

Chapter IV

**Development Of Multimedia Instructional
System And Research Procedure**

Chapter IV

DEVELOPMENT OF MULTIMEDIA INSTRUCTIONAL SYSTEM AND RESEARCH PROCEDURE

4.1 INTRODUCTION:

Development of multimedia instructional system includes planning, designing, construction and testing of the system. There are various configurations of system development; the investigator has used one of the configurations discussed in detail in the following paragraphs.

This chapter deals with the procedure used by the investigator in developing multimedia instructional system on educational technology for B.Ed. pupil-teachers. The chapter also includes research procedure, experimental design and description of tools used in experimenting and evaluating the instructional system so constructed.

4.2 MULTIMEDIA DEVELOPMENT PROCEDURE:

A simplified flowchart of multimedia development procedure is shown in Fig.1. This process is more complex than presented. It involves considerable numbers of additional steps.

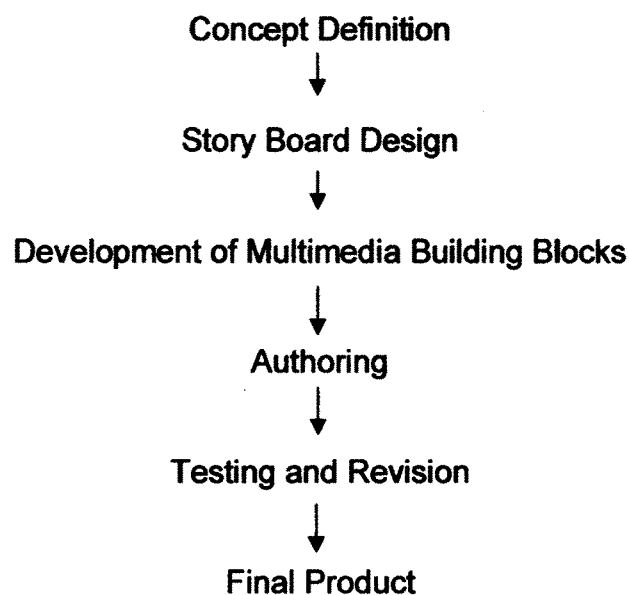


Fig.1: A simplified Multimedia Development Process Flow Chart

A step by step development process is presented in Fig. 2 below which will slightly vary from concept to concept.

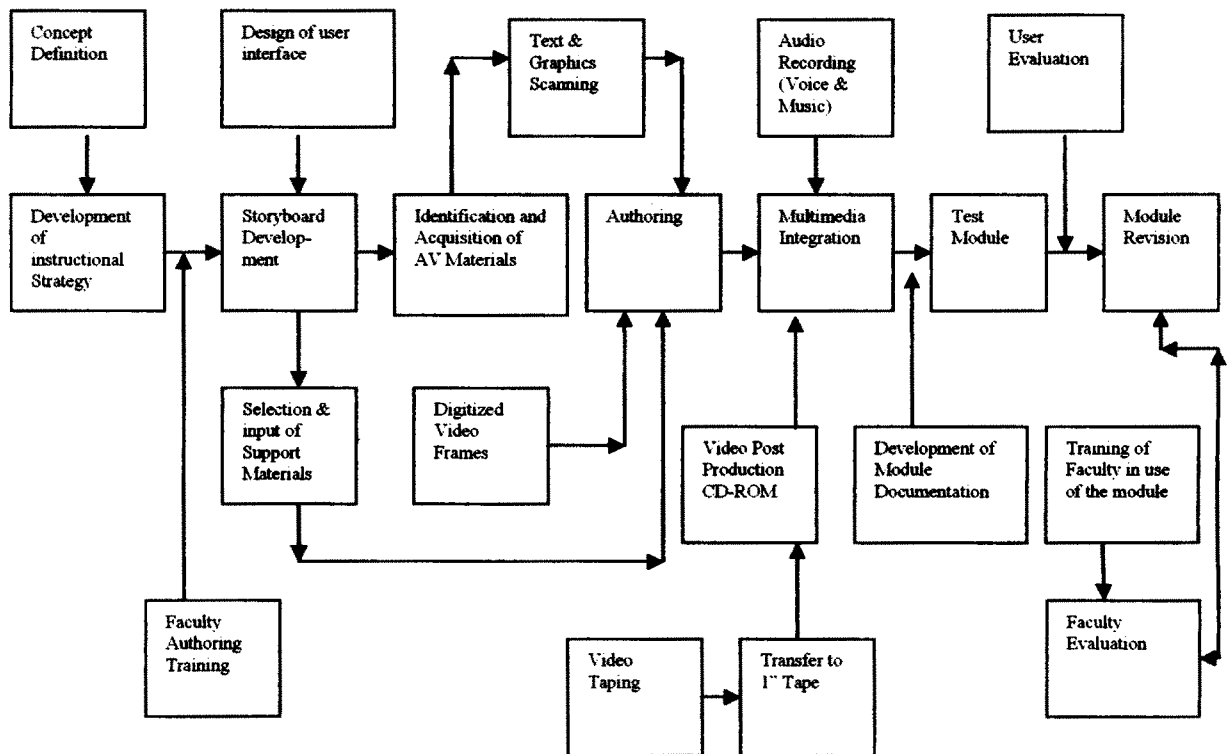


Fig. 2: A step-by-step development process of Multimedia System

The meanings of the terms included in the above flowcharts are as follows.

1) Concept Definition:

The clarification, content analysis, program script of the thing that is to be developed through multimedia technology means concept definition.

2) Story Board:

The storyboard is a graphic representation of the proposed multimedia project. It is an extension of the ideas presented in the script.

3) Multimedia Blocks:

The multimedia application includes multimedia blocks such as Graphic, Text, Video and Sound. The multimedia architect is responsible for putting these components together as a multimedia application.

4) Authoring:

Multimedia authoring software is a program used to develop all types of multimedia building blocks, import and integrate all these elements into a comprehensive and possibly interactive application – Director 9.0 and Authware are powerful authoring programs.

The development process followed following major steps.

Step 1: Survey of present setting

In this step of the development following are the sub-steps.

A questionnaire for teacher-educator was constructed to obtain information about present setting of Educational Technology course instruction. All teacher-educators teaching the course (approx. 50) in colleges of education affiliated to Shivaji University, Kolhapur was asked to respond. The analysis and interpretation of the data had done which helped in designing of the system. The survey also helped in the analysis of the roles other related human factors and non-human factors such as classroom situation, learning tasks, methods-materials-media, facilities, resources and constraints in existing system.

Unstructured interview of 20% teacher-educators (approx. 10) and some experts was conducted to obtain further related data.

The analysis of human and non-human factors helped the team in deciding about planning and designing the instructional system.

The outcome of this step was a rough sketch of the instructional system.

Step 2: Planning of the Multimedia Application (Pre-production phase):

In this step investigator had gone through the following sub-steps:

- The goals, objectives, content and the activity matrices of the system were defined.
- The application scripts were developed and were translated into outlines and outlines into logic flowcharts. Video and audio files, production scripts and schedule was decided.
- Program storyboards for each screen was developed. Production of music, audio and video was planned.

The outcome of this step was a complete design of the proposed system.

Step 3: Production of Multimedia Application:

The investigator has gone through following sub-steps:

- Text blocks, 2-D and 3-D graphics were developed.
- Computer animations were designed and developed.
- Video and audio files were produced.
- Authoring software was selected accordingly and a first working model of this proposed multimedia instructional system with user manual was developed. The system was stored on CD-ROM.
- The internal evaluation of a multimedia application was done within the multimedia development team.
- Alpha testing of the system was done on selected group of teacher-educators to receive feedback and recommendations about the system.

The outcome of this step was prototype of the system.

Step 4: Evaluation of the Multimedia Instructional System:

This was done in following manner.

- The investigator used focus group testing and Beta testing for external evaluation of the system. Focus group testing is pilot testing of the system. The one group, Pretest-Post test

Experimental design was used. A program evaluation form and a retention scale were provided to the group. The group consists of 24 pupil-teachers from College of Education, Barshi. The group was evaluated by administering pre and post tests specially prepared for the purpose. The application was revised accordingly.

- Copies of revised system stored in CD-ROM were made available to the group of pupil-teachers from College of Education, Barshi called Beta testing group. Beta testing of the system is an experiment. The Solomon Four-Group Experimental Design was used. Beta testing reporting form and a reaction scale was provided to the group. The group was evaluated by administering pre and post achievement tests.
- The data obtained was classified, analyzed and interpreted.

Step 5: Report Writing:

The instructional system so developed and experimented and inferences and conclusions based on the experimentation were systematically presented in seven chapters.

4.3.1 ANALYSIS AND INTERPRETATION OF THE PRETEST DATA OF SMALL SCALE TRY-OUT SAMPLE:

A pretest was administered on the try-out sample to collect the information of the pupil-teachers about the performance of the pupil teachers in Educational Technology content, which was decided by the investigator to be use in the instructional system. The scores obtained by the male, female and total 20 pupil teachers are given in the Appendix (L)

Means and S.D. of the pretest and protest scores were calculated.

Table IV.1

FREQUENCY DISTRIBUTION TABLE OF THE SCORES OBTAINED BY THE PUPIL-TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN A PRE TEST (SCORES OUT OF 25)

C.I.	Control Group			Experimental Group		
	M ₁	F ₁	T ₁	M ₂	F ₂	T ₂
08 – 10	0	1	1	0	1	1
06 – 08	1	1	2	1	2	3
04 – 06	3	2	5	3	1	4
02 – 04	1	1	2	1	1	2
00 – 02	0	0	0	0	0	0
Total	5	5	10	5	5	10

The above table is based on the data given in Appendix (L). The means and S.D.S. of the scores were calculated and tabulated in the next table.

The data is explained with the help of fig. 4.1 is a graph of the scores obtained from every individual from control group and experimental group in pretest. The obtained scores by the pupil-teachers from control and experimental groups are not equivalent but the means are nearly equivalent.

Fig. 4.2 is a frequency distribution graph of the pupil-teachers from control group. Females found to be superior to the male pupil-teachers.

Fig. 4.3 is a frequency distribution graph of the pupil teachers from the experimental group. Females found to be superior to the male pupil-teachers.

