CHAPTER-II
THEORETICAL FRAMEWORK OF MULTIMEDIA LEARNING

2.0.0 INTRODUCTION:

Multimedia learning has potential in education and improves the teaching learning process. The studies show that multimedia is based on theoretical framework. In this chapter different theories which support the potential of multimedia learning and information processing system of human beings have been described. This chapter also includes various models of developing multimedia package and various steps involved in the process of development and validation of these programmes.

2.1.0 THEORIES OF MULTIMEDIA LEARNING

Multimedia instruction uses different type of media like text, graphics, audio etc to facilitate the learning. Studies conducted by Mayer (1992), Mayer and Anderson (1992) Krueger & Schor (2000) and Driscoll (2002), etc have shown that students performance was enhanced by using multimedia instruction. All the studies also agree that multimedia presentation is based on theoretical understanding of how people learn from words and images. The important theories of multimedia learning are as under:

The cognitive theory of information focuses on how human memory system acquires, transfers, celebrates, retrieves and uses information. According to this theory the memory is of three types-sensory, short term and long term memory. The sensory memory receivers the input through sight and sound and processes it for three to five seconds. The information is held until the stimulus is recognized or forgotten. Then this information is transformed to short term memory and remains active for 15-20 seconds without rehearsal and it is rehearsed celebrated and used for decision making or stored in long term memory before it is forgotten. According to Muler (1950) “The short term memory has room for about seven chunks of information, plus or minus two, depending upon the individual. Long term memory is an unlimited and
permanent storehouse of information it receives from sensory and short term memory and stores it for longer time.”

Another theory which is concerned with multimedia learning is cognitive load theory. According to this theory “When the learning material has high intrinsic load or high elements interactivity and these are presented as text, with other kind of visuals, it is better to present it aurally because the efficiency of information powering in working will be enhanced if information is presented in different modalities (modality effect) when visuals are combined with text presented visually, learning is impaired because learners have to split their attention between text and visuals in order to integrate both sources of information (split attention effect).” These effects seem to be confirmed in studies conducted by Sweller, Mayer, Pass (1988), Kalyuga, Chandler and Sweller (1999), Mayer and Moreno (1998, 2002) etc. The advocates of cognitive load theory often refer to studies reviewed by Pennyc (1989) and the working model proposed by Baddeley (2000) According to this model “Working memory consists of a control executive and at least three subsidiary systems: the phonological loop, the visual spatial sketchpad and episodic buffer. The central executive is an attention controller that can supervise and coordinate the subsidiary system. The phonological loop has the function of processing speech or printed text whereas the visuospatial sketchpad is responsible for setting up and manipulating mental images. The episodic buffer is assumed to be the place where information from the subsystems of working memory and long term memory is integrated.”

The cue summation theory specifically deals with learning and retention in multimedia environment. According to this theory learning is increased by increasing of the available stimuli (Severian, 1967) According to Severin, “Multiple channels communication appear to be superior to a signal channel communication when relevant cusses are summated across channels, rather is superior when redundant between channels, and are inferior when irrelevant cues are combined, in other words, stimuli provided should be relevant to each other or the distraction world cause a decrease rather that an increase in learning and retention.” Severing (1968) found that the combination of auditory signals with visual presentation, providing a different but
related cue to the stimulus object, was more effective in producing recognition than a combination with visual presentation of the same cue in a redundant condition.

Paivio and other's theory of dual coding which explains that cognitive process occurs within two separate information processing systems the visual system process the visual knowledge while the verbal system is meant for processing of verbal knowledge. Both the verbal and non verbal systems are part of a symbolic system hierarchy which is orthogonally related to sensory motor system. Neale (1994) examined prediction of this theory by using multimedia package and found that although dual coded group performance was better than single coded group. The finding also shows that dual coded group spent more time in reviewing the contents but less time in answering the questions.

According to Generative theory as propounded by Wittrock & others “learning occurs when learner selects relevant information from the presentation, organization in to a coherent mental representation and integrates the new acquired knowledge with others.”

Mayer's (1997) explained the learning in multimedia environment through his cognitive theory which is based on the dual theory and generative theory. He considered the learner as knowledge constructor who actively selects and connects the verbal and visual process of knowledge. The basic theme of this theory is that the design of multimedia instruction affects the degree to which learners engage in the cognitive process required for meaningful learning within verbal and visual information process.

Mayer cognitive load model describes that human mind is limited in this capacity to attend, share and integrate information into level term memory (Mayer 2009) There are three basic assumptions of these cognitive theory (i) humans have dual channel (visual and auditory) (ii) limited capacity to process information at one time by each channel and (iii) active processing assumption which means selecting, organizing and integration of information. In addition to cognitive assumptions, Mayer's model outlines five cognitive processes necessary for meaningful multimedia learning (i) selecting relevant words from presented text for working verbal memory processing (ii) selecting relevant images for visual working memory (iii) organizing
selecting words into coherent verbal representation (iv) organizing selected images into content visual representation with pre existing knowledge.

