## Chapter 4: Development of ICSH

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4.1 INTRODUCTION

This chapter represents the core of the research because it describes in detail the steps of development of ICSH. The development is based on specific theory, (derived theory of research). This theory explains teaching/learning process for HI persons via e-learning. According to our survey we did not find such theory which deals directly with teaching/learning process for HI persons via e-learning. Hence development of such theory is a prerequisite to designing ICSH.

The derived theory leads to computer model for developing ICSH. This model was designed to be a typical, systematic and to realize the optimal effectiveness of the instructional outcomes when used by HI learners. Thus the model depends on many factors like theory of research, HI modes of communication, HI teaching methodology, Software Engineering models, ELMs methods, visual programming and multimedia technique. ICSH represents a Master or Generic software for authoring system which assist the instructor of HI students in developing ELMs of any given topic.

This ICSH has been used to develop real (experimental) ELMs for standard HI school classes in India. These experimental ELMs were demonstrated to experts, professionals and teachers of HI students to get feedback from them, in order to improve and modify ICSH. Case studies were then conducted with the help of HI students from local schools. All these factors have contributed in all-round development of ICSH.
4.2 TEACHING / LEARNING PROCESS FOR HI PERSONS VIA ICSH

In order to design ICSH, one should understand the teaching / learning process of HI person. The sign language, finger spelling, lip movement, text and pictorial form of input forms represent the instruction material in the e-Lesson. In such case, new information of the instructional material is to be systematically prepared as sequential operations.

When a computer system is used, it presents this information to the HI person as visual sign teaching on its screen. This sign teaching is successfully realized in three modes via computer (normal text / pictures, sign language with lip movement and finger spelling in our ICSH). Such visual symbol-teaching leads to meaningful learning for HI person. The mind of the HI person has to link (interact positively) the new information with the corresponding current / past experience of the instructional topic.

As a result of this interactive linking, it is expected that HI person’s mind can reconstruct the frame structure of information in the mind. Continuous feedback / reinforcement helps in realizing the needful changes in behavior of HI student. Hence learning results.

What is the basic theory teaching / learning process for HI student via e-learning? The mechanism of this theory is:

The **input** deals with presenting the instructional material via computer (ie Teaching). The **process** represents the HI student’s mind, when it receives the new information via e-modules and process them. The **output** deals with the needful positive change in HI student behavior after trying the ELMs lessons.
It is planned and expected that HI person would use the needful ELMs individually and with his own speed of learning. The following diagram depicts the mechanism of ICSH process.

<table>
<thead>
<tr>
<th>Input</th>
<th>Process</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Instructional material is presented systematically by dividing the main instructional objective into sub instructional objectives. Each sub-objective needs certain activities under specific conditions, to realize that sub-objective. 2- Use of suitable teaching methodology during presentation of the instructional material to the HI student. 3- Visual symbols teaching via multimedia of normal text / picture, sign language, finger spelling and lip movement successfully realizes the meaningful learning for HI student, therefore each activity of teaching for HI student must be presented through multimedia of sign language, finger spelling, lip reading and normal text / picture. 4- Use of suitable visual aid to match HI students age / level and the instructional material. 5- Individual teaching with continuous feedback / reinforcement helps in realizing the needful teaching for HI candidate.</td>
<td>1- Sign learning (via multimedia presentation of sign language) supports HI student mental learning process to stimulate to link the new information with current / past experience of the corresponding topic. 2- Effective multimedia supports the HI student’s mind to compensate the audio mode of communication by strengthening the visual mode in teaching / learning process via ELMs. The process is interactive. 3- As a result of the previous two items, the effective multimedia supports HI student’s mind in building the needful environment of learning. This environment helps in reconstructing the new frame structure of information after receiving and processing the new information. 4- Positive use is made of enhanced visual perception of HI in learning process.</td>
<td>1- Reconstruction of the frame structure of the new information in the HI student mind. This is similar to Script form in Knowledge Representation scheme in Artificial Intelligence. 2- As a result of the previous item, ICSH realizes the positive desired change in the behavior of HI student after the end of ELMs lesson. This amounts to learning. 3- Lessons can be repeated without boredom. HI student can learn of his own grasping speed.</td>
</tr>
</tbody>
</table>

Figure 4.1: Mechanism of ICSH Process
**Summary of theory**

HI student receives the new information via multimedia presentation of sign language and continuous interaction between HI student and ICSH presentation. Such mechanism of teaching/learning process would stimulate HI student’s mind to link the new information with current/past knowledge. Then HI student’s mind can reconstruct the frame structure of the information. This reconstruction leads to positive change of HI student behavior. The instructional material needs to enhance the mind frame of HI person. Therefore it should be prepared systematically so as to trigger mental activities and cause positive behavioral change.