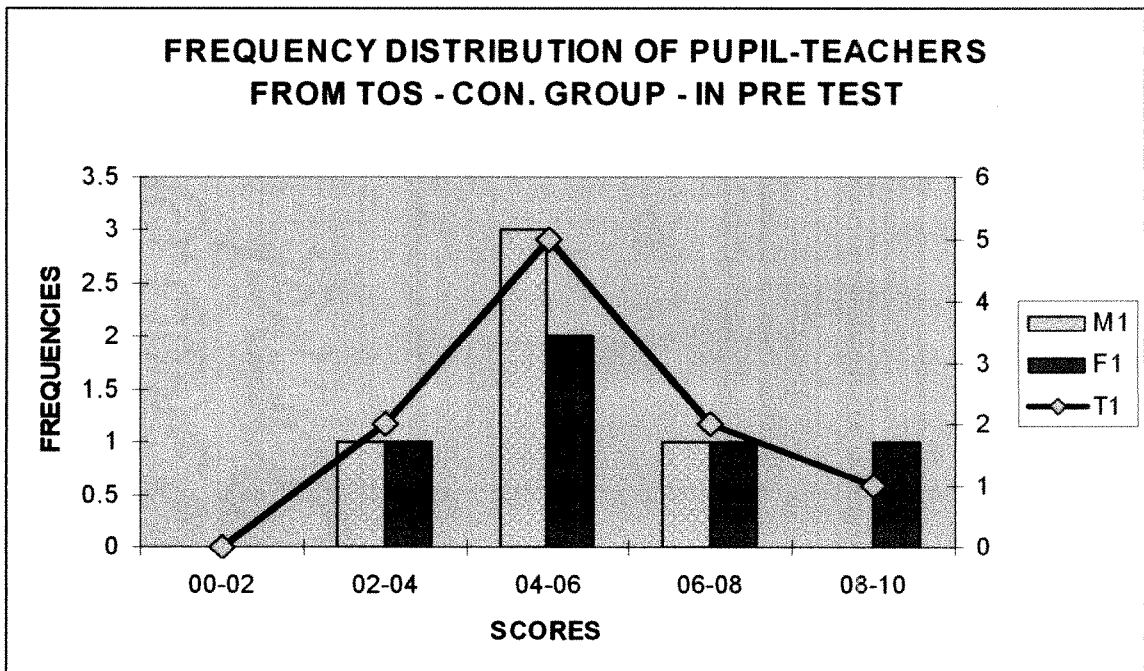
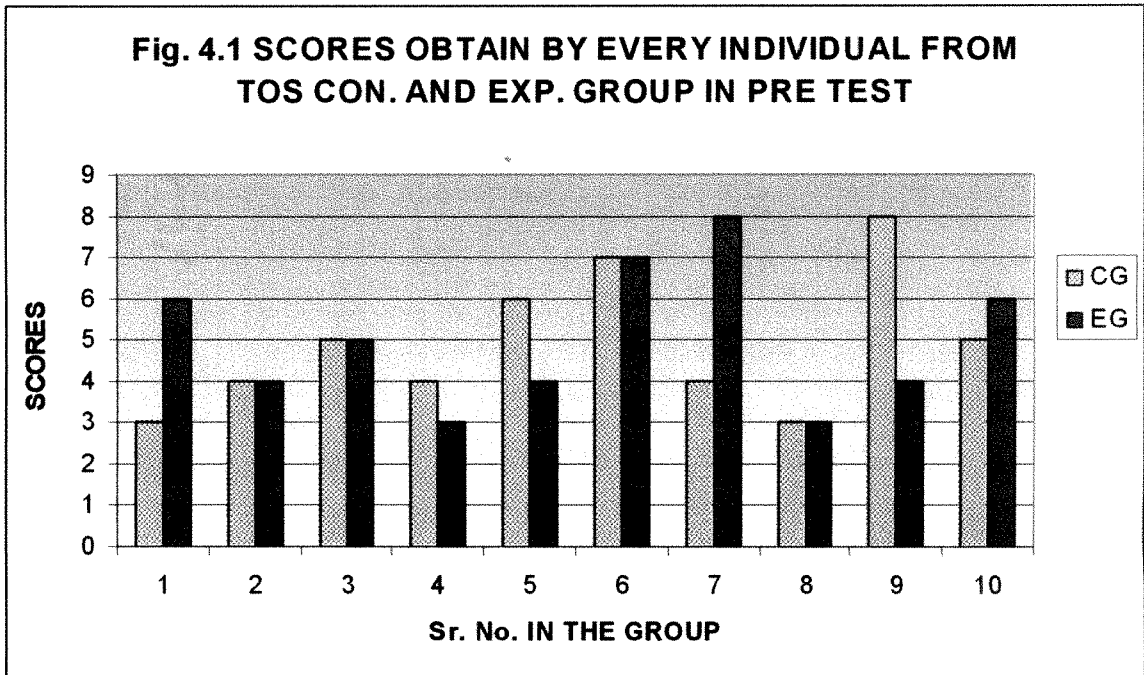
Fig. 4.4 is a frequency distribution graph of the male pupil-teachers from both the groups. Their scores in pretest coincide.

Fig. 4.5 is a frequency distribution graph of female pupil teachers from both the groups. Their scores in pretest nearly coincide.

14387

A

Fig. 4.6 is a frequency distribution graph of the pupil teachers from both the groups. Total pupil teachers from both the groups nearly have coinciding frequency distribution.



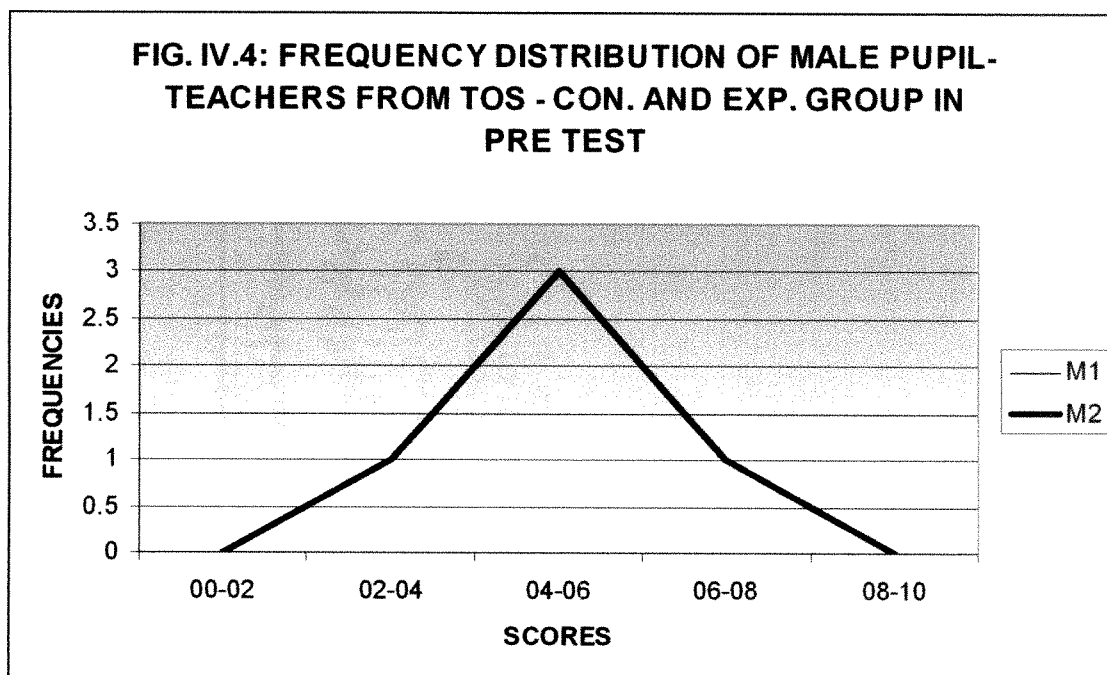
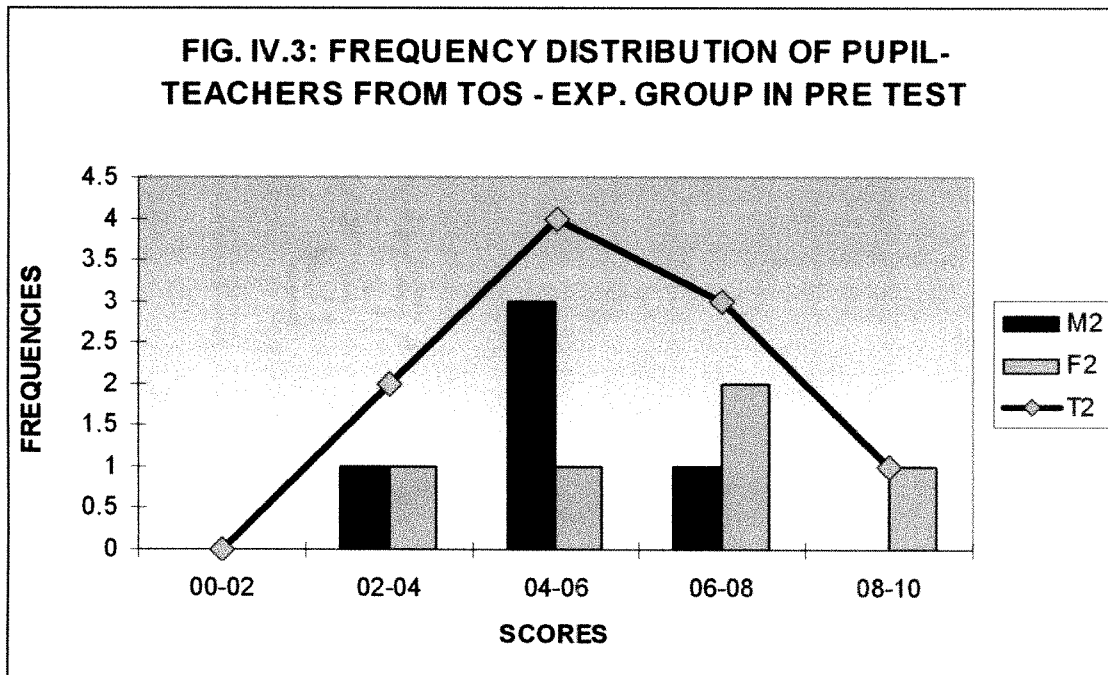


