CHAPTER-V

SUMMARY AND
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5.1 Background of the Study

The educational technology finds a place in the national policy on education (NPE) 1986. Part VIII of NPE contains provision entitled “Media and educational technology”. Educational technology has emerged in educational scenario as an instrument of total quality education (TQE). Polytechnics in India admit students who have passed either X standard or XII standard and provide education leading to the award of diploma in Engineering. The duration of the diploma program is usually three years. There are 2000 polytechnics in India and around 2000 polytechnics in Karnataka.

5.2 Need for the Study

In the third semester curriculum of Diploma Technicians in Electrical and Electronics Engineering, a subject “Communication Electronics” is included. The curriculum contains a very important topic viz., “fiber optic communication”. Students are required to study the concepts, principles, rules, and laws in this topic which lays foundation for other subjects in the course as well as
elsewhere. The students will be studying during the rest of the diploma program.

The topic of fiber optic communication includes a number of concepts such as Electromagnetic radiation, laws of reflection, refraction, refractive index, conditions for total internal reflection, propagation of radio waves, etc. The topic has to be taught by providing practical demonstrations wherever possible in order to understand the concepts clearly.

In the polytechnics in India, there are many constraints in providing practical experience for individual students. For every teacher, there are around 30 students to be taught and guided amidst limited laboratory resources for practical work. Individual interaction is a causality in theory as well as in practical classes. In view of the above, there is a felt need for the development and use of multimedia learning package for facilitating students in the learning of concepts in electrical and electronics engineering. In general, the fiber optic communication is not an exception.

5.3 Statement of the Problem

“A Study on the Effectiveness of Multimedia Learning Package on Fiber Optic Communication in Technician Education”
5.4 Objectives of the Study

1. To develop a Self Instructional Program Book version on fiber optic communication for the third semester diploma students and to evaluate the effectiveness of textual presentation and to convert remedial program chunk (RPC) and remedial adjunct material (RAM). SIP versions.

2. To package the self instructional program (SIP) with multimedia features such as synchronized voice, contextual visuals and reading supports, and computer based features such as controls, feedback, and self-test to get CBML Basic Package.

3. To get Multimedia Learning Package Remedial Adjunct material (RAM) branch version by building into CBML Basic Package with adequate remedial adjunct materials as branches at error prone points.

4. To get Multimedia Learning package Remedial Program Chunk (RPC) branch version by building into CBML Basic Package adequate remedial program chunks as branches at error prone points.

5. To evaluate and judge the relative effectiveness of above three versions CBMLP - Basic, CBMLP - RAM branch, CBMLP - RPC branch presentations.
5.5 Hypothesis

Given the essential entering behaviors and self manageable controls such as pacing, feedback and remediation, the multimedia presentations do not differ significantly in terms of learning gain percentage. The preference is in terms contextual and individual advantages and disadvantages.

5.6 Limitations of the Study

1. The proposed multimedia learning package is for the developing for third semester Diploma. Electrical and Electronics Engineering Students of Karnataka state.

2. The proposed multimedia-learning package covers only on fiber optics Communication unit in Communication Electronics subject for third semester Diploma Electrical and Electronics Engineering Students.

5.7 Definitions of the Terms Used

The terms multimedia learning package, remedial frames, module, feed back, programmed instruction and the like terms important in the proposed study have been defined.
5.8 Review of Related Literature

Review of related literature is presented under four aspects of multimedia development research. The aspects are:

1) Self instructional program development technology
2) Multimedia Learning Package development technology
3) Computerization of multimedia learning package
4) Research on the effectiveness of multimedia learning package

5.8.1 Self Instructional Program Development Technology

Programmed instruction was concerned with the selective and arrangement of subject matter based upon theories of learning. It is a process by which sequence of instructional material are constructed in a way that maximized the rate and depth of learning. Four major styles of programming with the exponent names in the parenthesis are:

1) Linear programming (B.F.Skinner)
2) Branching programming ( N.A.Crowder)
3) Adjunct programming ( Sidney Pressey)
4) Mathetics programming (T.F. Gilbert)
The process of instructional program development involves certain common steps which were followed in all programming styles. There are;

1) Program writing
2) Program tryout
3) Program evaluation

5.8.2 Multimedia Software Development Technology

Multimedia can be defined as an integration of multiple media elements such as audio, video, text, graphics, and animation into one synergetic and symbiotic whole that results in more benefits for end users than any one of the media elements can provide individually. (Reddi, 2003).