**Questions and Answers**

In order to develop ELMs for HI persons, based on above theory we have to answer the questions, indicated in conventional diagram. It would be clear from the diagram that the six conventional theories of learning have been extended to accommodate the teaching/learning process of HI student via e-learning.
How could information be presented to HI persons via e-learning?

Information is integrated systematic and sequential manner so as to be received by the HI person via e-learning like "snowball" rule (Landa). This process gradually builds the knowledge frame of HI learners.

What is the role of reinforcement?

Learning is a function of change in overate behavior. This reinforcement is the key of change (Skinner).

Changes in behavior are the result of an individual's response to event via e-learning environment for HI person. Reward and punishment are used. Visual score also serves as reinforcement.

What is the role of interactive technology (e.g. multimedia)?

Use of interactive technology supports the reception of information and motives HI person for meaningful behavior change. Also, it compensates the disability of Hearing perception by visual reception of information. The system may be tuned to the grasping speed of learner. Representation of lessons are easily done without boredom.

How could learning be realized?

Learning is an active process. HI person constructs new idea/concept based on their current/past knowledge (Bruner, Spiro, Ausubel).

HI person thus reconstructs his knowledge structure by linking the new information with his past/current experience.

What is the role of sign learning?

It leads to meaningful behavior change (Tolman). It is considered the bridge between the behavior and the cognitive theories.

How could cognitive activities be analyzed?

All cognitive activities could be analyzed into sequential systematic operations (Landa). The instruction material for HI learner is planned according to this strategy.

Figure 4.2: Questions & Answers about Applying Theory of Research
4.3 MODEL OF RESEARCH

Based on the modified learning theory of last section, a model for developing ELMs for the HI persons is now presented here. This would be an effective and typical guide for professionals who would like to develop their own ELMs for the HI persons. The generated ELMs are expected to be systematic and realizing the maximization of the instructional outcomes (quantity & quality). It is thus a technical model. It depends upon several integrated factors. Each factor deals with specific area of study.

The aimed model is based mostly on the developed theory (theory of the reach work) of previous section.

**What is the difference between theory and model?**

The theory means generalization of observations to predict behavior. It must hold true confidently for at least certain period of time.

The model means mental picture or computational framework based on theory to simulate behavior. However the development of model is based on theory. It serves as an ideal guide to accomplish production. An additional element here is teaching methodology for HI students, which are suitable to e-learning technique. The third factor deals with ELMs, methods, strategies, design etc. The fourth factor deals with software engineering for computer based systems (models and components) the system engineering hierarchy. The fifth factor represents modes of communication between HI person and computer via e-learning process, like sign language or lip movement. The sixth element is about visual programming technique and corresponding interactive multimedia.

The new Instructional Computer Model of this research is thus a function of the above seven factors.
What is the mechanism of the model when it is used to develop ELMs for HI persons?

There are five stages, from the initial start stage (analyzing the instructional material) to the final stage (evaluation of the generated ELMs). The output of each stage leads the input of the next stage; as shown in the following diagram:

Figure 4.3: Stages of the Model of Research
Stage I: Analysis of instructional material

Based on the developed theory of research (teaching / learning process for HI persons) the instructional material is analyzed for proper presentation. The analysis aims at realizing the maximization of instructional outcomes (quality & quantity). As the model is built on this analysis, it is also expected to maximize the instructional outcomes.

The instructional material is analyzed according to the theory of research as follows.

