematical Learning Disability through Traditional Method

Table 1.7 :

Mean GLAD scores of group A students on pre-test and post-test

Testing Stage	N	M	SD	r	T
Pre-test	32	32	10.11		
				0.84	3.75**
Post-test	32	35.63	9.11		

* Significant at 0.05 Level

**Significant at 0.01 Level

A perusal of Table 1.7 clearly said that mean GLAD scores achieved by group A subjects, taught through Traditional method, on pre-test and post-test were 32.00 and 35.63, respectively. The difference in mean score was highly significant (t=3.75, P<0.01). The significant gain in post –test scores shows that the Traditional method of teaching was significantly effective in improving mathematical learning disabled for students of grade VIIth of age group 11 to 14 years.

Furthermore, a high and positive correlation (r=0.84) was obtained by pre-test and post-test through students. This implies that the traditional method of teaching was effective and consistent for all the students.

Phase – III Remediation of Mathematical Learning Disability through Programmed Instruction (PI)

Table 1.8

Mean GLAD scores of group C students on pre-test and post-test

Testing Stage	N	M	SD	r	t
Pre-test	32	31.38	8.01		
				0.70	9.57**
Post-test	32	44.75	9.06		

* Significant at 0.05 Level

**Significant at 0.01 Level

In Table 1.8, the mean scores on GLAD achieved by group C students on the pre-test and post-test were 31.38 and 44.75, respectively. The difference in mean scores was found to be highly significant (t=9.57, P<0.01). It shows that PI method of teaching was effective in remediation of mathematical learning disability in VIIth grade students of selected group of age 11-14 years.

The product moment correlation between pre-test and post-test scores for group B students was highly positive (r=0.70). But its value which is r=0.70 was again less than its value for traditional method (r=0.84). The reason was same as discussed earlier in Table 1.8.

Phase – IV Remediation of Mathematical Learning Disability through Computer Assisted Instruction

Table 1.9

Mean GLAD scores of group B students on pre-test and post-test

Testing Stage	N	M	SD	r	T
Pre-test	32	31.75	9.53		
				0.51	13.75**
Post-test	32	56.75	10.82		

* Significant at 0.05 Level

**Significant at 0.01 Level

In Table 1.9, the mean GLAD scores achieved by students of Group B on the pre-test and post-test were 31.75 and 56.75. The difference in mean score was found to be highly significant (t=13.78, P<0.01). It shows that CAI method of teaching was effective in improving disability of mathematical learning disabled children of grade VIIth of age group 11-14 years.

The product moment correlation between pre-test and post-test scores for group B students was highly positive (r=0.51), but it was less than that achieved in case of traditional method and PI method. Hence, it declared from findings that CAI method was consistent as compared to traditional method.

Phase V Comparing Relative Effectiveness of PI and Traditional Method in remediation of Mathematical Learning Disability

Table 1.10

Mean GLAD scores of group A and group C students on the post-test

Groups	N	M	SD	T
Group A	32	35.63	9.11	
				4.56**
Group C	32	44.75	9.06	

* Significant at 0.05 Level

**Significant at 0.01 Level

In refer to table 1.10, it shows that the variation in the mean scores on GLAD achieved by group A and group C students on the post-test 35.63 and 44.75, respectively was statistically significant (t=4.56, P<0.01) in favor of group C students. It concludes that PI method of teaching was better in improving the learning disabled students' ability to solve mathematics as compared to Programmed Instruction method. In summing of table 1.7, table 1.9, and 1.10, it shows that PI method of teaching as well as traditional method were effective in improving sample subjects' ability but PI method was better than the traditional method. However, traditional method was better in consistency than the CAI method.