FIG. IV.5: FREQUENCY DISTRIBUTION OF FEMALE PUPIL-TEACHERS FROM TOS - CON. AND EXP. GROUP IN PRE TEST

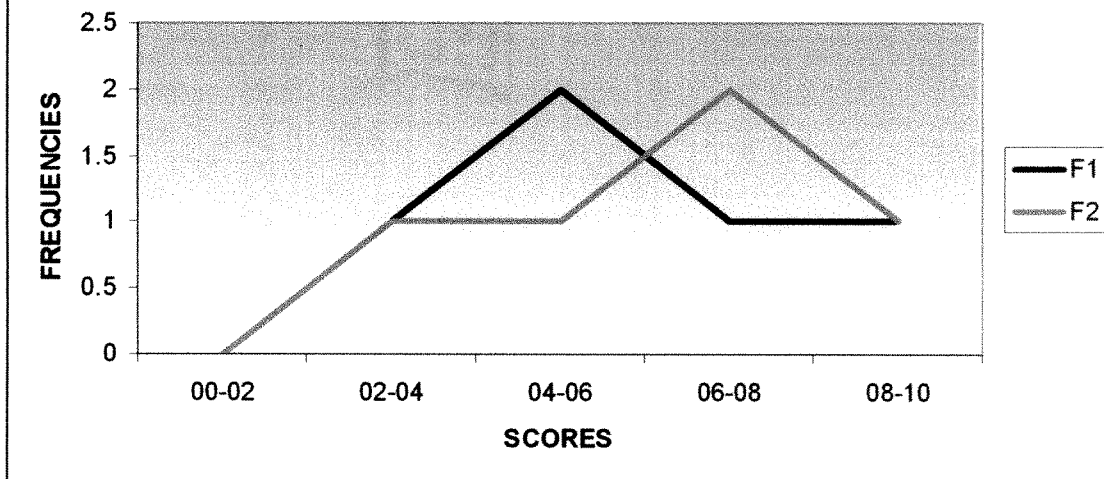


FIG. IV.6: COMPARATIVE GRAPH OF THE FREQUENCIES OF TOTAL PUPIL-TEACHERS FROM TOS - CON. AND EXP. GROUP IN PRE TEST

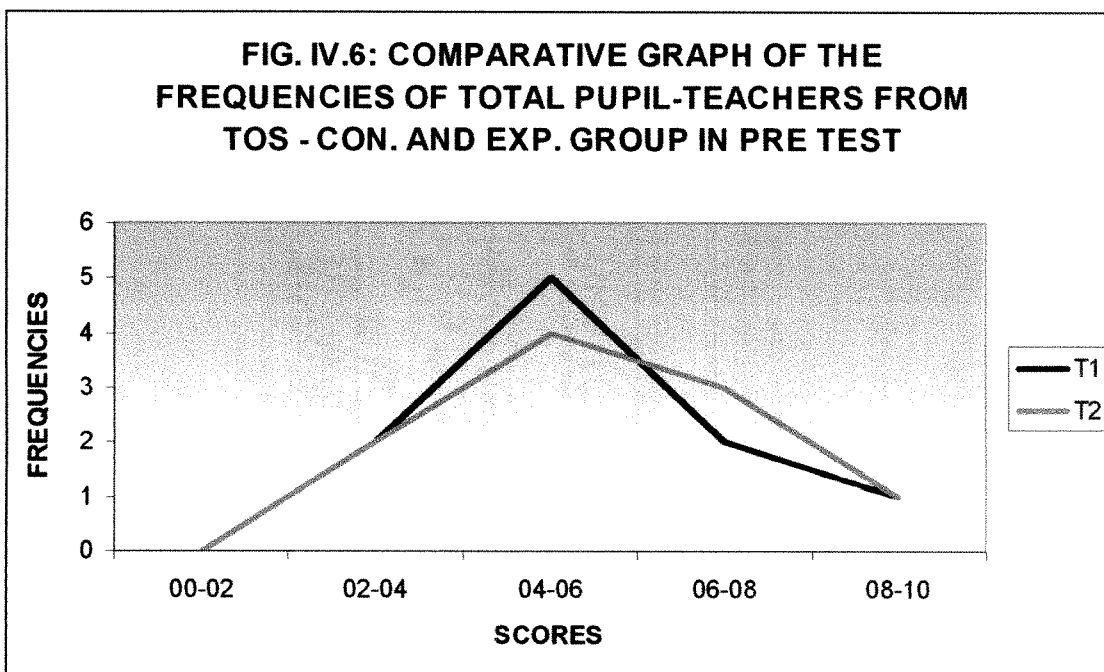


Table IV.2
MEANS AND S.D.s OF THE SCORES OBTAINED BY THE PUPIL
TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN A PRE TEST

Measure	Control Group			Experimental Group		
	M ₁	F ₁	T ₁	M ₂	F ₂	T ₂
N	5	5	10	5	5	10
M	4.4	5.4	4.9	4.4	5.6	5.0
σ	1.264	2.161	1.784	1.264	2.304	1.887

The significance of the difference between the statistical measures were calculated by using t technique and interpreted in the following tables.

Table IV.3
SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE MALE
AND FEMALE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL

Measure	Control group		Experimental group	
	M ₁	F ₁	M ₂	F ₂
N	5	5	5	5
M	4.4	5.4	4.4	5.6
σ	1.264	2.161	1.264	2.304
D means	1.0		1.2	
t	0.945 (NS)		1.134 (NS)	
df	8		8	

NS: Non Significant at 0.05 and 0.01 levels of significance.

The differences between the means of male and female pupil teachers from control and experimental groups in pre test scores were 1.0 and 1.2 are found to be non-significant at 0.05 and 0.01 levels of significance because the t values are less than 2.31 and 3.36 for df 8. It means that male and female pupil teachers from any group do not differ in their performance in the pre test.

Table IV.4
SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE FEMALE
TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE TEST
SCORES

Measure	Control group	Experimental group
	F ₁	F ₂
N	5	5
M	5.4	5.6
σ	2.161	2.304
D means	0.2	
t	0.152 (NS)	
df	8	

NS: Not significant at 0.05 and 0.01 levels of significance.

The difference between the means of females pupil-teachers from control and experimental groups in pretest scores was 0.2, is found to be non-significant at 0.05 and 0.01 levels of significance because the t value is less than 2.31 and 3.36 for df 8. It means that the female pupil teachers from control and experimental groups do not differ in their performance in the pre test.

Table IV.5
SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE MALE
PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE
TEST SCORES

Measure	Control group	Experimental group
	M ₁	M ₂
N	5	5
M	4.4	4.4
σ	1.264	1.264
D means	0	
t	0	
df	8	

NS: Non Significant at 0.05 and 0.01 levels of significance.

The difference between the means of male pupil-teachers from control and experimental in pre-test scores was 0, is found to be non-significant at 0.05 and 0.01 levels of significance because the t value is less than 2.31 and 3.36 for df 8. It means that the male pupil-teachers from control and experimental groups do not differ in their performance in the pre test.

Table 4.6
SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE PUPIL-TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE TEST SCORES

Measure	Control group	Experimental group
	M_1	M_2
N	10	10
M	4.9	5
σ	1.784	1.887
D means	0.1	
t	0.133 (NS)	
df	18	

NS: Not significant at 0.05 and 0.01 levels of significance.

The difference between the means of pupil-teachers from control and experimental in pre-test scores was 0.1, is found to be non-significant at 0.05 and 0.01 levels of significance because the t value is less than 2.10 and 2.88 for df 18. It means that the pupil-teachers from control and experimental groups do not differ in their performance in the pre test.

From the above tables (table 4.3 to 4.6) it can be confidently interpreted that as the differences between the means were non-significant, both the groups were equivalent in their achievement w.r.t means before going for any further treatment in the experiment.

The significance of differences between the S.D.s of the pupil-teachers was further tested with the help of F test. The details are tabulated in following four tables.

Table 4.7
SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE MALE
AND FEMALE PUPIL-TEACHERS OF CONTROL AND EXPERIMENTAL
GROUPS IN PRE TEST SCORES

Measure	Control group		Experimental group	
	M ₁	F ₁	M ₂	F ₂
N	5	5	5	5
M	4.4	5.4	4.4	5.6
σ	1.264	2.161	1.264	2.304
D.S.D.s	0.897		1.04	
F	0.797 (NS)		1.042 (NS)	
df	4-4		4-4	

NS: not significant at 0.05 and 0/01 levels of significance.

The differences between the S.D.s of male and female pupil teachers from control and experimental groups in pre test scores were 0.897 and 1.04 are found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 6.39 and 15.98 for df 4 - 4. It means that male and female pupil teachers from any group do not differ in their variability about the performance in the pre test.

Table IV.8**SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE FEMALE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE TEST SCORES**

Measure	Control group	Experimental group
	F_1	F_2
N	5	5
M	5.4	5.6
σ	2.161	2.304
D.S.D.s	0.143	
F	0.02 (NS)	
df	4 - 4	

NS: not significant at 0.05 and 0/01 levels of significance.

The differences between the S.D. of female pupil teachers from control and experimental groups in pre test scores was 0.143 is found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 2.31 and 3.36 for df 4 - 4. It means that female pupil teachers from control and experimental group do not differ in their variability.

Table 4.9**SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE MALE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE TEST SCORES**

Measure	Control group	Experimental group
	M_1	M_2
N	5	5
M	4.4	4.4
σ	1.264	1.264
D.S.D.s	0.00	
F	0.00 (NS)	
df	4 - 4	

NS: Non Significant at 0.05 and 0.01 levels of significance.

The differences between the S.D.s of male pupil teachers from control and experimental groups in pre test scores was 0, is found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 2.31 and 3.36 for df 4 - 4. It means that male pupil teachers from control and experimental group do not differ in their variability about the performance in pre test.

Table IV.10

SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE TOTAL PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS IN PRE TEST SCORES

Measure	Control group	Experimental group
	T ₁	T ₂
N	10	10
M	4.9	5
σ	1.784	1.887
D.S.D.s	0.103	
F	0.0148 (NS)	
df	9 - 9	

NS: Non Significant at 0.05 and 0.01 levels of significance.

The differences between the S.D.s of the total pupil teachers from control and experimental groups in pre test scores was 0.103, is found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 3.23 and 5.47 for df 9 - 9. It means that male pupil teachers from control and experimental group do not differ in their variability about the performance in pre test.

From the above tables (table 4.7 to 4.10) it can be confidently interpreted that as the differences between the S.D.s were non-significant, both the groups were equivalent in their achievements w.r.t. S.D.s before going for any further treatment in the experiment.

The analysis and interpretation of the data obtained in pre testing confirmed the equivalency of the control and experimental groups before going to a further treatment. The sub-groups of male and female pupil teachers i.e. M₁, F₁, M₂ and T₂ were also found to be equivalent in their performances at pre test. This analysis helped the investigator to form four parallel groups for further analysis and interpretation.