1- The main objective of the material is divided into independent sub-objectives.
2- Each sub-objective leads to certain activities (mental activities) to realize achievement of that sub-objective.
3- Each activity is to be done under certain conditions. However these conditions are created by the instructional material itself. The conditions describe the past knowledge and current experience of learner to accomplish corresponding activity.

The following objectives represent the outcomes of ELMs.

The following diagram shows the analysis technique via the model of research:

<table>
<thead>
<tr>
<th>Outcomes (Objectives)</th>
<th>Activities</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1</td>
<td>Activity 1</td>
<td>Condition 1</td>
</tr>
<tr>
<td>Objective 2</td>
<td>Activity 2</td>
<td>Condition 2</td>
</tr>
<tr>
<td>Objective 3</td>
<td>Activity 3</td>
<td>Condition 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective n1</td>
<td>Activity n2</td>
<td>Condition n3</td>
</tr>
</tbody>
</table>

Figure 4.4: Analysis Stage of Model of Research
Objectives: After dividing the main objective (of the e-learning module lesson) into sub-objectives, each sub-objective is considered as independent, individual objective (objective1, objective2,......, objective n1).

Activities: They represent the set of mental activities which must be held by the mind in order to achieve that objective. So they are not physical activities but set of mental sequential, interactive and integrated activities which deal with the material contents (text, exercises, pictures, etc). These are experienced by HI student via e-learning module.

Conditions: There are two main types of conditions:

a- conditions of the specific activity created by the contents of the material for that activities, conditions due to past experience and the current knowledge which have certain relation with that activity..

b- Conditions due to the past experience and current knowledge which have certain relation with that activity.

After completing the analysis of objective(i), we move to the next objective(i+1), according to the snow ball rule of the research theory.

Stage II: Technical design

The output of analytical stage leads to input of technical design, This design uses Entity-Relation (ER) type diagram. Technical design represents selecting and designing the items (illustrated through the field of the following diagram).
<table>
<thead>
<tr>
<th>1</th>
<th>Instructional objective item in technical design</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The Analysis of content of the instructional objective</td>
</tr>
<tr>
<td>3</td>
<td>Selection and design of e-Learning Method</td>
</tr>
<tr>
<td>4</td>
<td>Select e-Learning strategy</td>
</tr>
<tr>
<td>5</td>
<td>Mode of communication between computer and HI student</td>
</tr>
<tr>
<td>6</td>
<td>Select and Design computer based system model (S/W engineering)</td>
</tr>
<tr>
<td>7</td>
<td>Design of question / answer for the item</td>
</tr>
</tbody>
</table>

**Item (i)** (objective i in the analytical stage)

Rewrite Activities and Conditions with renewed aspect, so that the new content represents the instructional material which would be displayed on the screen of computer for HI student.

However all the output on screen must be translated into languages of HI student (finger spelling, sign language, lip movements, etc).

After finishing of technical design of item (i), we repeat all details to design item (i + 1)

---

**Select the e-Learning method** (tutorial, drill & practice, testing) that supports the objective of ELM of that lesson by HI student.

There must be a specific block diagram which describes the mechanism of the e-lesson and flow of information via the e-lesson for tutorial method is depicted below as an example.

Output of this diagram forms input of presentation design and S/W design of the e-learning module.

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**Select the strategy which is suitable with the selected method like Pressy or Crawder**

Three main modes of communication would be recommended by the model: sign language, finger spelling and lip movement besides normal text/picture presentation.

Computer based systems hierarchy strategy would be recommended for the needful ELMs to HI person and system modeling and system simulation

If there is any needful question with multiple choices to the item they should be written here.

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**Figure 4.5: Technical Design Stage of Model of Research**
Stage III: Presentations and Software Design

The output of Technical design stage leads to input of presentation and software design of ICSH.

The designer must prepare blank papers (forms). Each paper represents an individual and separate form (screen of output) of the desired ELMs. Therefore if the designer uses visual programming (e.g., Visual Basic), each paper would represent an individual form of the project. Visual programming technique is strongly recommended to be used for ELMs coding. For Visual Basic there are three steps of coding of the form: Objects design, properties of objects and coding of objects. The designer should set the object’s design, their properties as well as necessary coding on the paper.

Q: How could the designer convert the technical design report into visual programming forms?

