Intelligent Tutoring System using Interactive Agent (Echem)

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Intelligent Tutoring System using Interactive Agent
(Echem)

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Abstract

Echem is an intelligent tutoring system using interactive agent. It is a web based learning package that offers the subject chemistry for the SPM candidates. This ITS will fulfill six out of thirteen important topics from the syllabus. The target users are Sijil Pendidikan Malaysia (SPM) candidates. There is an agent named interactive agent that will assist the users throughout the learning session. In the system there consist of learning materials, tutorials' questions and examination models. The aim of the system is to increase the interaction between the system and the users.

The process model that is going to be used for this project is Waterfall model because it is simple and easy to understand. Besides that, Waterfall model is suitable for small scale system.

The main development tools for this project are Microsoft Visual Studio.Net 2003, Microsoft SQL Server 2000 and other related authoring tools like Adobe Photoshop or Macromedia Flash.

The main characteristic of the system are user-friendly, attractive interface, easy to navigate and modifiable. The functional requirements for Echem are leaning module, tutorial module, examination module and administrator. For non-functional requirements are user friendliness, interactivity, flexibility and usability.

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CHAPTER 1: INTRODUCTION

1.1 Project Overview

Information technology (IT) has been gradually developed in Malaysia since 1990s. IT

not only can be applied in the public and corporate sector but also in the field of

education. Malaysian's government has announced that smart school and e-learning

project will be the main applications of Multimedia Super Corridor. Education is

extremely essential to produce the efficient and effective workers that can contribute to

the country.

Intelligent tutoring system (ITS) using interactive agent is a multimedia learning

package. The different between ITS and other e-learning web site is ITS apply artificial

intelligence techniques to computer-assisted instruction allowing a fully Socratic mode

to develop with individualized instruction [1]. The name of the proposed system is

Echem (E-Chemistry). Echem is a web based learning package that offers the chemistry

subject for the form five students. The aim of ITS is to increase the interaction between

the system and the users. Notes, tutorials' questions and examinations models are

prepared for the users. The system also includes of interesting graphics and animation

images.

1.2   Problem Definitions

The current trend of learning system is not individualized, confusing and do not

motivate the students (Smith, 1999). According to Smith, the conventional teaching and

computer based training disappointed the students because the learning process has to

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depend on the understanding level of others students. Other situations like poor students seldom ask questions they don't understand and students can't concentrate in the class.

For some of the existing learning website (e-learning), the materials that presented to the students are in the HTML file format and text based application makes users bored. Static here means that almost same with reading the reference books. The aim of these existing systems is just to present the materials (notes or questions) to the students only. Thus, the propose system will has the interaction between the system and the users and the learning materials will be presented in an interactive way. Users thus can refer to the interactive agent just like referring to their teachers at school.

The benefits of the proposed system are:

- Accessibility of the learning material anywhere and any time.
- Students can take up the course at their pace.
- Promotes self-study.

1.3 Project Objective

The objectives of the system are:

- To develop an intelligent learning package that has interaction between the system and users.
- To promote self study among the students using intelligent tutoring system.
- To instill the use of internet on education purpose among Malaysian students.

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1.4 Project Scopes

The project scopes are defined as below:

    i.   Subject taught – Chemistry Form Five.

    ii.   Language used – Bahasa Melayu.

    iii. Topics covered – Fulfill six out of thirteen in the syllabus.

    iv. Target users – SPM candidates.

Echem will only fulfill six important out of thirteen topics in the syllabus. This is because Echem is only a prototype and the main objective of the proposed system is to develop an "intelligent" web learning package that has interaction between the system and users. The limitation on building a complete ITS will discuss in chapter two.

There are several assumptions and limitations regarding this system.

Assumptions:

i)   The system can be used only when there is a connection to internet.

ii)   Target users must have basic in the handling of computers.

iii)   Users fully concentrate when learning through the system so that they can maximize the benefits of the system.

Limitations:

i)   Only can be used by SPM candidates.

ii)   Must have internet access.

iii)   Need supervision and guidance from parents or teachers so that the students

        will not misuse the internet for other purpose.