Major multimedia building blocks are;

(1) Text  (2) Sound  (3) Visual and Graphics  (4) Video  and  (5) Animation

(1) Selection of Authoring Software

Most multimedia learning package were developed using visual programming languages, such as Macromedia director, Authorware professional, Allegiant super card and Asymetrix tool
Book, Macromedia Director is a powerful and complex multimedia authoring software. It has a broad set of features to create multimedia presentations, animations. Director imports the files such as sound recorded in sound Forge software and pictures created in Flash and Adobe photo shop played in the director Package.

5.8.3 Computerization of Multimedia Learning Package

1) Screen Design: Screen design plays the same role as "gaining attention" in Gagnes events of instruction well designed screen should allow for maximize learning from the materials by providing the learner with appropriate control of the learning process. A visual consists of elements such as words, lines, figures and blanks, careful arrangement of its elements can maximize the impact of a visual. This is achieved by considering the attributer of a visuals i.e. unity, colour, shape, balance etc. Colour adds a new dimension to a visual. According to Dwyer (1978), use of colour in a visual contributes to improvement in the achievement of specific objectives. Research on colour reveals that colour should be used selectively and meaningfully. Colours which produce less strain and fatigue should be preferred.
2) **Preparation of Story Board:** The story board defines all the resources required for each screen in the multimedia learning package, text, sound, pictures and animation and their respective source files.

3) **Interaction and Feedback:** Interaction is commonly viewed as stimulus response reinforcement, immediate feedback, knowledge of results, controlled sequence, small step size, prompting and confirmation improve the learning. Feedback is information about the appropriateness of the learners response that is given to the learner by the courseware.

4) **Navigational Methods:** Navigation and management features serve to enhance learning and make an interactive learning item location should be consistent throughout the project so as student does not have to search for the buttons.

5) **Learner Control:** Many studies suggests that learners should be given more control over the content, access to the content and interaction with multimedia content improve the learner performance.
5.9 Research on the Effectiveness of Multimedia Learning Package

Major Trends in Multimedia Research

In multimedia research the latest trend is to view all isolated media together in a computer based environment available with the advent of multimedia computers and internet. Mona Massood (2004), reviewing the status of adoption and use of instructional technology cited Molenda et.al. to suggest major trends of research and development in the field: (a) incorporation traditional audiovisual media into instructional mainstream,(b) incorporation of computer-based media into instructional mainstream, (c) application of advanced interactive technologies, and (d) growing interest in learner -centered, inquiry -based instruction. In studying effectiveness, Molenda recognizes a shift .The shift is towards patterns of use and their consequences. Molenda et.al. (1998, 2000, 2001, and 2002) have attempted to track the diffusion and use of instructional

As a follow up to the 1998 survey, Molenda and Harris (2000) reported that the rapid emergence of new technological developments, the convergence of previously distinguishable media into digital format, and accompanying changes in the affected
businesses, made it increasingly difficult to be sure what the issues were and what entities should be measured. The shift was towards patterns of use and the consequences of those patterns of use. (Masood, 2004). Review of studies in narrow based of concerns of the present study, trends in respect of sample, methods, analysis and computerization have been highlighted.

5.10 Design of the Study

The design of the study is divided into Five Stages


B. Formation of RAM and RPC branching versions
   i. Self-instructional program (Remedial Adjunct Material) branched version viz. SIP – (RAM).
   ii. Self-instruction (Remedial Program Chunk) Branched version viz. SIP –RPC.

C. Building multimedia features into above version to obtain respective multimedia packages.


E. The Experiment.
5.10.1 Development of Self Instructional Program

Development Linear Book Version (SIP-Book)

The process of instructional program development was based on well established steps namely,

1) Selection of the unit
2) An overview of topic
3) Content analysis.
4) Specification Terminal behaviors.
5) Construction of tests
6) Identification of entering behaviors.
7) Task analysis and Task description
8) Development of modules of Instructional program.
9) Tryout and modification
10) Program Evaluation

1) Selection of the Unit: After examining several chapters in communication Electronics subject, the present topic fiber optic communication was selected.

2) An Overview of Topic: Fiber optic communication, communication basics, communication transmitter, communication receiver, communication channel, transmission medium, properties of light, construction of fiber optic cable,
working principles of fiber optic cable, types of fiber optic cable, light transmitters and receivers, fiber optic cable connectors and losses in fiber optic cable, advantages of fiber optic cable.