4.3.2 ANALYSIS AND INTERPRETATION OF THE POST TEST DATA OF A SMALL-SCALE TRY-OUT SAMPLE. (TOS)

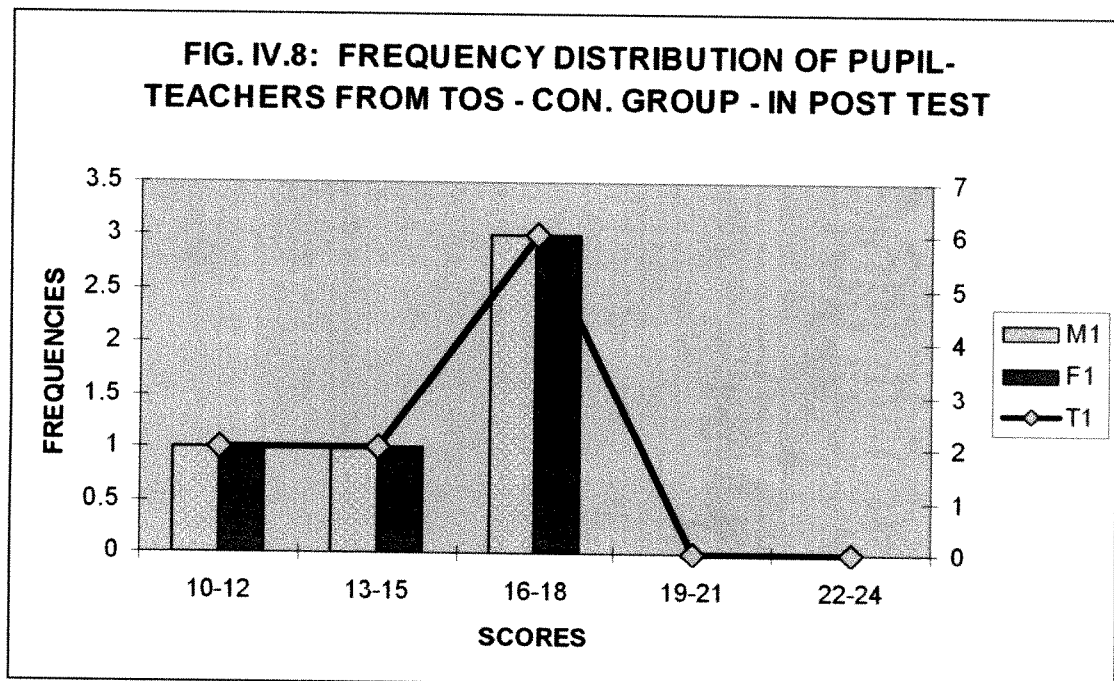
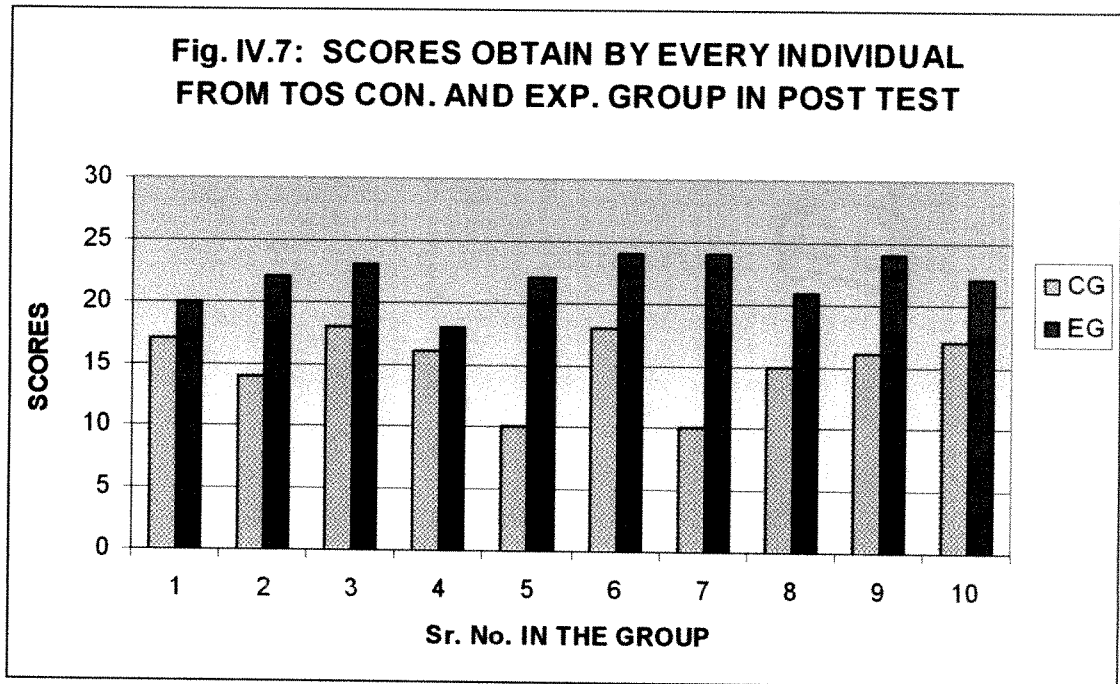
The analysis and interpretation of the data obtained in pre-testing confirmed the equivalency of control and experimental groups. M₁, F₁, M₂, T₂ groups were also found to be equivalent. The control group from TOS was then exposed to conventional instructional system for the units decided and the experimental group from TOS was treated with the developed multimedia instructional system for the same units. A post test was again administered on both the groups after the treatment. The data obtained in terms of scores was further analyzed and interpreted in the following tables. The original scores are given in Appendix (M).

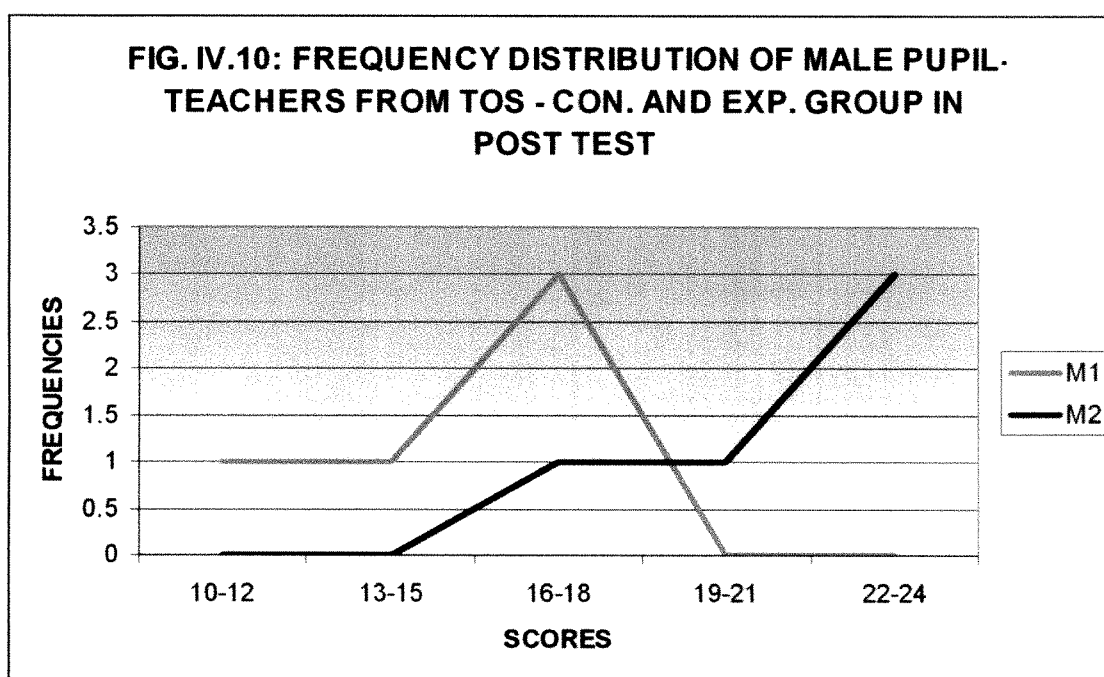
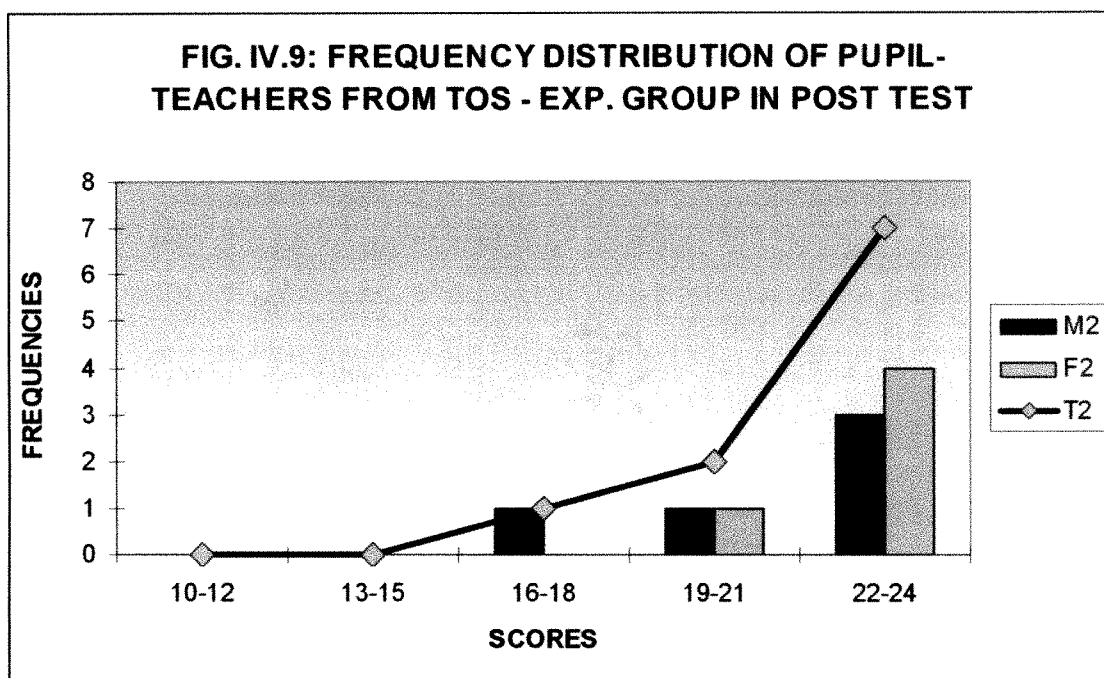
Table IV.11

FREQUENCY DISTRIBUTION TABLE OF THE SCORES OBTAINED BY THE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN A POST TEST (SCORES OUT OF 25)

C.I.	Control Group			Experimental Group		
	M ₁	F ₁	T ₁	M ₂	F ₂	T ₂
22 – 24	0	0	0	3	4	7
19 – 21	0	0	0	1	1	2
16 – 18	3	3	6	1	0	1
13 – 15	1	1	2	0	0	0
10 – 12	1	1	2	0	0	0
Total	5	5	10	5	5	10

The scores obtained by the pupil teachers from TOS are analyzed with the help of Fig. 4.7 to 4.12