1.5 Project Schedule

Project schedule organizes the project into various, discrete tasks that can be completed

within stipulated time frame. The Gantt chart below shows the proportion of time

allocated to each single task. Figure 1.1 shows the starting and ending for each activity

in the project

No	Description										
1	Feasibility Study										
2	System Definition										
3	System Analysis										
4	System Design										
5	Report										
6	Coding										
7	System Documentation										
8	Testing & Review										
9	Documentation										
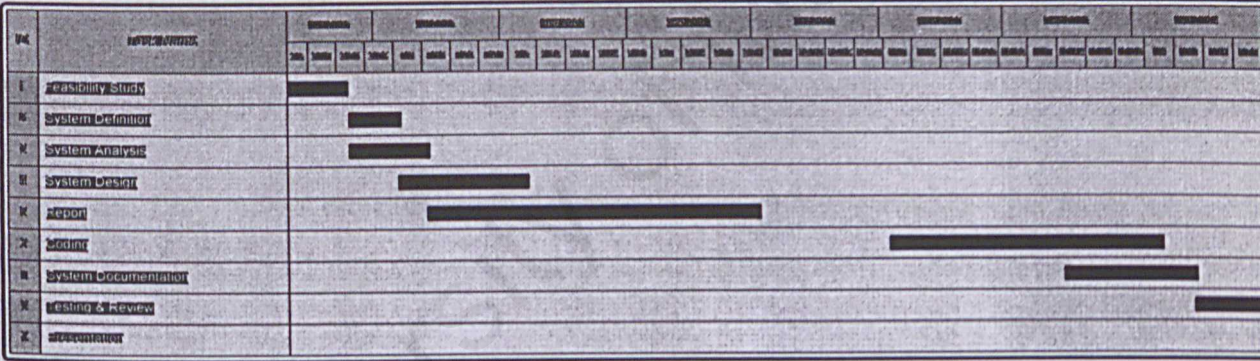
Figure 1.1 Gantt chart shows the starting and ending for each activity in the project

CHAPTER 2: LITERATURE REVIEW

2.1 Domain Studies

Background study about the knowledge and information gained to develop this project is the meaning of literature review. The purposes of this subsection are:

- To better understanding on the relevant information on the proposed system.

- To better idea on the development methodologies.

- To review on the features of the existing current system.

2.2 Applications of Artificial Intelligent in Education

Computers have been used in education for over 20 years. Computer based training (CBT) and computer aided instruction (CAI) were the first such systems deployed as an attempt to teach using computers. In these kinds of systems, the instruction was not individualized to the learner's needs. Instead, the decisions about how to move a student through the material, such as "if question 21 is answered correctly, proceed to question 54; else go to question 32". The learner's abilities were not taken into account (Joseph Beck, 1993).

While both CBT and CAI may be somewhat effective in helping learners, they do not provide the same kind of individualized attention that a student would receive from a human tutor (Bloom, 1984). For a computer based educational system to provide such attention, it must reason about the domain and the learner. According to Rosenberg (2001), the weaknesses of CBT are:

i.   Unsuitable contents – Contain some error and old syllabus.

ii.   Doubtful – Students hard to believe the concept, steps, procedure, situation, problems and questions that offered by the system.

iii. Boring environment – Learning environment is boring because the teaching materials are not fascinated.

iv.   Lack of guidance - Lack of support from the developer and tutor make the students fell isolated when they learn through the system.

This has prompted research in the field of intelligent tutoring system (ITS). ITS offer considerable flexibility in presentation of material and a greater ability to respond to idiosyncratic student needs. These systems achieve their "intelligence" by representing pedagogical decisions about how to teach as well as information about the learner. This allows for greater versatility by altering the system's interactions with the student.

Intelligent tutoring systems have been shown to be highly effective at increasing students' performance and motivation. For example, in one of the university in United State, students using Smithtown, an ITS for economics and they performed equally well as students taking a traditional economics course, but required half as much time covering the material (Shute, 1989).

2.3 Intelligent Tutoring System

In 1984, Benjamin Bloom defined the two-sigma problem, which states that students who receive one-on-one instruction perform better than students who receive traditional classroom instruction.

Imagine that each learner in a classroom or web based training (WBT) setting has a personal training assistant who pays attention to the participant's learning needs, assesses and diagnoses problems and provides assistance as needed. However, providing a personal training assistant for each learner is beyond the training budgets of most schools or organizations. So, the idea of a virtual training assistant that captures the subject matter and teaching expertise of experienced trainers provides a captivating new option. The concept, known as intelligent tutoring systems (ITS) has been pursued for more than three decades by researchers in education, psychology, and artificial intelligence. Currently, ITS mainly used in the fields of corporate training, college or university education and military training.

Intelligent tutoring system (ITS) has been under development at least since WEST (Burton and Brown, 1982) and SOPHIE (Brown, Burton and deKleer, 1982) nearly twenty years ago.

In 1926, Sidney L. Pressey built a machine with multiple choice questions and answers. This machine could be the notion of intelligent tutoring system for teaching purpose. This machine delivered questions and provided immediate feedback to the user.

Educational Psychologists have since reported that carefully designed individualized tutoring produces the best learning for most people.

