4.1 Introduction

Based on the instructional models and general guidelines for developing educational multimedia applications, the researcher has designed four types of computer based multimedia packages for learning Human Excretory System. However, since the packages were developed purely for present experimentation purpose; the development process is unique and specific in nature. To develop the multimedia package for the selected content, the researcher first developed a Programmed Learning Material (PLM), then converted it into Computer Based Instruction (CBI) and finally designed and developed the multimedia packages.

Thus, these packages were developed for the present purpose of experimentation and to see the effectiveness of multimedia in learning. The factors such as, Computer availability and facility in schools, Functionality and Time constraint were also taken into consideration for the present experimentation. After careful analysis of the availability of the resources, need of the content, learners' ability concerning multimedia access and the affordability. The researcher has identified the multimedia elements such as
visuals, animation effect and audio in addition to text in designing the multimedia packages.

4.2 Development of Multimedia Packages

The steps followed in the development and validation of the Computer Based Multimedia Packages are as follows:

**Selection of Content**

As the first task, the researcher identified the content for developing the multimedia package.

The secondary level students under the State Board of Education studying Biological Science as a part of their General Science curriculum were taken as experimental sample for the development and validation of the packages. In the prescribed textbook, there are 7 units of Biological Science as a subject of study covering various aspects of Biological Science. After a thorough analysis of the units, the researcher has selected the unit “Life Processes / Human Excretory System” as the content for the multimedia package.

*Figure-4.1: Flow Chart of Development of Computer Based Multimedia Packages*
Reasons for Selecting the Particular Unit:

- This unit talks about the excretion, which is one of the important function of Human body.

- It provides ample scope for the development of multimedia packages.

- It is not possible to visualize many aspects of working of Kidney without any visual aids.

- Students with less imaginative skill may find it difficult to understand some of the aspects of this unit.

- The researcher was able to collect rare resource material (Pictures, books, etc.,) related to this topic.

- This is an abstract topic which can be presented effectively
with the augmentation of multimedia elements.

The time allocated for this particular unit in the General science curriculum is approximately three hours which is inclusive of revision, test and other curricular activities of this unit.

**Content Analysis**

After selecting the unit, the researcher read the content thoroughly. Apart from the prescribed text book, various other books, reference materials and websites were also referred. The outline of the content was prepared by using various resources. The major topics of the content were specified and moduled. It was decided to sequence the related modules under three sub-headings viz.,

i. Human excretory system – An Overview

ii. Structure and function of Nephron

iii. Disorders of Kidney and their treatment

The package was organized as Heading, Sub-heading and Modules. Module refers to each page of the content. The content is mostly collected from the prescribed text book. Some additional information has also been included. The authenticity of the information drawn from various source like World Wide Web has been verified. An informal discussion with the subject experts and school teachers was undertaken by the researcher at this stage.
Learner Analysis

The students of IX standard (secondary level of education) under the State Board of Education are considered as sample for the present study. The researcher visited such schools in Haliyal taluka to collect information in order to analyze the learner characteristics. Most of them belong to middle class families of Haliyal taluka, whose socio-economic status is at average level. Both boys and girls are included in the learner group. The students of IX standard belong to pre-adolescent stage and mostly between 14-15 years of age. Further, they have already completed 8 years of schooling. They have reasonably well prepared academic skills to gain higher levels of literacy, knowledge, skills and values, the core elements of school education.

The basic pre-requisite skill needed for learning the content is the fundamental skills of reading and writing in English. Since, the learners are studying in the English medium they possess the required language skills. Some of them do have knowledge about the basic computer operations and some do not have. Hence, the researcher decided to design the multimedia package in such a way those students who are new to the computer can also learn.

Identifying Instructional Objectives
Prior to the development of the content, the researcher framed the instructional objectives. Instructional objectives are the descriptions of what students should do after learning. A widely acceptable format for a well-written instructional objective is to present it in sentence form, comprising four important components or parts i.e., Audience, Behaviour, Conditions and Degree (Angela, F. L. Wong, 2000).

Due to the specific nature of the content, the identified objectives are mainly focused on the three stage of Cognitive domain such as Knowledge, Comprehension and Application. The general objectives identified were;

After learning the package, the selected students for learning Biological Science will be able to do the following tasks within the given time:

- describe the structure of kidney
- describe the structure of nephron
- list out the different functions of nephron
- Identify different parts of nephron
- describe various causes and treatment for kidney failure

The above objectives can be broken into number of specific objectives with reference to the content of each module.