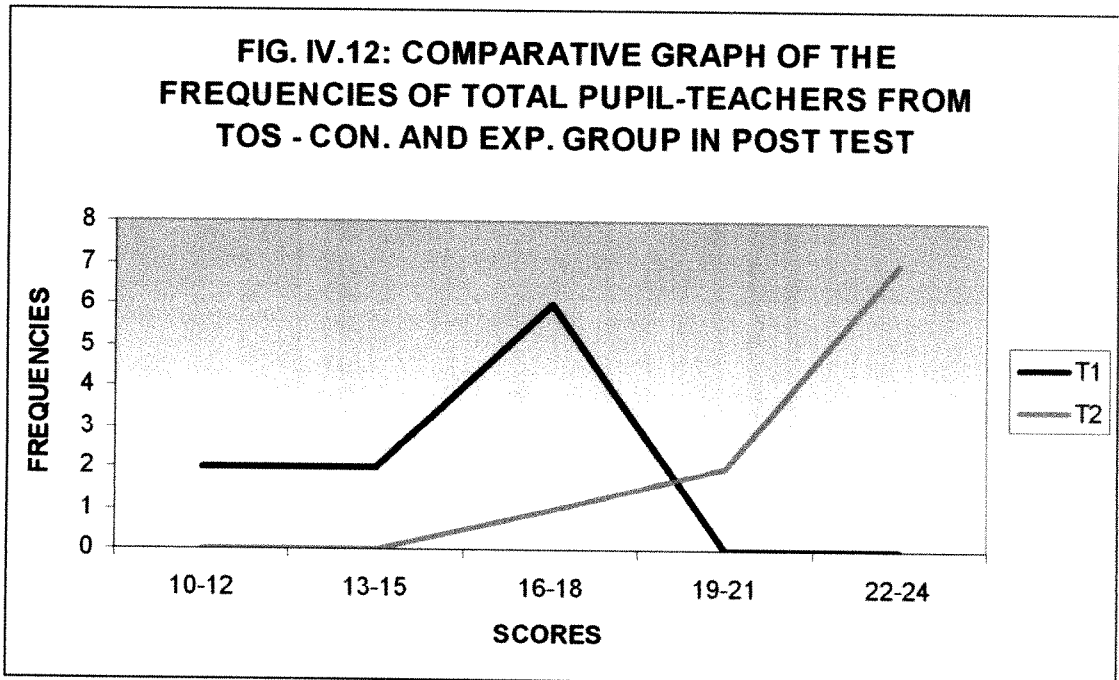
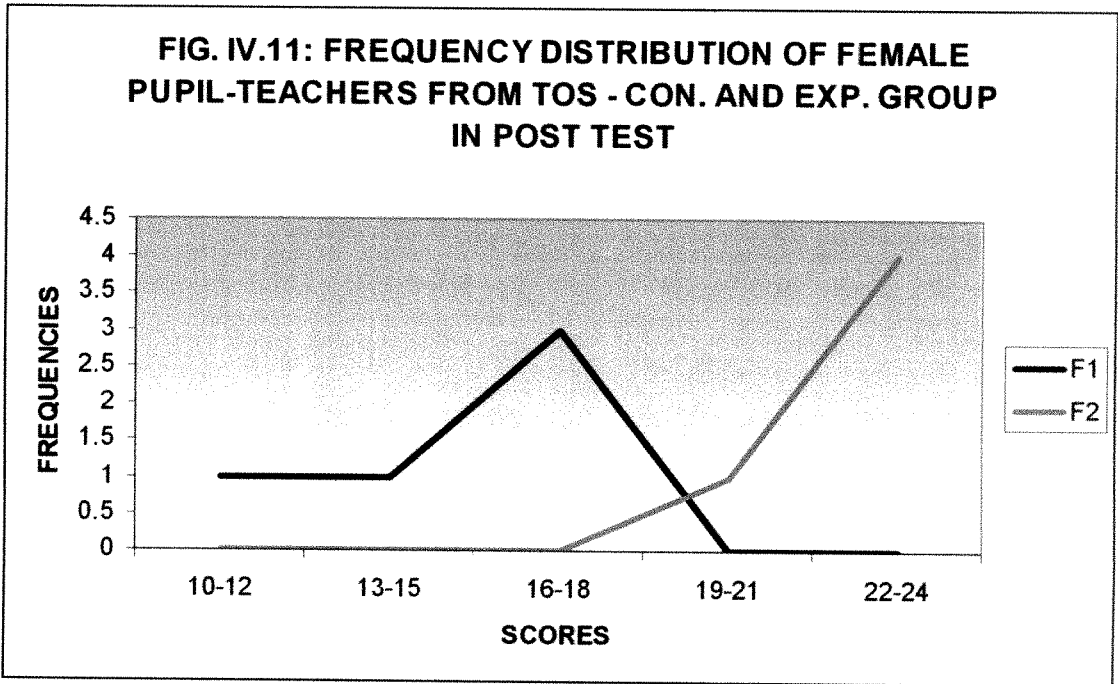


Fig. 4.7 is of the scores obtained by every individual from TOS in post test. Experimental group comparatively achieved more scores than the control group pupil-teachers.

Fig. 4.8 is of frequency distribution of pupil teachers form control group in TOS.

Fig. 4.9 is a graph of the frequency distribution of pupil-teachers from experimental group in TOS.

Fig. 4.10 is a graph of frequency distribution of male pupil teachers from both the groups in TOS. The frequencies do not coincide.

Fig. 4.11 is a graph of the frequency distribution of female pupil teachers from both the groups in TOS. The frequencies do no coincide.

Fig. 4.12 is a graph of the frequency distribution of total pupil teachers from both the groups in TOS. The frequencies do no coincide.

The means and S.D.s of the scores in post test were calculated and tabulated in the next table.

Table 4.12
MEANS AND S.D.S OF THE SCORES OBTAINED BY THE PUPIL
TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN A
POST TEST
(SCORES OUT OF 25)

Measure	Control Group			Experimental Group		
	M ₁	F ₁	T ₁	M ₂	F ₂	T ₂
N	5	5	10	5	5	10
M	15.0	15.2	15.1	21.0	23.0	22.0
σ	2.889	2.889	2.945	4.457	4.976	4.969

The significance of the difference between the statistical measures were calculated by using t technique and interpreted in the following tables

Table 4.13

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE MALE AND FEMALE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group		Experimental group	
	M ₁	F ₁	M ₂	F ₂
N	5	5	5	5
M	15.0	15.2	21.0	23.0
σ	2.889	2.889	4.457	4.976
D means	0.2		2.0	
t	0.1008 (NS)		1.828 (NS)	
Df	8		8	

NS: not significant at 0.05 and 0.01 levels of significance.

The differences between the means of male and female pupil teachers from control and experimental groups in pre test scores were 0.2 and 2.0 are found to be non-significant at 0.05 and 0.01 levels of significance because the t values are less than 2.31 and 3.36 for df 8. It means that male and female pupil teachers from any group do not differ in their performance in the post test.

Table 4.14

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE FEMALE TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group	Experimental group
	F ₁	F ₂
N	5	5
M	15.2	23
σ	2.889	4.976
D means	7.8	
t	5.104 *	
df	8	

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of females pupil-teachers from control and experimental groups in post test scores was 7.8, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for df 8. It means that the female pupil teachers from control and experimental groups differ in their performance as compared with the female pupil teachers from the control group in the post test. It means the **Developed Multimedia Instructional System (MIS)** used in the experimental group favored the female pupil-teachers treated with **Conventional Instructional System (CIS)** in the control group.

Table IV.15

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE MALE PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group	Experimental group
	M_1	M_2
N	5	5
M	15.0	21.0
σ	2.889	4.457
D means	6.0	
t	3.58*	
df	8	

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of male pupil-teachers from control and experimental in post test scores was 6.0, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for

df 8. It means that the male pupil-teachers from control and experimental groups differ in their performance as compared with the male pupil-teachers from control group in post test. It means the **Developed Multimedia Instructional System (MIS)** used in the experimental group favored the male pupil-teachers treated with **Conventional Instructional System (CIS)** in the control group.

Table IV.16
SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE TOTAL PUPIL-TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group	Experimental group
	M_1	M_2
N	10	10
M	15.1	22.0
σ	2.945	4.969
D means	6.9	
t	6.1607*	
df	18	

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of total pupil-teachers from control and experimental in post-test scores was 6.9, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.10 and 2.88 for df 18 which means that the pupil-teachers from control and experimental groups differ in their performance as compared with the total pupil-teachers from the control group in the post test.

From the above tables (table 4.13 to 4.16) it can be confidently interpreted that as the differences between the means were significant in case of females, males and total pupil-teachers.

The significance of differences between the S.D.s of the pupil-teachers was further tested with the help of F test. The details are tabulated in following four tables.

Table IV.17
SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE MALE
AND FEMALE PUPIL-TEACHERS OF CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group		Experimental group	
	M ₁	F ₁	M ₂	F ₂
N	5	5	5	5
M	15.0	15.2	21.0	23.0
σ	2.889	2.889	4.457	4.976
D.S.D.s	0		0.519	
F	0.119 (NS)		0.448 (NS)	
df	4-4		4-4	

NS: Non Significant at 0.05 and 0/01 levels of significance.

The differences between the S.D.s of male and female pupil teachers from control and experimental groups in post test scores were 0 and 0.519 are found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 6.39 and 15.98 for df 4 - 4. It means that male and female pupil teachers from both the group do not differ in their variability about the performance in the post test.

Table IV.18
SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE FEMALE PUPIL
TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST
TEST SCORES

Measure	Control group	Experimental group
	F ₁	F ₂
N	5	5
M	15.2	23.0
σ	2.889	4.976
D.S.D.s	2.087	
F	9.190*	
df	4 – 4	

* Significant at 0.05 and 0/01 levels of significance.

The differences between the S.D. of female pupil teachers from control and experimental groups in post test scores was 2.087, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 6.39 but less than 15.98 for df 4 - 4. It means that female pupil teachers from control and experimental group differ in their variability about the performance in the post test.

Table IV.19
SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE MALE PUPIL
TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST
TEST SCORES

Measure	Control group	Experimental group
	M ₁	M ₂
N	5	5
M	15.0	21.0
σ	2.889	4.457
D.S.D.s	1.568	
F	6.355 (NS)	
df	4 – 4	

NS: Non Significant at 0.05 and 0.01 levels of significance.

The differences between the S.D.s of male pupil teachers from control and experimental groups in post test scores was 1.568, is found to be non-significant at 0.05 and 0.01 levels of significance because the F value is less than 6.39 and 15.98 for df 4 - 4. It means that male pupil teachers from control and experimental group do not differ in their variability about the performance in post test.

Table IV.20

SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF THE TOTAL PUPIL TEACHERS OF CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN POST TEST SCORES

Measure	Control group	Experimental group
	T ₁	T ₂
N	10	10
M	15.1	22.0
σ	2.945	4.969
D.S.D.s	2.024	
F	14.27*	
df	9 - 9	

* Significant at 0.05 and 0.01 levels of significance.

The differences between the S.D.s of the total pupil teachers from control and experimental groups in post test scores was 2.024, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 3.23 and 5.47 for df 9 - 9. It means that male pupil teachers from control and experimental group differ in their variability about the performance in post test.

From the above tables (table 4.17 to 4.20) it can be confidently interpreted that as the differences between the S.D.s were found to be significant for female and total pupil teachers but non-significant for male pupil teachers. It means

that the treatments in the groups affected the variability for female and total pupil teachers but did not affect the variability for male pupil-teachers.