The developer must study the technical design report, particularly the method of e-learning and its contents with the help of diagram. After studying the contents of each block in the diagram of the method, the designer would select the proper objects for the activity of that block. For example, the following block diagram represents an e-learning module of tutorial item.
How to change each block into separated Visual Basics standard forms is illustrated below.
Stage IV : Coding stage

After finishing all of presentation forms and corresponding software design, the developer would transform all the forms into visual programming coding with needful specification of coloring, dimensions, fonts, etc. The output for each word / letter must be translated into sign language or finger spelling or lip movement (according to the developer’s decision). The developer can use certain functions and commands of the visual programming language for that linking / translation. Alternatively, he may use data base technique. Each word must be linked with its corresponding clip file of sign language or each letter must be linked with its corresponding picture file of alphabets of finger spelling.

Stage V : Evaluation and modification for improvement

After finishing the applied e-learning module for HI person, the developer may evaluate his e-learning module by try run to teachers of HI students and Experts to get feedback from them. Then the designer would modify his e-learning module for improvement and put it in its final form to be disseminated by HI person.

Q: What are the categories of the Experts and Professionals who would try ELMs to evaluate them?

There are four types of Experts:
1- Experts in the field of Instructional Computer Science, to evaluate the e-learning method, strategy, technical design, analysis of contents, etc.
2- Experts in HI education to evaluate the HI teaching methodology via e-learning module. The mode of communication, HI learning environment via e-learning, effectiveness of sign language clips and
finger spelling pictures used, etc are also evaluated. This quality audit is an important contribution of our research.

3- Experts in the field of computer science and software Engineering to evaluate the effectiveness of software design, algorithms used, files design, data base used (if any), data structure technique (if any ) and multimedia technique used (clips, motion, pictures, colors, and voice " if any ").

4- Teachers of the instructional material of the e-learning module, particularly who teach HI students. They evaluate the contents of the instructional material and how best the e-learning module presents these contents. The questions, reinforcement, teaching aids used via e-learning module, etc are also evaluated.

4.4 DEVELOPMENT OF SYSTEM OF RESEARCH i.e ICSH

4.4.1 Introduction

ICSH has been developed according to the derived model of the research. Therefore same five stages are applied to develop ICSH. Analysis stage; Technical design stage; Presentations design and Software design stage; Coding stage and Evaluation stage.

ICSH represents an authoring system. It includes two projects: teacher project and student project. Both of these projects consist of blank templates. The first user is the teacher who wants to develop his e-Learning module for his own topic. ICSH generates instructions for the teacher to enter his instructional material in these blank templates.

The student project also presents blank templates. According to the entry material by the teacher, the material ( texts, pictures, exercises,
questions, etc) is transferred to the blank templates of student project. Then this transferred data is presented in sign language and finger spelling, lip movement or plain text form.

The approach of developing ICSH is wide. The detail steps of developing ICSH from start point up to disseminate stage are presented in the sequel. Each stage is discussed individually to describe all details of that stage.

4.4.2 Analysis Stage for Teacher Project in ICSH

Analysis stage includes following three types of ELMs. Hence three types of ELMs are analyzed according to the methodology of the research model.

a- Analysis of text presentation (tutorial) module

steps of analysis are:

The main objective of tutorial lesson is divided into three sub objectives (time wise). Each subjective is associated with certain activities. Each activity works under some conditions in order to successfully realization the sub-objective. The following diagram shows this analysis of tutorial module:
**Objectives**

**Sub objective 1**
- Text presentation with pictures besides Q & A for more interaction with HI student. These text presentation, pictures and Q & A represent the instructional material which realizes sub objective 1.

**Sub objective 2**
- As previous activities of sub objective 1

**Sub objectives 3**
- As previous activities of sub objective 1

**Conditions**
- Depends on the skills and experiences of the teacher to present these activities so that the HI student can link them with his past experiences and current knowledge.

**Objectives**

**The main objective related with the corresponding exercises**
- Q & A exercise by multiple choices method. Continuous reinforcement and feedback. The teacher can enter up to six (1 → 6) exercises to ICSH

**Conditions**
- Depend on the experience of the teacher. How these exercises linked and interacted the past with the current knowledge of the learner.