3) **Content Analysis:** content analysis for the present topic was carried out so as to develop a suitable content structure that would go with the program ultimately.

4) **Specification Terminal Behaviors:** Goal and sectional objectives for each unit were written on the basis of specific instructional objectives modules were developed.

5) **Construction of Tests:** Two types of tests were developed achievement test and criterion referenced test. Achievement test for checking entry behavior and criterion referenced test was for checking learning outcome. The purpose was evaluating the program in terms of specified objectives of the program. Since the final aim was to develop the computer based multimedia learning package.

6) **Identification of Entering Behaviors:** It is necessary to identify the specific skills that students must have prior to beginning of instruction. The Student will have passed first year Diploma in Electrical and Electronics Engineering of Board of Technical Education Karnataka state. Student will have scored less than 30% of marks in an achievement test on fiber optic
communication constructed for the purpose prior to actually studying the topic. The student will have scored 5 or less in one or more of the modular pretest, and less than 5.5 on the average of five pretests.

7) **Task Analysis and Task Description:** Task analysis and task description for the present topic was carried out so as to develop a suitable content structure that would go with the program ultimately.

8) **Development of Modules of Instructional Program:** The program has five modules viz.,

**Unit-1: Communication Basics:**
- 1.1 Communication Basics
- 1.2 Communication Transmitters.

**Unit-2: Communication medium:**
- 2.1 Communication Medium
- 2.2 Communication Receiver.

**Unit-3: Optical Communication-I:**
- 3.1 Light Wave Communication
- 3.2 Properties of Light
- 3.3 Fiber Optic Cable.

**Unit-4: Optical Communication-II:**
- 4.1 Optical Transmitters
- 4.2 Optical Receivers
- 4.3 Losses in Fiber Optic Cable.

**Unit-5 Advantages of Fiber Optic Cable:**
- 5.1 Fiber optic cable has an E.M.I.
- 5.2 Fiber optic cable have wider...
band width  5.4 Fiber optic cable have smaller in size and lower loss  5.5 Fiber optic cable have signal and security.

**Writing of Learning Frames:** - Mainly branching style was used to write the frames as it suited the present topic- fiber optic communication. But on the whole program was a hybrid of linear, branching and skip styles. Frames were written keeping in mind the entering behavior present. They were also according to the specified terminal behaviors. The information contained in the frames was based on operator matrices prepared for sectional objectives. The general pattern of the frames included in a module was introductory, teaching, practice, review and testing frames.

The content was so sequenced that response of earlier frame functioned as stimulus for next frame. For all error prone points remedial frames were written. Frames varied in size from few words in a sentence to a paragraph. The structure of each module was pre-test, program and post-test. Thus the first draft of instructional program was ready for tryout. The linear self instructional program (SIP) at this stage consisted of five modular units and had 314 frames in all.

**Tryout and Modification**

Tryout was done at three stages
1) one-to-one tryout (N=2)

2) Small group tryout (N=5)

3) Field tryout (N=10)

1) One-to-One was carried out mainly to locate and rectify the errors related to content matter. It also enabled the programmer to improve the logical sequence, modify the defective frames and examine effect of feedback.

2) Small Group Tryout (N=5): After suitable modifications, the small group tryout was done. The sample consists (N=5) of intended learners for whom the program was being developed. This tryout involved student self administered and program monitored print form of presentation of the program. The data thus obtained at small group tryout was analyzed to find out the following.

   i) Error Rate: Error rates for five modules were calculated. The obtained error rate for five modules was less than 10.

   ii) Gain Percentage: Gain percentage for five modules was calculated. Average gain percentage was program density for five modules ranged between.

3) Field Tryout (N=10): Field tryout was done to validate the program before it was taken up for developing the computer software. The sample consisted of ten diploma second year
students. The program was administered five days and data were collected and data analyzed. This resulted in an error rate of 15% and gain percentage of 65% finally.