If words or images disrupt any of these five cognitive processes, learning suffers due to incomplete representation of information; based upon this model Mayer has articulated different principles of designing multimedia instruction. These are (i) multimedia principle (ii) spatial contiguity principle. (iii) temporal contingently principle (iv) coherence principle (v) modality principles (vi) redundancy principle and (vii) individual differences principles.

2.2.0 DEVELOPMENT AND VALIDATION OF MULTIMEDIA PACKAGE

Development of multimedia packages requires multitude of skills and expertise including conceiving an idea, writing scripts, developing visual illustration, production and editing of final product. All these skills are not commonly available in all teachers. Similarly multimedia packages are not something which can be produced by a commercial comparing. Thus production of multimedia packages is an academic pursuit which can be supported by people having technical knowledge of production of such programmes. Thus good multimedia packages are developed by teachers having long experience, passion about innovative teaching and the ability to work with different people working in different areas and having trans – disciplinary skills. Thus the developer has to work with expertisation in different aspects for development and validation of multimedia learning package. There are different models of multimedia development. Some of the important models are as under:

Story and McMahon(1998) adapted Gould’s (1995) model of multimedia developer and identified four basic phases “(i) information design which includes the planning of content and analysis of the audience (ii) interface design which connects the learner with the content in the most functional and intuitive way possible (iii) navigation to connect the pages logically to content. (iv) interaction design which determines working of programme and way of using this by leaner.”

Allessi and Trollip (2001) also identified four phases of development which are (i) presenting information (ii) guiding the learning (iii) practicing and (iv) assessing learning. Glasgow ((1998) identified five common components for
development of a multimedia package. These steps are (i) analysis (ii) design (iii) development (iv) implement (v) evaluation. Within context of instructional design Greer (1992) introduction a ten step ID management model that includes following steps (i) determine project scope (ii) organizing the project (iii) gathering information (iv) developing blueprint (v) creating draft material (vi) testing draft material (vii) producing master material .

2.3.0 STEPS OF DEVELOPMENT AND VALIDATION OF MULTIMEDIA PACKAGE

The main objective of the present study was to develop and validate MMP in Economics and see its effect on learning outcomes of students. Before developing multimedia package the investigator consulted various models of developing packages. On analysis of these models it can be concluded that the development of multimedia package takes place in three phases. (i) Planning phase (Pre Production) (ii) development phase (Design) (iii) validation or implementation phase. These are described as under

Planning Phase:

Planning plays an important role in development of multimedia package. Planning before starting ensures that the product will be cohesive to the target group. The first stage in any software development is that emergence of an idea. The investigator after making a thorough review of existing application decided to develop a multimedia packages in Economics for senior secondary school students. The following steps were followed for developing the package.

i) Selection of Units:- After taking decision regarding development of multimedia package the investigator selected four units viz. Poverty, Unemployment, Population and Agriculture for developing the package.

ii) Defining Instructional Objectives and writing them in behavioural terms :- After selection of the units, it was very important to identify the instructional objectives of each unit. Identification of aims and objectives of the content to be taught helps the teacher to define what students will learn and understand. Specification of them in behavioural terms helps the teacher to specify the content, teaching aids, content, evaluation’ techniques and teaching
methods. Thus instructional objectives were identified and written in behavioural terms by using Bloom’s taxonomy.

iii) **Analysis of target audience**: The next step was analysis of the learners. The present package is for teaching Economics to Senior Secondary school students. So the entry behaviour characteristics, intellectual level, potential of learning aptitude, interest, socio-economic status and general scholastic abilities of these students analysed. This was done with the help of developer’s own experience, students’ cumulative records and various testing devices. Thus the target group was accurately identified by the investigator and assumptions were written.

iv) **Selection of content, its analysis and other Activities**: After identification of instructional objectives and analysis of target audience, the investigator selected the content from prescribed syllabus of CBSE, New Delhi with the desired rationale. After selection of content, it was analysed into topics, sub topics, principles theories etc. After content analysis these sub topic were organised in a sequence according to various maxims / principles of content organisation. Every effort was made to sequence the content in such a way which could help learner to minimise the energy and efforts to make links between information. Consistency between learning objectives and content was maintained so that lessons be presented logically and smoothly from frame to frame or from section to section.

v) **Developing evaluation strategies & criteria to determine effectiveness of package**: Evaluation examines the effectiveness of instruction by considering how well outcomes, assessment and activities are designed within the instruction and whether they are appropriate for the needs and characteristics of the learners (Cennan & Kack, 2005). While drafting and formation of module, we should also consider how to measure the overall effectiveness of package. A well defined evaluation can confirm the value and validity of the tool. Pre testing, embedded testing and post testing strategies were employed to determine the effectiveness of package. Pre testing determines current understanding. Embedded test helps the learner practice and transfer
knowledge to confirm that learning is taking place. For evaluation of a tool expert opinion was obtained by the investigator to know the opinion about content, language, images etc. If the package is not meeting the objectives, it should be reviewed for its validity.