---

**Figure 4.8: Analysis Stage of Teacher Project (tutorial module)**

**b- Analysis of drill and practice module (exercises)**

Present system supports Drill and Practice module, only one objective at time. The teacher can pose up to six exercises (1–6).

The following diagram shows analysis aspect of drill and practice module used in ICSH for teacher project:

**Figure 4.9: Analysis Stage for Teacher Project (drill & practice module)**
c- Analysis of Testing Module

For any objective, there are several kinds of e-exam so as to evaluate the achievement of HI student for that topic. The teacher can choose the type of e-exam he wants. Also he may choose his number of questions as shown:

Multiple choices (1 - 8) questions, matching (5 words in each column) Yes Or No (1 - 10) questions, fill in blank (1 - 10) questions and answer in one word (1 - 10) questions.

The following diagram shows the analysis aspect of testing module:

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Activities</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives of exam is to evaluate the achievement of HI student.</td>
<td>Five types of Q &amp; A for e-exam with controlled score</td>
<td>The teacher can decide how to design the exam so as to successfully evaluate the achievement of HI student for that topic. Also to estimate the knowledge of the corresponding topic.</td>
</tr>
</tbody>
</table>

Figure 4.10: Diagram of Analysis Stage for Teacher Project (testing module)

4.4.3 Technical Design for Teacher Project

According to the derived model of research, the output of analysis stage leads to the input of technical design stage. Three types of ELMs result in three types of analysis stages for each ELMs. Similarly the following diagrams summarize the Technical Design for tutorial module (Fig 4.11), Drill & practice module (Fig 4.12) and testing module (Fig 4.13)
<table>
<thead>
<tr>
<th>Objectives &quot; Item &quot;</th>
<th>Content analysis</th>
<th>Diagram (teacher project )</th>
<th>Strategy (tutorial)</th>
<th>Mode of Communication with HI student</th>
<th>S/W engineering design</th>
<th>( 3 ) Q &amp; A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1 ( sub objective 1 in analysis stage )</td>
<td>The teacher must prepare the needful text presentation which realizes objective of item1 (sub-objective 1) the teacher can prepare suitable picture ( if any ) for the text.</td>
<td>Choose item &quot; item 1 - sub objective 1 in analysis</td>
<td>Pressy is standard and most suitable for common tutorial modules</td>
<td>The teacher may select : 1. Sign language + normal text 2. finger spelling + normal text. 3. normal texts only. 4.Lip movement with sign language 5. all of previous four kinds.</td>
<td></td>
<td>The teacher prepares suitable question with multiple choice answers according with to text presentation of instructional material in content analysis.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Same details as previous item1</td>
<td>As previous item (1) same steps. as previous item similar details as previous item 1</td>
<td>Pressy</td>
<td>Same modes</td>
<td>Same design</td>
<td>Same details</td>
</tr>
<tr>
<td>Item 3</td>
<td>As previous item 1</td>
<td></td>
<td>Pressy</td>
<td>Same modes</td>
<td>Same design</td>
<td>Same details</td>
</tr>
</tbody>
</table>