5.10.2 **Formation of RAM and RPC Branching Versions from SIP-BOOK**

On the basis of data collected at small group tryout and field tryout, written responses of learners to program were analyzed on the basis of errors given as response. Errors may be due to concept missing sequence defects and absence of learning. To increase the effectiveness of program, to make program easily understandable, remedial adjunct reading materials and remedial program chunk frames were written to give better understanding at error prone points to result in two versions viz., RAM and RPC. Thus the programmes were tried out on second semester electrical and electronics engineering students. The selection of samples was based on the specified entering behaviours noted earlier. Thirty students were selected and three groups were formed. The gain percentage for five modules was 65% and error rate for five modules were 16. Three versions of the program were ready for building multimedia features.
5.10.3 Building Multimedia Features into Package

Multimedia Features such as text, line diagrams, pictures were added to learning frames of five modules. Three versions of program viz., SIP-Book Linear SIP Book with remedial adjunct materials SIP-Book and (RAM) and SIP-Book with remedial program chunk (SIP-Book-RPC) versions were ready for computerization.

5.10.4 Development of Respective Computer based Multimedia Learning Packages (viz., CBMLP-Linear, CBMLP-RAM, CBMLP-RPC packages)

A computer program had to be written in order to present the already tested instructional program. The computer had to perform some distinct functions for presenting the instructional program with respect to the following aspects.

(i) Meaning the criterion tests
(ii) Presenting the learning materials
(iii) Recording and maintaining student performance data.

1. Selection of Authoring Software

Macromedia director 8.5 authoring software was selected for developing multimedia learning package.
Sound forge 6.0 version was used for recording and editing the sound, recording sound files were converted into MP3 and imported into director 8.5 diagrams and animated picture were created into Adobe Photoshop and micro media flash 5.0 version and imported into director 8.5.

2. Navigational Methods

Buttons and menus were used for navigational purpose user response data also used for navigation, buttons like, home, back, next, check and quit buttons were used in learning package.

3. Interaction and Feedback

Interaction was provided for each screen, student could interact with learning frame and learner could fill the response and check for knowledge of results. Pre-test score was displayed at the end of pre-test and program response data can be viewed at the end of program and after completing each module name of student, pre-test, post-test score were displayed.

4. Learner Control

Learner can move frame to frame by using next and back button. If the learner response is wrong learner can move to adjunct program after clearing the mistake student can return to main program.
5.10.5 Multimedia Program Development Technology

Multimedia can be defined as an integration of multiple media elements (audio, video, graphics, text, animation, etc.) into one synergetic and symbiotic whole that results in more benefits for the end user than any one of the media elements can provide individually" (Reddi, 2003).

5.10.6 The Experiment

Three versions of computer based multimedia learning package on fiber optic communication were (A) Computer Based Multimedia Learning Package Linear Version (CBMLP-Basic), (B) Computer Based Multimedia Learning Package Remedial Adjunct Material (CBMLP-RAM), and (C) Computer Based Multimedia Learning Package Remedial Program Chunk (CBMLP-RPC) branch version.

Experimental Design

For these three treatment versions, two levels i.e., all frame feedback and student selective feedback plans were employed. This requied treatment by levels 3X2 ANOVA Experimental design.
The Sample of the Study

The present study was conducted at two different places, one at B.V.V.S. Polytechnic, Bagalkot Karnataka and other at K.H.K. Polytechnic, Dharwad. The sample selected at B.V.V.S Polytechnic Bagalkot was 60 students studying in second semester Diploma in Electronic and Electronics Engineering. The sample selected at K.H.K. Polytechnic, Dharwad was 54 students studying in second semester Diploma in Electrical and Electronics Engineering. The students had not studied the topic on fiber optic communication and communication electronics subject and would be checked by pre test for less than average performance. A final replication of the experiment would be a further option in case there is a need and there are eventualities.

The Experiment Conducted at Bagalkot

The students were posted to six experimental groups on the basis of 1, 2, 3 for N=60 with n=10 each in six groups required in 3x2 experimental design. Three computer centers of B.V.V.S Polytechnic were selected for conducting the experiment. They were Electrical, Electronics and Communication and Computer Science Department. Each center had 15 multimedia computers with headphone and UPS facility. A+ Electrical Department computer
center linear program with two feedback levels were loaded, at E&C Department computer Center RAM program with two feedback levels were loaded and at computer science Department Computer center RPC branch version with two feedback plans were loaded. Three lecturers of Electrical Engineering Department were asked to conduct the experiment at each center. At the first day, instructions were given to the students at respective center allotted staff. Morning session for at three centers all frame feedback was conducted and in the afternoon session selective feedback was conducted. On the first day, module-1 was administered, on the second day, module-2 was administered. After every session completion students data such as pre-test and post-test score and student response report were collected. The experiment ended in five days.