**Development Phase or Design:**

After completing the first phase, the next step was development of multimedia package its design or development. The design stage includes (i) delivery platform selection (ii) Media selection (iii) Selection of tools (iv) outlining and prototype (v) designing a script (vi) Flow chart. These are described as under:

i) **Selection of delivery platform**: A point that should be considered at the software design stage is how the application will be distributed. The most popular ways of multimedia application distribution are CD-ROM and www. Both types of ways have their advantages and disadvantages. In this study the investigator decided to develop the package in the form of CD-ROM.

ii) **Selection of Hardware and software**: The investigator planned to include all the basic elements viz. text, animation, graphic and video in the package. There are various softwares like windows 98, windows 2000, MS Word 2007 etc. Similarly for graphics the softwares are Mac Plus, Aldus Page Maker, Apple Laser Writer, Adobe Photoshop etc. The software which helps in video production and editing are Applie I Movies, Adobe Premier Pro, Punnacle Studio. The authoring software other than HTML are dreamweaver GO live author professional, Flash is used for animation and there are various softwares for integrating all the elements. The investigator used Adobe Photoshop, Adobe sound booth, Swish 2.0, Adobe after effect and Microsoft word 2007 for the development of the package. The format of main software i.e. Swish is shown in fig., Corel, PaintNet, dreamweaver 9, Microsoft front page 2002, MS Excel etc. Audio-MP3, WMA, Wave, Real Audio & Midi Video – Flash MPEG, AVI, WMV and quick time.

**Script Writing of Multimedia Package:**

The investigator wrote the script of all the basic elements of multimedia package i.e. Text, audio video and animation which are explained as under :-
i) **Textual Content**: Text content is the most common media type and basic step towards development of multimedia package. The pattern adopted was with that used in self instructional material developed by open universities. The unit started with instructional objectives, followed by introduction, evaluation and sum up. The textual content consisted of topic, sub topics, definitions, questions, examples etc. Text can provide specific information or it can act as reinforcement for information contained in other media.

ii) **Graphics**: In the package a large number of photographs, diagrams, images, pictures, graphs related to various topics and sub topics are given to enhance the learning experiences. The graphics make teaching and learning interesting. The still pictures and photographs were collected from different books, magazines, newspapers and internet. The pictures were also shot as per requirement and downloaded pictures were edited with the help of Adobe Photoshop. These were kept as simple and attractive to the students.

iii) **Audio**: To enhance the visual effect, audio sound were used. These were used in the form of natural sound, music and conversation. Two types of sound are generated by computer while other imported from outside was used. Making sound of multimedia included following steps. (i) recording (ii) editing (iii) mixing and (iv) delivery. The sound has also been used as background music which makes the package more interesting.

iv) **Animation**: Animation makes the package more interesting and live. All computer animation is achieved by making small changes to screen images rapidly enough so that the sequence appears to be moving. These are different techniques of creating animation. The textual content was animated by the researcher by using software.

**Preparing a Blueprint:**

Blueprint in multimedia package initially deals with the division of topics according to tentative duration of sessions and selecting different modes in which the sub topics are to be presented in front of students. It works with the help of outlined information about subtopics to be covered. The instructional objectives to be achieved
after teaching are also kept in mind. After dividing the topic into subtopics, these are arranged in a sequence for presentation.

**Developing flow chart and paper prototype:**

The flow charts are the visual method which present a clear overview of content. The flow chart confirms each slide purpose and relationship with learning process. The flow chart helps the designer to plan audio text, graphics and user interaction or each screen (Cinnamo & Kalik, 2006)

After preparing detailed outline, a prototype design was prepared to tryout ideas layout, interface to see if they work. A prototype help the developer to apply and test before too much time and money are wasted in the process.

**Assessment of Multimedia Package**

During this the performance testing is carried out to consider the effectiveness of the content in realising instructional objectives and usability of technology. The data were collected from teachers, technical experts by administering the opinionare developed for this purpose. This was completed in three phases (i) one to one (ii) small group tryout and (iii) filed try out. The feedback received from subject experts and ICT experts was incorporated and necessary changes were made before production of package.

**Production stage or completing the package**

After validation of prototype, the next step was the completion of the multimedia learning package. The different components of multimedia like text, images, audio were developed by using suitable hardware and software and were integrated into one complete product. Now the product was ready for summative evaluation.

**Summative Evaluation of Product & Process**

As the formative evaluation is done during the development of package to know the strength and weakness for making improvement. The summative evaluation is done after completing the product to assess its effectiveness for learning. It includes getting the feedback directly from the targeted audience. The effectiveness of
multimedia package was checked by teaching the experimental group during treatment by using multimedia package in Economics during treatment period.