Figure 4.11: Technical Design ( teacher project ) of Tutorial Module
<table>
<thead>
<tr>
<th>Objectives &quot;Item&quot; (1)</th>
<th>Content analysis</th>
<th>Diagram of tutorial module (teacher project)</th>
<th>e-Learning Strategy</th>
<th>Modes of communication</th>
<th>S/W engineering design</th>
<th>Q &amp; A related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1 &quot;The main objective related with corresponding exercise &quot;The teacher selects that objective&quot;.&quot;</td>
<td>Q &amp; A (Multiple choices) with suitable feedback &amp; reinforcement. The teacher prepares (1 to 6) exercises according to his requirement. All the exercises deal with the objective (field (1)) for each question, three multiple choices are provided, one correct answer and others incorrect answers with the needful feedback for each choice.</td>
<td>The teacher enters Q1 &amp; the multiple choices for that question → The teacher enters reinforcement for the correct choices → The teacher enters suitable feedback for each incorrect choice</td>
<td>Pressy</td>
<td>The teacher selects his request of communication mode with HI. 1. Sign language + normal text. 2. Finger spelling + normal text. 3. normal text. 4. Lip movement with sign language. 5. all the previous four modes.</td>
<td>Enter Q &amp; A multiple choices → Enter feedback &amp; reinforcement → Move to next question</td>
<td>No need for this field</td>
</tr>
</tbody>
</table>

```
Figure 4.12: Technical Design (teacher project) of Drill & Practice Module
```
<table>
<thead>
<tr>
<th>Objectives &quot;Item&quot;</th>
<th>Content analysis (2)</th>
<th>Diagram of the exam module</th>
<th>Strategy</th>
<th>Modes of communication</th>
<th>S/W engineering design</th>
<th>Q &amp; A related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective/objectives which has been selected by the teacher in the analytical study.</td>
<td>The teacher selects: 1. The type/types of e-exam. a) multiple choices. b) Yes or No. c) fill in blanks. d) matching. d) answer in one word. 2. Number of questions he wants for each type.</td>
<td>[Diagram of the exam module]</td>
<td>No need</td>
<td>Like modes in tutorial and drill &amp; practice</td>
<td>[Diagram of S/W engineering design]</td>
<td>No need</td>
</tr>
</tbody>
</table>

Figure 4.13: Technical Design (teacher project) of Testing Module
4.4.4 Presentations and Software Design

There are two main projects, (teacher project and student project). First teacher project should be developed then student project. Because teacher project represents the prerequisite of student project according to mechanism of data (data entry in the teacher project), we then expect the generated ELMs in the student project.

For teacher project

In this stage the output of technical design leads to the presentations design and software design. Each block in the diagram would be developed into an individual Visual Basic form. We could select the suitable objects from tool box and set the essential properties for that object. Finally the code is represented according to the purpose of each object. In this stage, as in previous stages, we will divide the section into three kinds; tutorial method exercise method and testing method.

a) Presentations design and software design for tutorial method

Separate blank pages have been prepared. Each page represents an individual VB form in the project.

Here is a sample to show how presentations design and software design have been developed in the teacher project.
b- Presentations design for drill & practice (exercise) method.

Similar in tutorial method, the diagram of technical design would be developed into separate VB forms. Here we show a general sample:

![Diagram](image)

Figure 4.16: Sample of Block Diagram of Drill & Practice (teacher project)

Here (block3) the teacher enters suitable feedback to each incorrect answer. The block is expanded into form below.

![Form](image)

Figure 4.17: Sample Form of Drill & Practice (teacher project)
c- Presentation design of e-exam

Similar to the previous two methods, diagram of technical design would be developed into separate VB forms. But e-exam diagram is more complex because there are five types of e-exams. For each type the teacher should enter his required number of questions and select any set of the five e-exam kinds.

For example the block diagram shown below has been developed into standard VB forms:-

![Flowchart](Image)

**Figure 4.18 : Sample of Block Diagram (e-exam)**

Now for example the first block would be developed into standard VB form. The designer would use the suitable objects for that block.
Figure 4.19: Sample of VB Form (e-exam method) for Teacher Project

**Student project**

After finishing the presentations design of teacher project, we would start in the presentation design for student project. Each form in teacher project has its corresponding form in the student project.

Here the same samples (in the teacher project), we will develop the suitable corresponding forms in the student project for the three samples. We will show only tutorial module. The drill & practice module and testing module (e-exam) could be developed by the same technique.
So all the entry data in the teacher project by teacher must be transferred into corresponding blank objects of the student project. In the student project output should be translated into sign language and finger spelling (alphabets).

In the next section we shall explain the basic idea behind the technique of data transfer from teacher project into student project.

Thus ICSH includes two project with three modules each. Hence it is better to draw the complete block diagram of ICSH. This block diagram will help in writing the needful code for each form.