The analysis and interpretation of the data obtained in post testing indicate that the male and female pupil-teachers from control group are equally good in the performance; the male and female pupil-teachers from experimental group are also equally good in the performance in post test. There is no significant difference between the achievement of the male and female pupil-teachers from any group. When the performance of the female pupil-teachers from control group was compared with the female pupil-teachers from experimental group, the female pupil-teachers from experimental group significantly achieved more. Same is true with male pupil teachers and total pupil teachers. It means that **Developed Multimedia Instructional System** helped the female pupil-teachers, male pupil-teachers and also the total pupil-teachers from experimental group in performing better than the female pupil-teachers, male pupil-teachers and total pupil-teachers from the control group. The difference between the S.D.s was found to be significant w.r.t. female and total pupil-teachers but non-significant w.r.t. male pupil teachers.

4.3.3 ANALYSIS AND INTERPRETATION OF THE PRE OVER POST TEST DATA AND SMALL-SCALE TRY OUT SAMPLE.

From the preceding tables, it was found that the control and experimental groups performed well in achievement in their respective groups. In order to understand 'How much they could improve in the achievement in their respective groups?' The data was further analyzed to compare the differences between their performances on pre over post test. t-test technique is used.

Fig. 4.13 is comparative graph of the scores obtained by every individual from control and experimental group in pre and post test. The graph clearly contains

that the scores obtained by the pupil-teachers from experimental group in post test are superior to the students from control group.

Fig. 4.14 shows the scores obtained by the male pupil-teachers from both the groups in pre and post test. The graph clearly explains the difference in performance in pre over post test.

Fig. 4.15 shows the scores obtained by the female pupil teachers from both the groups in pre and post test. The graph clearly explains the difference in performance in pre over post test.

Fig. 4.16 is means of scores obtained by sub groups F_1 , F_2 and M_1 , M_2 and also total groups T_1 , T_2 in pre and post test. The post test means are higher than pre test means w.r.t. each sub-group and total pupil teachers from control and experimental group.

The coefficients of correlation between the pre test and post test scores were calculated and used in computing t values.

Since it is one-tailed test considering positive gain, statistics regarding one-tailed test is used.

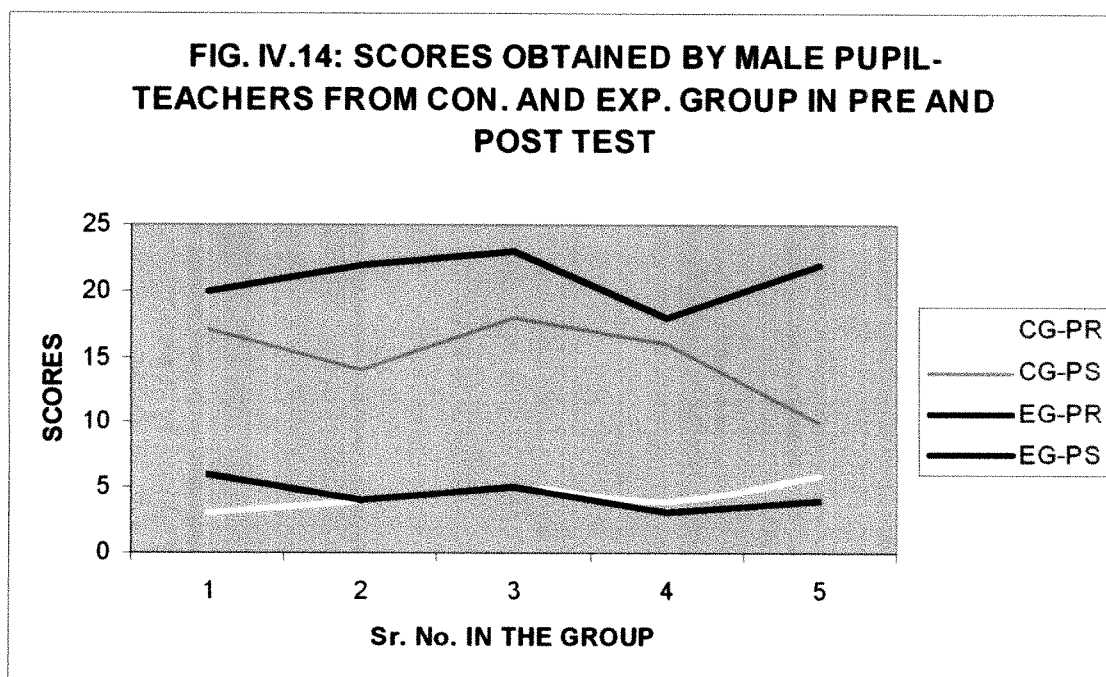
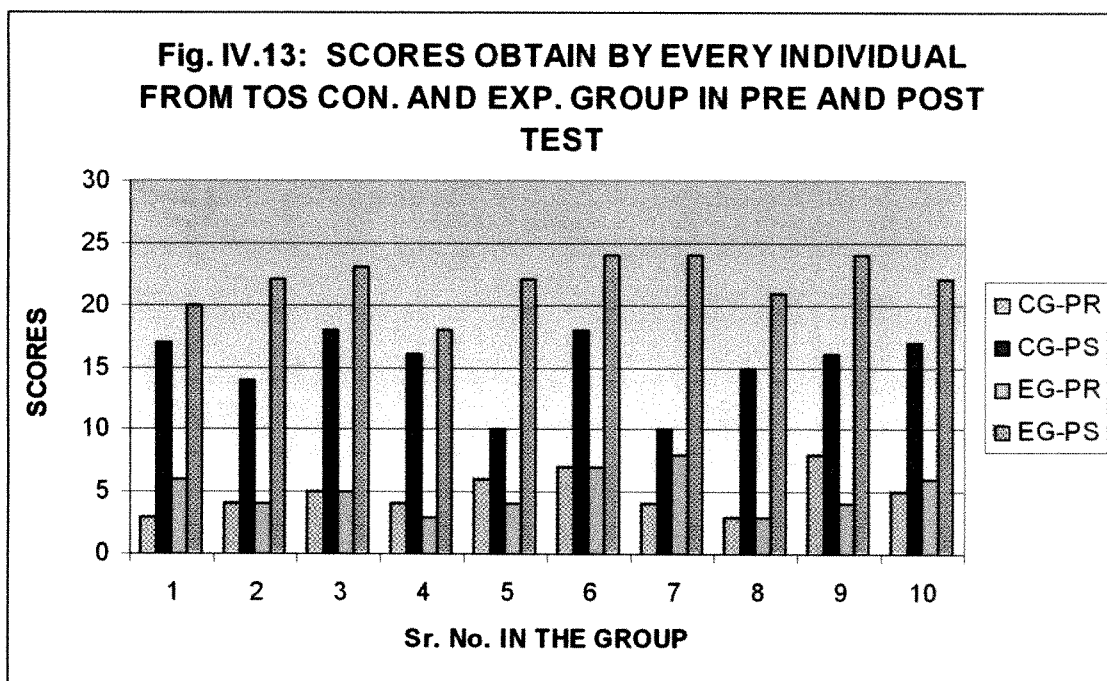


FIG. IV.15: SCORES OBTAINED BY FEMALE PUPIL-TEACHERS FROM CON. AND EXP. GROUP IN PRE AND POST TEST

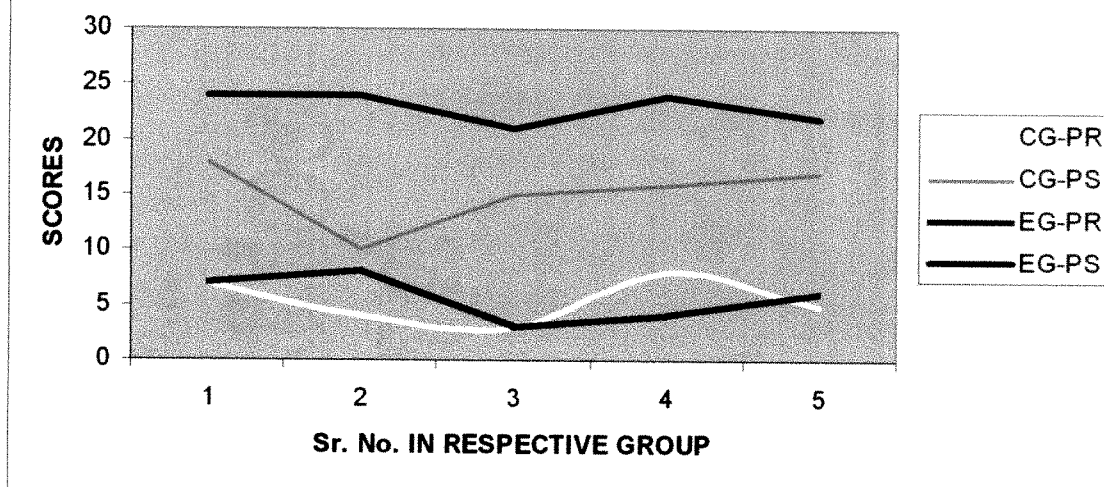


FIG. IV.16: MEANS OF THE SCORES OF PUPIL-TEACHERS FROM TOS IN PRE AND POST TEST

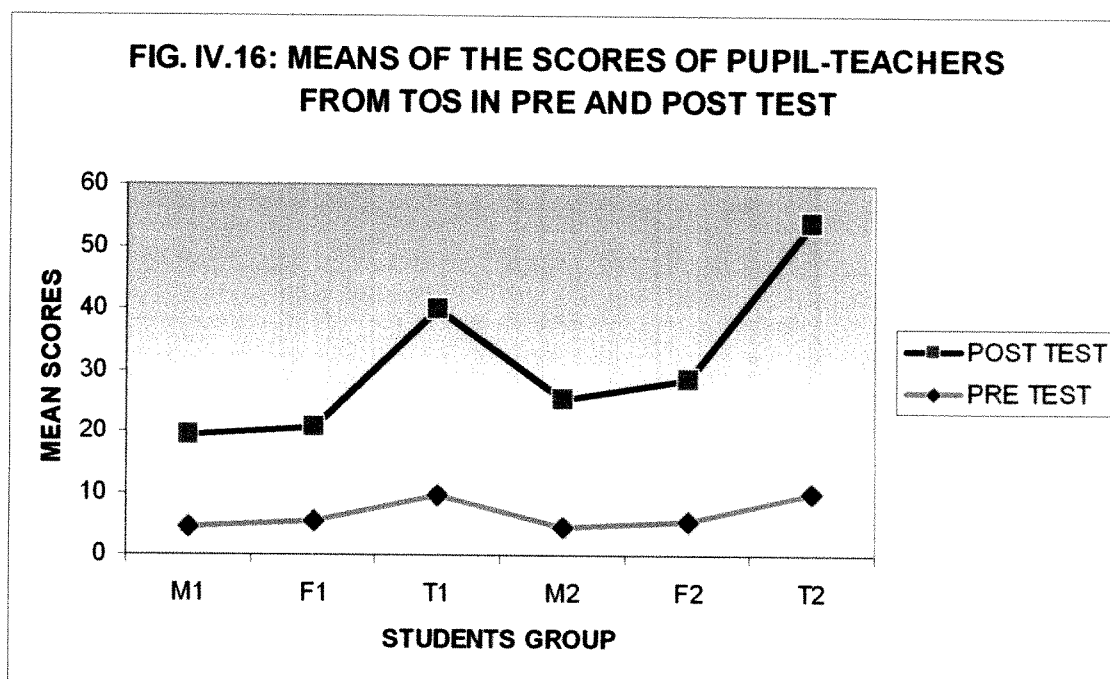


Table IV.21

**SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF SCORES OBTAINED
BY THE FEMALE PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN PRE OVER POST TEST**

	Pre Test			Post test					
	N	M	σ	N	M	σ	r	Mean diff	t
CG									
F₁	5	5.4	2.161	5	15.2	2.889	0.561	9.8	5.518*
EG									
F₂	5	5.6	2.304	5	23.0	4.976	0.583	17.4	15.27*

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of female pupil-teachers from control group in pre and post test scores was 9.8, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for df. 8. It means that female pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Conventional Instructional System** used in the control group favored the female pupil teachers in achieving better performance.