*Development of Programmed Learning Material (PLM)*
Programmed Learning Material (PLM) is typically a text based material presents the content to be learned in a series of very small steps, called frames. With the help of readily available resource materials, the content for PLM was developed and sequenced under the three identified sub-headings. The basic principles of branching style programming were followed. Petite titles were given to each module as follows:

**Human Excretory System – An Overview**

- Position of kidney
- Structure and function of kidney
- Structure and function of ureter
- Structure and function of urinary bladder
- Structure and function of urethra

**Structure and function of Nephron**

- Structure of Nephron
- Malpighian Corpuscle
- Proximal Convoluted Tubules
- Henle’s loop
- Distal Convoluted Tubules
- Collecting Tubules
- Blood capillaries
- Vasarecta
- Glomerular filtration
- Selective reabsorption
- Tubular secretion
Disorders of Kidney and their treatment

- Kidney stones
- Nephritis
- Dialysis
- Kidney failure
- Kidney transplant

The instructional material of each module contains a main/information page, question/test page and a feedback page. Main page contains the content or information which leads to a test page. A test page consists of a multiple choice question. Each option/choice will branch the individual learner to a feedback page which choice question. Each option/choice will branch the individual learner to a feedback page which leads to the next or previous main page depending on the correct or wrong answer respectively. Simple language is used in the pages for the easy understanding of the concepts. Important terms were highlighted. Diagrams/Visuals were included in the appropriate places. A small introduction and instructions were given at the beginning.

Try Out – I

The developed PLM was given to a small group of students for try out. The time taken to complete the material was noted down. The students were asked to give a feedback and encouraged to state suggestions about the
content and other aspects. Some school teachers who are handling Biological Science subject were also consulted. Based on the suggestions and feedback given by the students and teacher, various modification such as removing and merging the pages, language corrections, clearing vague sentences, etc., were incorporated.

**Converting as Computer Assisted Instruction (CAI)**

After the development and validation of the PLM it was converted into CAI package on tutorial mode by using the software called ‘Flash’ (MX 2004). There are many software viz., Swish, Flash, Director, Lectora, Adobe After Effects, Jumpwel, Studiomax, Cyberdelia. Text designs, animations and navigation can be done effectively with Flash. Flash is the 2D animation software which is very user friendly and suitable for vector graphics. It also allows creating simple drawings and buttons (link to other pages).

Moreover, Flash will support the incorporation of other multimedia elements such as audio in later stages. Flash makes it easy to Import and Export various files in different formats. Synchronizing the animation with audio can also be done with this software. Multimedia package developed by using this software could be run in the low configured computers available in the schools. Hence, the researcher decided Flash as the suitable software material by using the Flash software.

The validated content of the PLM was keyed into the computer and
placed in appropriate pages. Fonts such as Verdana and Book Antiqua were used. Contrast lettering with the background was selected. Important points were highlighted in different colour. CAI pages are similar to the pages of PLM, however, it is more user-friendly and attractive to the students. The learners cannot move to the next main page without answering it correctly. Instructions regarding the operation of the package are given in a detailed manner in the package itself.

**Try Out – II**

After the development of the CAI package, it was given to the subject experts, computer professionals and a small group of students. The average time taken to complete the package was noted and it was 35 minutes. Students were asked to give suggestions for improvement of the CAI package. They said about the lengthy texts of few pages, ambiguity of certain questions, etc. Appropriate modifications were done based on the suggestions given by the students and other experts. Finally, the number of information pages was reduced to 20.

**Developing Multimedia Packages**

Multimedia combines media elements such as text, graphics, video, animation, and audio to represent and convey information. It allows effective teaching-learning, enriches (as they go beyond the textbook, allowing students to acquire additional knowledge), and encourages creative thinking.
In general, it is enjoyable and provides motivation for students to learn and to take part in.

The researcher planned to develop four types of computer based multimedia packages by combining the media elements. The “Text & Still Pictures” were combined together to design the Type I package. These two elements were kept constant in all types of the package. In the Type II package “Audio” was added in the spoken text form. The Type III package was enriched with the feature of “Animation” without Audio element. Finally, all the elements i.e., Text & Still Pictures, Audio and Animation were included in the Type IV package. In short,

Type I — Text & Still Picture  
Type II — Text & Still Pictures + Audio  
Type III — Text & Still Pictures + Animation  
Type IV — Text & Still Pictures + Audio + Animation

Though, the packages are different in the multimedia elements many other features like Basic design of the screen, interface, navigation and pages of all types were same. The following operational flow presents the design of all four packages.

Figure-4.2: Flow Chart of Basic Operational Flow of Multimedia Packages
**Information Page**

This page presents the information (Content / Text) to the learner and then directs to the question page.