The Experiment Conducted at K.H.K. Polytechnic Dharwad

On the same lines as in Bagalkot for N=54 with n=9 each in the six groups.
5.11 Results and Analysis

Program Effectiveness indicators

1. SIP-book version small group tryout (N=5)
   gain percentage : 65%
   error rate : 11.70%
   Program density : 0.33

2. SIP-book version field tryout (N=10)
   gain percentage : 72%
   error rate : 24.22%

3. SIP-book MLP Linear
   gain percentage : 63.65%
   error rate : 17.65%

4. SIP-book MLP-RAM
   gain percentage : 62.65%
   error rate : 15.53%

5. SIP-book MLP-RPC
   gain percentage : 65.11%
   error rate : 17.40%
Program Effectiveness of three CBMLP versions

<table>
<thead>
<tr>
<th>CBMLP-Version</th>
<th>Gain Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBMLP-Linear</td>
<td>60%</td>
</tr>
<tr>
<td>CBMLP-RAM</td>
<td>65%</td>
</tr>
<tr>
<td>CBMLP-RPC</td>
<td>80%</td>
</tr>
</tbody>
</table>

Three program versions by two feedback levels experiment conducted Bagalkot ANOVA results

The gains obtained on CBMLP package on fiber optic communication for all five modules administered at B.V.V.S Polytechnic Bagalkot sample (N=60%). The ANOVA results were

1. The obtained $F_A=514$ value is exceeds the table value for degree of freedom df (2,54) at 0.01 level. The programming styles create the difference in learning.

2. The obtained $F_B=0.50$ value is less than table for degree of freedom df (1,54) at 0.01 level. Hence programming levels did not create any difference in learning.

3. The obtained $F_{AB}=34$ is significant because obtained value is more than table value for degree of freedom df (2,54), interaction effects programming style and programming levels create the difference in learning.

For testing the significant difference among means by using DUCAN’s multiple range test, computer based CBMLP-RPC program
with student selective feedback plan was superior to CBMLP-RAM and CBMLP-Linear.

Further, CBMLP-RAM was superior than CBMLP-Linear program.

Dharwad Experiment ANOVA Results

The gains obtained on CBMLP package on fiber optic communication for all five modules administered at KHK Polytechnic Dharwad (N=54).

i). The obtained $F_a=352.21$ exceeds the table value for degree of freedom df (2,48) at 0.01 level. Programming style creates difference in learning.

ii). The obtained $F_b=4.78$ is less than table value for the degree of freedom df (1,48) at 0.01 level. Programming levels did not create any difference in learning.

iii). The obtained $F_{ab}=0.79$ is less than table value for the degree of freedom df (2,48) at 0.01 level. Treatment and levels did not create any difference in learning.

For testing the significant difference among means by using DUCAN's multiple range test, CBMLP-RPC branching program with student selective feedback plan was superior to CBMLP-RAM and
CBMLP-Linear program. Further CBMLP-RAM program was superior to CBMLP-Linear program.

5.12 General Discussion

The present study examined three programming styles namely Linear RAM and Branching Program because using branching program is more consistent with current presentation strategies applied in today’s computer assisted instruction. Results of present study revealed that branching in an instructional interface resulted in a significantly better learning outcome when compared to remedial adjunct material program or linear program styles.

The results of this study also indicated that subjects in the computer based branching program and interactive handling students selective feedback plan is superior to RAM as well as linear presentation at both feedback levels. Further, computer based presentation of RAM with all frame feedback as well as student selective frame feedback is significantly superior to linear with both types of feedback plans.

Feedback is an essential element in a learning process. It provides learners with confirmation on the accomplishment of a learning purpose. A variation in the information provided in
feedback seems to produce different levels of gains in learning. This study has shown that learning gains increase as the feedback provided become more informative.

5.13 Suggestions for Further Research

1. Development of CBMLPs for students of Diploma programs in Electrical Engg for learning other topics such as satellite communication, mobile communication, and electrical machines.

2. Development of CBMLPs in various core engineering subjects for learning of polytechnics students.

3. The present study covers only five units. Programs can be developed using media variables, such as Text + sound, Text Sound + pictures, text alone.

4. To make the program more vivid and learner control, data base for the learning frames could be developed.

5. In keeping with fast developing technology, hypermedia and web based learning materials could be developed.