The difference between the means of female pupil-teachers from experimental group in pre and post test scores was 17.4, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for df. 8. It means that female pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Developed Multimedia Instructional System** used in experimental group favored the female pupil teachers in achieving better performance.

Table IV.22

**SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF SCORES OBTAINED
BY THE MALE PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN PRE OVER POST TEST**

	Pre Test			Post test						
	N	M	σ	N	M	σ	r	Mean diff	t	df
CG										
M₁	5	4.4	1.264	5	15.0	2.889	- 0.58	10.6	6.60*	8
EG										
M₂	5	4.4	1.264	5	21.0	4.457	0.306	16.6	15.83*	8

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of male pupil-teachers from control group in pre and post test scores was 10.6, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for df. 8. It means that male pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Conventional Instructional System** used in the control group favored the male pupil teachers in achieving better performance.

The difference between the means of male pupil-teachers from experimental group in pre and post test scores was 16.6, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.31 and 3.36 for df. 8. It means that male pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Developed Multimedia Instructional System** used in experimental group favored the male pupil teachers in achieving better performance.

Table IV.23

**SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF SCORES OBTAINED
BY THE TOTAL PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN PRE OVER POST TEST**

	Pre Test			Post test						
	N	M	σ	N	M	σ	r	Mean diff	t	df
CG										
F₁	10	4.9	1.784	10	15.1	2.945	0.112	10.2	9.497*	18
EG										
F₂	10	5.0	1.887	10	22.0	4.969	0.537	17.0	20.833*	18

* Significant at 0.05 and 0.01 levels of significance.

The difference between the means of total pupil-teachers from control group in pre and post test scores was 10.2, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.10 and 2.88 for df. 18 which means that total pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Conventional Instructional System** used in the control group favored the total pupil teachers in achieving better performance.

The difference between the means of total pupil-teachers from experimental group in pre and post test scores was 17.0, is found to be significant at 0.05 and 0.01 levels of significance because the t value is greater than 2.10 and 2.88 for df. 18. It means that total pupil-teachers from the control group differ in their performance on pre over post test scores. It means that the **Developed Multimedia Instructional System** used in experimental group favored the total pupil teachers in achieving better performance.

Table IV.24

**SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF SCORES OBTAINED
BY THE FEMALE PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN PRE OVER POST TEST**

	Pre Test			Post test			r	S.D.D.s	F	df
	N	M	σ	N	M	σ				
CG										
F₁	5	5.4	2.161	5	15.2	2.889	0.561	0.728	36.89*	4-4
EG										
F₂	5	5.6	2.304	5	23.0	4.976	0.583	2.672	50.35*	4-4

* Significant at 0.05 and 0.01 levels of significance.

The difference between the S.D.s levels of female pupil-teachers from control group in pre over post test scores was 0.728, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 6.39 and 15.98 for df. 4-4. It means that female pupil-teachers from the control group differ in their performance on pre over post test scores.

The difference between the S.D.s of female pupil-teachers from experimental group in pre over post test scores was 2.627, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 6.39 and 15.98 for df. 4-4. It means that female pupil-teachers from the control group differ in their performance on pre over post test scores.

Table IV.25

**SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF SCORES OBTAINED
BY THE MALE PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL
GROUPS FROM TOS IN PRE OVER POST TEST**

	Pre Test			Post test			r	D.S.D.s	F	df
	N	M	σ	N	M	σ				
CG										
M₁	5	4.4	1.264	5	15.0	2.889	- 0.58	1.625	56.50*	4-4
EG										
M₂	5	4.4	1.264	5	21.0	4.457	0.306	3.193	41.71*	4-4

* Significant at 0.05 and 0.01 levels of significance.

The difference between the S.D.s levels of male pupil-teachers from control group in pre over post test scores was 1.625, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 6.39 and 15.98 for df. 4-4. It means that male pupil-teachers from the control group differ in their performance on pre over post test scores.

The difference between the S.D.s of male pupil-teachers from experimental group in pre over post test scores was 3.193, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 6.39 and 15.98 for df. 4-4. It means that male pupil-teachers from the control group differ in their performance on pre over post test scores.

Table IV.26

SIGNIFICANCE OF DIFFERENCE BETWEEN THE S.D.S OF SCORES OBTAINED BY THE TOTAL PUPIL-TEACHERS FROM CONTROL AND EXPERIMENTAL GROUPS FROM TOS IN PRE OVER POST TEST

	Pre Test			Post test			r	D.S.D.s	F	df
	N	M	σ	N	M	σ				
CG										
T ₁	10	4.9	1.784	10	15.1	2.945	0.112	1.161	71.13*	9-9
EG										
T ₂	10	5.0	1.887	10	22.00	4.969	0.537	3.082	82.88*	9-9

* Significant at 0.05 and 0.01 levels of significance.

The difference between the S.D.s levels of total pupil-teachers from control group in pre over post test scores was 1.161, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 3.23 and 5.47 for df. 9-9. It means that total pupil-teachers from the control group differ in their performance on pre over post test scores.

The difference between the S.D.s of total pupil-teachers from experimental group in pre over post test scores was 3.083, is found to be significant at 0.05 and 0.01 levels of significance because the F value is greater than 3.23 and 5.47 for df. 9-9. It means that total pupil-teachers from the control group differ in their performance on pre over post test scores.

The analysis and interpretation of the data obtained in pre over pos testing indicate that when the performance in both tests of the female pupil-teachers from control group and experimental group was compared separately the female pupil-teachers from control group differ in their performance in pre over post test scores. The female pupil-teachers from experimental group also differ in their performance at pre over post test. It is true with the male pupil-teachers was compared the pupil-teachers from control group differ in pre over post test scores. Same is true with the total pupil-teachers from experimental group in pre over post test scores.

4.3.4 CONCLUSIONS REGARDING SMALL SCALE TRY-OUT OF THE PROTOTYPE:

The data received in small scale try-out of the prototype was tabulated in 26 tables (table 4.1 to 4.26). The analysis and interpretation of the data brought out following conclusions.

- 1) It was confirmed that that the small scale try-out sample was representative one.
- 2) The male and female pupil-teachers do not differ in their achievement w.r.t. the scores in the pre test. The male and female pupil-teachers do not differ in variability's w.r.t. their achievement in pre test. The pre test data of a small-scale try out sample confirmed that both groups were equally good or bad in the performance of content at pre testing.
- 3) The male pupil-teachers and female pupil-teachers from the try out sample do not differ in means and variability of their achievement w.r.t. scores in the post test in that group.
- 4) The male pupil-teachers, female pupil-teachers and total pupil-teachers from the try-out sample improved in pre over post test

occasion. The treatment of prototype of the instructional system helped them in their achievement. The male pupil-teachers, female pupil-teachers and total pupil-teachers from the try-out sample differ in means in pre over post test.

- 5) The male pupil-teachers, female pupil-teachers and total pupil-teachers from the try out sample in experimental group achieved more than the male pupil-teachers, female pupil-teachers and total pupil-teachers form the try out sample in control group.

4.4 A) IMPROVEMENTS IN THE PROTOTYPE:

The small scale try-out of the prototype helped the investigator in improving the system before its full scale try-out. As the overall impact of the prototype was found faithful, it was not found necessary to improve the entire prototype in total.

Following improvements were made in the prototype.

- 1) It was found that all items from the pre test and post test need no improvements; hence he items were kept as it is.
- 2) It was found that size of the text were small. It was decided to increase the size.
- 3) The 2-D and 3-D graphics were decided to improve in some extent.
- 4) It was found that computer animations in some subtopics were not proper, hence these animations were removed and new animations were designed and developed.
- 5) Audio files were changed in some extent.
- 6) It was decided to test the prototype through selected group of teacher-educators to receive feedback and recommendations about the system.

The above improvements were done before experimentation.

The small-scale try-out of the prototype also helped the investigator in formulating research and null hypothesis of the final experiment.

4.4 B) IMPLEMENTATION OF REVISED SYSTEM:

Implementation of the system is a function of putting revised and total validated instructional system into full-scale operation. Implementation means experimentation in case of the preset study. The process of experimentation is fully explained in 4.5

4.4 C) ANALYSIS AND INTERPRETATION OF THE FULL-SCALE TRY-OUT DATA:

This is the last function of the development of the instructional system. The data received after experimentation is analyzed and interpreted after experimentation is analyzed and interpreted which is fully explained in the next chapter, viz. 'Analysis and Interpretation of the Data'. The analysis of the full-scale try-out data helped the investigator for overall assessment and evaluation of the newly developed instructional system. The conclusions are explained in the chapter VI, viz. 'Conclusions and Recommendations'.

4.5 EXPERIMENTATION PROCEDURE IN FULL-SCALE TRY-OUT:

The investigator was ready with the revised and reshuffled multimedia instructional system. The investigator had decided to conduct an experiment for full-scale try-out of the revised system. The experimental procedure used in the full scale try-out is discussed in the following paragraphs.

4.5.1 A RESEARCH PROBLEM:

The research problem amenable to experimentation was defined and delimited as follow:

"Development of Multimedia Instructional System on Educational Technology for B.Ed. Pupil-teachers."

The various terms used in the statement of the problem are defined below for the sake of clarity and also limiting the scope of the experiment.

1) Development:

The term development includes the planning, designing, constructing and testing of an instructional system.

2) Multimedia Instructional System:

A system designed for and dedicated to instruction i.e. human instruction is an instructional system. An instructional system is defined as an integrated set of methods, media, equipment and personal performing efficiently, the system functions required for accomplishing one or more instructional objectives. The term multimedia refers to the integration of multiple media such as visual imagery, text, video, sound and animation which together can multiply the impact of message. Multimedia instructional system is an instructional system developed through multimedia technology.

3) Educational Technology:

It is one of the elective courses of B. Ed. Level. Educational Technology is the systematic application of scientific knowledge about learning and conditions of learning to improve the effectiveness and efficiency of teaching and learning.