**Question Page**

For each ‘information page’ there is one ‘question page’. The learner has to answer the question, which is based on the information learned. By answering the question correct or wrong the learner can go to the next or
previous page respectively. The learner cannot skip any question.

*Feedback / Reinforcement Page*

The correct or wrong answer of the learner takes him/her to the feedback page, which is different for each option (Three options were given for each question). Text was provided for reinforcing the correct answer with more information and reasons for the wrong answers i.e., why it is wrong.

*Navigation*

Following are the navigational links which allow the learner to move through the package.

- The title is linked with the introduction page.
- The introduction page directs the learner to the instruction pages.
- After reading the instructions, the learner is linked to the first information (content) page.
- In each information page, there is a button which takes the learner to the question page.
- The options in the question page are linked with a feedback page.
- ‘Next’ or ‘Back’ buttons were given in the feedback page. If the answer is correct the learner can proceed to the next information page and if the answer is wrong the learner should go back to the previous page.
A storyboard is the representation of how each page will look like and how they are linked. It also provides a guideline for developing and designing the content. Separate storyboards were developed to represent the rough lay out of each page. The place of elements like text, picture, graphics, and buttons were mentioned. The navigation links were also and represented in the storyboard.

Following are the examples of the storyboards developed (1. Information Page, 2. Question Page, 3&4 Feedback Pages)

Presenting instruction in multiple media elements can be more effective than presenting it in a single medium (such as text), but the
important factor is combining the media elements effectively, which is not merely adding media. Effective multimedia for learning requires careful combination of various media elements in well thought/reasoned ways that takes the advantages of each medium’s unique characteristics in relation with the content. Hence, the researcher has designed and developed four different multimedia packages for the same content.

**Type – I : Multimedia Package (Text and Still Pictures)**

The Type – I package contains the text and still pictures. Since the textual matter is already finalized and typed in, the researcher started working with the still pictures. Suitable and appropriate pictures were collected from many sources such as internet, books and journals. Some of the pictures were drawn by the researcher if there are no suitable pictures available. Photographs, printed pictures and images were digitized with the help of the scanner machine.

All the pictures were modified and edited using the “Adobe Photoshop” software. With this software, images can be created and photographs and pictures can be modified effectively. Colours of the pictures were changed; image size was enlarged or reduced according the need. The designed still pictures were placed appropriately in each page. It is not a matter of placing some pictures and words together at random. Suitable pictures for each page were selected. Thus the Type – I package was
developed with the elements of text and still pictures.

**Type–II: Multimedia Package (Text and Still Pictures+ Audio)**

The Type – II package is the combination of text, still pictures and audio. Audio in the form of spoken text and sound effects was used in the package. Human voice was used with clear and good modulation and expression. The software used at this stage are ‘Protools’ and ‘Sound Forge’. These audio software are very useful for recording and editing the sound. Moreover, importing and exporting audio files can be done easily with this. Hence, the researcher selected these software for developing the multimedia package.

With Protools, the narrative voice for all the pages was recorded in a single file and then fragmented and edited by using Sound Forge. A good quality of audio was maintained by keeping a stable volume. Distracting noises were eliminated. Then the recorded and edited audio is synchronized with the text and images.

**Type – III: Multimedia Package (Text and Still Pictures + Animation)**

The Type – III package is designed with the text and animations, which makes learning more effective, attractive and interesting. Animation was made to capture the attention of the learners and also they could be enticed to think about the presented information. This package consisted of
the same text and still pictures but with appropriate and appealing animations. However, audio is not included in this Type – III package.

The animations were created using ‘Flash’ and ‘Adobe Photoshop’. As already mentioned, Flash is an effective animation software with which interactive content rich with video, graphics, and animation can be created. Moreover, it is easy to run the Flash files in any computer system on which the Flash software is not installed. Still pictures were modified with Adobe Photoshop and animated with the help of Flash. Textual animations and picture animations were also created in several modules to attract and to draw the attention of the learner. Animated text and animated picture helps the learners to remember the content well.

Care was taken to avoid the distraction from the main message (content) because of given animation. Inappropriate use of animation can do more harm than good to the learning process. Hence, they were used only when needed such as to gain attention, to explain some abstract concepts, to focus on a certain area, to stimulate curiosity, and to provide clear feedback.