Phase VI Comparing Relative Effectiveness of Computer Assisted Instruction (CAI) and Traditional Method in Remediation of Mathematical Learning Disability

Table 1.11 : Mean GLAD scores of group A and group B students on the post-test

Groups	N	M	SD	T
Group A	32	35.63	9.11	
				8.52**
Group B	32	56.75	10.82	

* Significant at 0.05 Level

**Significant at 0.01 Level

In table 1.11, it shows that mean GLAD scores of group A and group B students on post-test were 35.63 and 56.75, respectively. The 't' value obtained from mean GLAD scores was highly significant (t=8.52, P<0.01). It refers that CAI method was better than the traditional method of remediation of mathematical learning disability for the students studying in grade VII and in the age group of 9-11 years.

When study table 1.6, 1.10 and 1.11 together, it said that traditional and CAI method were effective in remediation of learning disability for the grade VIIth students in the age group of 11-14 years. As a result, CAI method was superior to traditional method in remediation of mathematical learning disability for the selected groups and traditional method was better in consistency.

Phase VII Comparing Relative Effectiveness of Computer Assisted Instruction (CAI) and Programmed Instruction (PI) in Remediation of Mathematical Learning Disability

Table 1.12

Mean GLAD scores of group B and group C students on the post-test

Groups	N	M	SD	t
Group B	32	56.75	10.82	
				4.84**
Group C	32	44.75	9.06	

**Significant at 0.01 Level

In table 1.12, the mean scores on GLAD achieved by Group B and Group C students on post-test are 56.75 and 44.75 respectively. The value of 't' was highly significant (t=4.84, P<0.01). It reveals that the CAI method of teaching was superior to PI method in remediation of mathematical learning disability of the concerned group.

1.13 MAJOR FINDINGS

The following results have been drawn from the study:

A.1 The traditional method of teaching, which included individual attendance, drill and practice, was significantly effective in remediation of mathematical learning disability for VIIth grade learning disabled children of the age group 11 to 14 years.

B. 1 The PI method of teaching was found to be significantly effective in remediation of mathematical learning disability for the grade VII of the age group 11 to 14 years.

C. 1 The CAI method of teaching was found to be significantly effective in remediation of mathematical learning disability among VIIth grade of the age group 11 to 14 years.

D.1 The PI method was significantly better than the traditional method of teaching in remediation of mathematical learning disability among VIIth grade of the age group 11 to 14 years learning disabled children.

E.1 The CAI method of teaching was found to be more consistent than the traditional method of teaching in remediation of mathematical learning disability among VIIth grade learning disabled children in the age group of 11 to 14 years.

F.1 The CAI method of teaching was found to be significantly more effective than PI method of teaching in remediation of mathematical learning disability among VIIth grade students of the age group of 11 to 14 years.

1.17 CONCLUSION

In this study, the findings were discussed below:

1. The null hypothesis H_1 that "there is no significant difference between the effectiveness of Traditional Method and PI in remediation of mathematical learning disability" is rejected since it has been prove that PI method of teaching is more effective than the traditional method of teaching in remediation of mathematical learning disability.

2. The null hypothesis H_2 that "there is no significant difference between the effectiveness of Traditional method and CAI method of teaching in remediation of mathematical learning disability" is rejected since it has been found that the CAI method is more effective than the Traditional method of teaching in remediation of mathematical learning disability.

3. The null hypothesis H_3 that "there is no significant difference between the effectiveness of CAI and PI in remediation of mathematical learning disability" is rejected since it has been found that the CAI method of teaching is more effective in remediation of mathematical learning disability as compared to PI.

4. The null hypothesis H_{10} that "there is no significant difference between the effectiveness of Traditional method in remediation of mathematical learning disability for learning disabled girls and boys" is accepted. The observed difference may be due to chance factor.

5. The null hypothesis H_{11} that "there is no significant difference between the effectiveness of PI method of teaching in remediation of mathematical learning disability for learning disabled girls and boys" is accepted. The observed difference may be due to chance factor.

6. The null hypothesis H_{12} that "there is no significant difference between the effectiveness of CAI in remediation of mathematical learning disability for learning disabled girls and boys" is accepted. The observed difference may be due to chance factor.

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