4.5.2 VARIABLES IN THE EXPERIMENT:

The dependent and independent variables in the study were located and listed. They were

Dependent Variables:

The dependent variables were achievement of the pupil-teachers in terms of scores, ability of learning, behavioral changes of the pupil-teaches. These dependent variables were combined into one that is; scores achieved in the pre over post test pupil teachers.

Independent Variables:

Sex, socio-economic status, intelligence and ability of the pupil-teachers, college atmosphere, facilities of instruction, equipments used in instruction, instructional materials, time and period of exposure to a

particular condition, reward and punishment during instruction, evaluation procedure, were the independent variables.

Though there were so many independent variables, the investigator had decided to consider only two independent variables in his experiment viz. sex and system of instruction. The effects of remaining independent variables on dependent variables were controlled.

4.5.3 CONTROL OF THE EXPERIMENT:

Randomization technique was used in controlling the extraneous variables. Two groups of the pupil-teachers selected from grantable colleges of education affiliated to Shivaji University, Kolhapur which helped the investigator in controlling socio-economic status, age, classroom situation, intelligence, reward and punishment effects, abilities of learning.

It was decided to complete both the units in same month helped in controlling time of instruction variable.

The equivalency of the two groups was checked by statistical measures.

4.5.4 RESEARCH AND NULL HYPOTHESIS OF THE STUDY:

Following research hypothesis were formulated.

- 1) The present setting of teaching of Educational Technology in B.Ed. Colleges is unsatisfactory for better learning of the pupil-teachers.
- 2) An instructional system for Educational Technology instruction through multimedia technology can be planned, designed and constructed.
- 3) The male pupil-teachers and female pupil-teachers perform differently on achievement in their groups irrespective of the system used in instructing them.
- 4) The conventional instructional system and the developed multimedia instructional system for educational technology instruction differ in their effectiveness on the performance in achievement of the total pupil-teachers.

- 5) The male pupil-teachers and female pupil-teachers perform differently in retention of achievement in their groups irrespective of the system used in instructing them.
- 6) The conventional instructional system and the developed multimedia instructional system for Educational Technology instruction differ in their effectiveness on the performance in the retention of achievement of the total pupil-teachers.

The research hypothesis R.H.3 and R.H.6 were stated below into null form for the sake of experiment and for testing purpose.

- Ho.1: There is no significant difference between the performance of the pupil-teachers from control and experimental group in pre test.
- Ho.2: There is no significant difference between the performance of the pupil-teachers from control and experimental group in post test.
- Ho.3: There is no significant difference between the performances of the pupil-teachers from control group in pre over post testing.
- Ho.4: There is no significant difference between the performances of the pupil-teachers from experimental group in pre over pos testing.
- Ho.5: There is no significant difference between the gains in achievement in terms of scores in pre over post test of the pupil-teachers from control and experimental group.
- Ho.6: There is no significant difference between the performance of the pupil-teachers from control and experimental group in retention test.

The above null hypotheses were subdivided which are given in chapter V viz. Analysis and Interpretation of Data.

4.5.5 THE EXPERIMENTAL DESIGN:

The investigator decided to use the **Solomon Four-Group Experimental Design** for large scale try-out of the revised instructional system. The investigator had decided to use this design because it provided equivalency accuracy with less labor and such is a source of economy. The hypothesis formulated by the investigator can be resolved with the help of this design.

$$R_1 \rightarrow O_1 \rightarrow X \rightarrow O_2$$

$$R_1 \rightarrow O_3 \rightarrow C \rightarrow O_4$$

$$R_3 \rightarrow \quad X \rightarrow O_5$$

$$R_4 \rightarrow \quad C \rightarrow O_6$$

In this design:

- 1) Pupil-teachers were randomly assigned to four groups. There were twelve (12) pupil-teaches in each group.
- 2) Two groups received the experimental treatment (X) which was implementation of the systems.
- 3) One experimental group received a pre test (O₁).
- 4) Two groups (control) were not received treatment (X).
- 5) One control group received a pre test (O₃).
- 6) All four groups received post tests (O₂, O₄, O₅, O₆).

4.5.6 THE EXPERIMENT:

The experiment was conducted within four months, the procedure of which is explained in the following paragraphs:

The investigator selected two colleges of Education i.e. College of Education, Barshi and Azad College of Education, Satara affiliated to Shivaji University, Kolhapur. Out of 160 pupil teachers, the pupil teachers with Educational Technology as an elective were called for experiment. 48 pupil teacher's form both colleges of education were the sample of the study. The investigator considered the group of pupil-teachers from Azad College of Education, Satara as a control group and the group of

pupil teachers from College of Education, Barshi as an experimental group.

The investigator administered a pre test on half of the pupil teachers (12) from both the groups and gave a treatment of developed multimedia instructional system to an experimental group; the control group was treated with traditional system. He then administered a post-test on both the groups and compared the results. The data was analyzed and interpreted and the effectiveness of the system was tested.

A pretest of 25 marks for pupil-teachers was administered on the sample. The answer-scripts were assessed; the scores were collected, analyzed and interpreted.

A post test of 25 marks for pupil-teachers was again administered on the sample. The responses of the pupil-teachers were collected in terms of scores. The data was analyzed and interpreted.

'Is the developed system used in experimental group of pupil-teaches proved helpful to the pupil-teachers fro the group?' was a question to be answered. A comparative analysis and interpretation of the gains both in achievement was dine to answer the question.

'Is the developed system used in experimental group of pupil-teachers proved helpful to retain the content?' was a question to be answered. Hence a retention achievement test was administered on the pupil-teachers from the sample after three months of the treatment to collect the information of the pupil-teaches about their retention in treatment. The data was collected, analyzed and interpreted.

Conclusions were drawn about the effectiveness of the developed instructional system and suggestions were stated.

4.5.7 SAMPLING DESIGN OF THE STUDY:

The investigator used following samples in his study.

- All teacher-educators (50) teaching Educational Technology in colleges of Education affiliated to Shivaji University, Kolhapur asked to respond the questionnaire.

- 20% of the teacher-educators (10) were selected for unstructured interviews. The sample was randomized sample and it was obtained through hat sampling method.
- Sample of teacher-educators used in Alpha testing. The sample contains teacher-educators those who were interviewed.
- Sample of pupil-teachers used in focus group testing were 24 pupil-teachers from Azad College of Education, Satara offering Educational Technology as an elective.
- A Sample of pupil-teachers used in Beta testing were 24 pupil-teachers offering Educational Technology as an elective in College of Education, Barshi.

4.5.8 DESCRIPTION OF THE TOOLS USED IN THE STUDY:

The investigator had used the following tools in data collection for the present study:

1) A Questionnaire:

Questionnaire was one of the tools that were used in analyzing the present system of instruction (Appendix A).

The questionnaire was framed with the help of experts, teacher-educators and consultants, suggestions were collected and improvement was done.

The questionnaire covered all questions related to the survey of present system of instruction of Educational Technology. There were three sections in the questionnaire.

Section A was personal information of respondent. Section B was related with unit 2 i.e. System Approach to Instruction and section C was related to unit 3 i.e. Resources of Instructional System.

2) Interview Schedule:

Interview of the teacher-educators and experts was one of the techniques used in the present study (Appendix B). The interview

schedule covered all questions related to the present and future system that was to be developed. The same questionnaire was used as interview schedule.

3) Internal Evaluation Form:

Internal Evaluation Form was developed and used in internal evaluation of the system within the team.

4) A Program Evaluation Form:

It was developed which was used in alpha testing, focus group testing and beta testing.

5) A Reaction Scale:

A reaction scale on overall performance of the system was developed and used to receive reactions of the teacher-educators and pupil-teachers.

6) Achievement Tests (Pre and Post) for Pupil-teachers:

The achievement tests was constructed and administered on two equivalent groups of the pupil-teachers. The same achievement test is used as pre and post test in experimental (Appendix G).

The main objective of the pre test was to examine the achievement level of the pupil-teachers before the treatment. The same test was administered on two groups as a post test. The main objective of the post test was to examine the achievement level of the pupil-teachers after the treatment.

Pre test was consisted with 25 questions of choose proper alternative type.

7) Retention Test:

The retention test was a same pre test (Appendix G).

4.5.9 RELIABILITY AND VALIDITY OF THE TOOLS:

Reliability and validity of the important characteristics of the measuring tools. Validity refers to accuracy with which a tool measures whatever it is supposed to measure. Test validity and test purpose is closely related. A test is said to be valid if it meets the purpose for which it is designed.

Reliability is another important characteristic of a measuring instrument. The reliability of a test or any measuring instrument depends upon the consistency with which it measures whatever is supposed to measure. A reliable test is one, which measures accurately and consistently. If a reliable test is given two or three time to the same group, each individual in the group should get approximately the same scores on all occasions. Reliability is a statistical concept and can be calculated by using statistical formula. There are various methods of establishing the reliability such as test-retest method, split method, parallel form method and method of rational equivalence.

Face and content validity of the questionnaire, interview schedule, pre test, post test, retention test was established through analysis by the experts.

1) Validity and Reliability of the questionnaire:

The validity of the tool questionnaire was established through on experts and careful analysis by experts having more than fifteen years experience of teaching Educational Technology in B.Ed. colleges. The investigator explained the purpose of the questionnaire situation upon which the tool is supposed to be based, content needed and asked the experts to evaluate the form of the questionnaire, structure, questions, language, weightage to different aspects of the content needed. Corrections were done according to suggestions. Thus face and content validity of the questionnaire were established which were found high enough. As it is subjective decisions, it can not be expressed in statistical terms.

The reliability of the questionnaire was established by administering the tool on sample under study (20 teachers) and gain on sub-sample

(5 teachers) of the sample. The responses at the two occasions were compared and reliability was established. Questionnaire was found moderately reliable.

2) Validity and reliability of the achievement tests:

The achievement test was one of the tool which was used in the study and have face and content validity. Ten experts confirmed the face validity of the achievement test through careful observation. Ten experts established the content validity of achievement test through careful analysis of objectives and actual subject matter. The investigator explained the main purpose of the achievement test, content involved in the test, objectives to be tested and asked the experts to evaluate various items in the test for their validity against purpose, content analysis and weightage, language, difficulty level, weightage to objectives and types of question. In this way content validity of the achievement test was established and it was found high.

The concurrent validity of the achievement test used for pupil-teachers was estimated by administering the test to the small sample of pupil-teachers and comparing the scores of the pupil-teachers in the sample at a pretest. Following raw score formula was used.

The formula used in estimating the validity coefficient was:

$$r_{xy} = \frac{N \sum xy - \sum x \sum y}{\sqrt{[N \sum x^2 - (\sum x)^2][N \sum y^2 - (\sum y)^2]}}$$

It is a new raw score formula where r_{xy} means coefficient of correlation between x and y scores. N means number of students.

The validity coefficient of the achievement test was found 0.69, which was high enough.

The researcher also estimated reliability of the achievement test by using the same spilt – half method. The formula is given below.