Type–IV: Multimedia Package (Text & Still Pictures + Audio + Animation)

The Type – IV package is enriched with all the elements used in other three types such as, Text & Still Pictures, Audio and Animation. Since all elements were designed and created already, the researcher combined them
in this package. But audio cannot be just added as in the Type-II package, since it has to be synchronized with the animations. For this the same audio software ‘Sound Forge’, is used. Necessary pause were inserted in the narrative voice to match it with the animated text and visuals.

The buttons are also designed with the Flash software. These buttons are the means of navigation which takes the learner to the corresponding page. Once the buttons are created it can be placed anywhere in the package. Buttons are used in all types of packages for navigational purpose.

Sample Pages of the Multimedia Packages

Title Page

Information Pages

Question Page

Feedback Page
**Pre-Study**

The finished products were tested/evaluated with the students. A pre-study was conducted with a small group of secondary level (IX standard) students. The students were asked to provide feedback on content and other matters such as graphic, design and formats. Also the researcher checked the functionality, usability, navigation, system requirement, average time needed to learn the package, etc. The students were divided into four groups and the four types of multimedia packages were tested and suggestions were received. The teachers and the experts were also asked to suggest on the above said points. Based on the suggestions and evaluations, various modifications were done in the packages. They are,

- Few information pages which were confusing were modified.
- Lengthy sentences were shortened.
- Unfamiliar words were given meaning and deleted.
- Some ambiguous questions were altered.
- More pictures were added.
- Very few undue animations were removed.

**Content Validity of the Multimedia Package**

Opinionnaire for high School teachers were given to five experienced
high school teachers and they were requested to go through the packages and give their candid opinion about the package on the five point scale given below.

**Table 4.1- Opinionnaire for High School Teacher**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Items</th>
<th>Rating</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The multimedia packages are comprehensive</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
<tr>
<td>2</td>
<td>The directions given are clear</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
<tr>
<td>3</td>
<td>The content page is comprehensive</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
<tr>
<td>4</td>
<td>The information in the package is relevant and clear</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
<tr>
<td>5</td>
<td>The objectives of the topic is covered</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
<tr>
<td>6</td>
<td>The administrative procedure is satisfactory</td>
<td>To a very great extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 4 3 2 1</td>
<td>Not at all</td>
</tr>
</tbody>
</table>

**Table-4.2 Responses of High School Teachers to the Opinionnaire (N=5)**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Items</th>
<th>Responses of High School Teachers</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The multimedia packages are comprehensive</td>
<td>4 4 5 5 5</td>
<td>4.6</td>
</tr>
<tr>
<td>2</td>
<td>The directions given are clear</td>
<td>5 4 5 4 5</td>
<td>4.6</td>
</tr>
<tr>
<td>3</td>
<td>The content page is comprehensive</td>
<td>5 5 5 5 4</td>
<td>4.8</td>
</tr>
<tr>
<td>4</td>
<td>The information in the</td>
<td>5 5 5 4 4</td>
<td>4.6</td>
</tr>
</tbody>
</table>
Since the obtained average value for all the items is more than the above average i.e. 4.5 the content validity is established for the entire tool. Thus it is evident that the tool along with the direction is objective and it has content validity.

**Pilot-Study**

In the pilot-study, the modified packages were again validated/evaluated with 100 IX standard students. The students involved in pre-study and pilot-study were not the same. The exact experimentation process was followed in this stage. Hence the other tools like Non-Verbal Group Test of Intelligence, Language Aptitude Test Attitude towards Science and Criterion Referenced Test also given in the planned time intervals. The time taken by the students to complete the package was also noted down. Few more changes were done in the packages after the pilot-study and then it was made ready for experimentation.

### 4.3 Restrictions in the Development of the Packages

The researcher has identified some limitations and constraints in the

<table>
<thead>
<tr>
<th></th>
<th>package is relevant and clear</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>The objectives of the topic is covered</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>The administrative procedure is satisfactory</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
development of the package. The elements like, computer availability and facility in schools, functionality, time constrain, etc., were analyzed and following points were noted.

- Very limited number of computers with CD drives available in schools.
- Advanced software cannot be installed due to the lower configuration of computers in schools.
- The package cannot run for hours. Time should be restricted.
- Less or nil knowledge among the students about the usage of computer.

Based on the above facts, the researcher has followed certain restrictions in the development of the multimedia package such as,

- Tutorial mode of instruction is suitable.
- Instructions about the usage of the package should be given.
- Limited information should be presented in each page.
- Learner control of the package should be minimum level.
- Very less navigation buttons should be given.
- Learner should not be able to quit the package in between.
- Same difficulty level should be provided for all learners.
- Hyper links should be avoided.
File forma should be in .exe (This type of files can be executed in any computer without installing any player/software).