The block diagram of ICSH is follows:-
e-exam five kinds
1- Multiple choices type
2- Matching type
3- Yes or No type
4- fill in blanks type
5- Answer in One word type

choose any set

Multiple choices

Y

Select No. of question (1-8)
Enter Q & A

Finish

N

Matching

Y

Enter words and corresponding match

Finish

N

Yes or No

Y

Select No. of question (1-10)
Enter Q of A

Finish

N

Fill in blank

Y

Select No. of questions (1-10)
Enter Q of A

Finish

N

Answer in one word

Y

Select No. of question (1-10)
Enter Q of A

Finish

N

Teacher project
Select type of ELM
Select mode of communication

Drill & practice
Offer 1 to 6 exercises
Enter exercise 1 & multiple choices

Enter reinforcement
Enter feedback for mistakes

Enter feedback for each incorrect answer

All items covered?

Home page of teacher project

Figure 4.21: Block diagram of ICSH (general diagram) only
Teacher Project
Figure 4.22: Block Diagram of Student Project (without e-exam)
Figure 4.23: Block Diagram of Student Project (e-exam)
**Coding stage**

It is the final stage before evaluation and testing of ICSH. All the presentations design and software design should be translated into coding to realize the purpose of ICSH.

**About multimedia technique**: 3000 separated video clips (mpg files) have been linked with ICSH. Each video clip-file represents the action/meaning of the word (the word represents the name of the file). Therefore the action/meaning of each video clip (mpg files) represents the sign language of its name.

Besides these action/meaning video clips words, there are video clips for all English letters (mpeg files). Also there are 42 picture files (gif files) representing alphabets, numbers and symbols in English language. In order to develop the code of ICSH, it is better to start writing code of the teacher project (he is the first user); form by form and then write the needful code of student project. We will present two diagrams which will support understanding the coding technique.

1- First diagram describes the basic idea of the technique used of data flow from teacher project into student project (Fig 4.24).

2- Second diagram describes the basic technique of displaying sign language and finger spelling via multimedia in student project (Fig 4.25).

More details of multimedia techniques used are given in Appendix 3.
The idea of above technique was developed into all data files in ICSH. Accordingly, for the teacher (i) all his entry data will be saved in the student Project. The first file (name of teacher & subject) would be the keyword.
The teacher (i+1) would enter his material and save and so on.

Figure 4.25: Technique of Displaying Multimedia Video Clips of Sign Language

This technique has been used in displaying multimedia of sign language video cut files. If sign-language representation is not possible, then the corresponding finger spelling is displayed letter by letter in sequence.
4.5 DEVELOPMENT OF EXPERIMENTAL ELMs

After designing ICSH, many experimental ELMs have been generated by the researcher. Seven Modules of tutorial lesson (General Science, Book Two, Standard Four, Indian School), four Modules of exam lesson (Mathematics Workbook, Standard 1, Indian schools, The Story Of Man, Standard Three Indian schools). A Four Modules of drill and practice (MATHEMATICS WORK BOOK standard 1).

Many pictures were uploaded to the tutorial lesson (General Science topics) after finishing the list of is experimental ELMs, these modules were demonstrated to experts and HI students. An e–dictionary has been added to ICSH in order to translate any text (edited by the user) into sign language and finger spelling online.

4.6 SUMMARY

This chapter covered detail steps of developing ICSH. Based on the theoretical background of chapter III, the theory of research learning (theory of teaching/learning process for HI persons via e–learning) was developed. It is thus an applied theory for HI persons based on general learning theories of chapter III.

The theory recommends sign teaching (Tolman), reinforcement, continuous feedback with interaction of new knowledge with past experience. These elements lead to instructional learning environment. This environment helps in the positive needful change of HI student behavior. The applied theory of research leads to systematic development of underlying ICSH. This model forms the backbone of ELMs for HI students developed using ICSH.
This model itself is based on many elements like HI teaching methodology, Software Engineering and ELMs techniques, etc. It consists of sequential stages. The output of each stage leads to input of next stage. The stages are: analytical study, technical design, presentation design, coding and evaluation stage.

ICSH uses some modified author-ware techniques. ICSH is coded in Visual Basic and its multimedia control components. Over fifteen ELMs has been generated experimentally by ICSH besides practicing of online e-dictionary.

In short, the development of ICSH is satisfactory as planned.

After successful development of ICSH and testing its experimental ELMs, available feedback was obtained by Expert as well as case study of HI students. This would be discussed in details in next chapter (Conclusion and Avenues for Future Work).