Intelligent tutoring system (ITS) is a system that provides individualized tutoring or instructions. Each ITS must have these three components:

- knowledge of the domain
- knowledge of the learner
- knowledge of teacher strategies

The domain refers to the topic or curriculum being taught. The learner refers to the user of the ITS. The teacher's strategy refers to the methods of instruction and how the material shall be presented. This basic outline of requirements was introduced by Derek H. Sleeman and J.R. Hartley in 1973. The goal for every ITS to communicate its embedded knowledge effectively.

The heart of ITS is expert system. The expert system has sufficient knowledge of a particular topic area to provide ideal answers to questions. The expert system thus allows the ITS to demonstrate or model a correct way of solving the problem. Often, it can generate many different answer paths or goal structures just like a human tutor (Burdorf, 1988). The same detailed data structures that expert systems generate in modeling expert reasoning also permit ITS to explain their reasoning at arbitrarily detailed levels. For example, if a student needs an explanation of why or how an algebra ITS did a step in solving an equation, the system might first say that it used the distributive rule. If the student requested more justification, it could elaborate by

describing the terms that were distributed and the arithmetic "cleanup" steps that followed. This shows that ITS able to give several answer upon request of the users.

According to Dr. Kurt Van Lehn who is a AI researcher and professor of computer science at the University of Pittsburgh, many hypertext based online learning applications give students a certain number of chances to find a correct answer before providing the right one instead of the smart tutoring systems method that act as coaches, offering hints when students stumble in the problem solving process and not just when they enter an answer. This kind of direct, intuitive instruction is already having an impact on student performance.

2.3.1 The 'I' in Intelligent Tutoring System

The definition of computer tutor intelligence is that the system must behave intelligently but not actually be intelligent, like a human. According to Ton de Jong (Dec. 10, 1993): intelligent in ITS stands for the ability to use different levels of abstraction in the representation of the learner, the domain and the instruction.

2.3.2 How does ITS work?

Many traditional instructional methods present users with facts and concepts followed by the test questions. These methods are effective in exposing people to large amounts of information and testing their recall (memory). However, they often instill inert knowledge that learners can recall but may not apply correctly when needed. Instead, ITS systems use simulations and other highly interactive learning environments that require people to apply their knowledge and skills. These active and situated learning

environments help them to retain and apply knowledge and skills more effectively in the practical situations.

The system selects a problem and compares its solution with that of the student and then it performs a diagnosis based on the differences. After giving feedback, the system reassesses and updates the student skills model and the entire cycle is repeated. As the system is assessing what the student knows, it is also considering what the student needs to know, which part of the curriculum is to be taught next, and how to present the material. It then selects the problems accordingly. Figure 2.1 below shows the overview of how an ITS works.

2.3.3 What ITS must do?

Although there are many types of Intelligent Tutoring Systems around, each one must behave intelligently, not actually be intelligent. They must be able to:

- accurately diagnose students' knowledge structures, skills, and styles
- diagnose using principles, rather than preprogrammed responses
- decide what to do next
- adapt instruction accordingly
- provide feedback
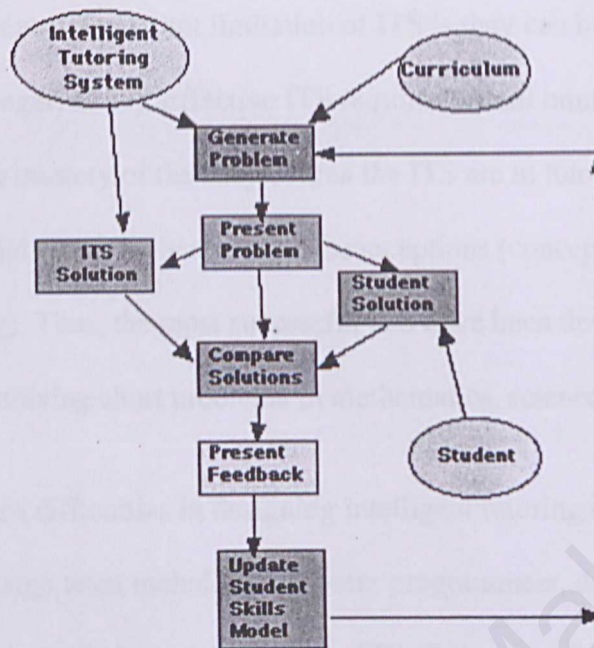
Figure 2.1 Overview of how ITS works (Hartley & Sleeman, 1973)

2.3.4 Successes of ITS

Most ITS still being used on a very small scale, and only a few have been tested widely.

Of these, just a handful claim to improve students' performance in the classroom using

standardized tests. Successful ITS have been mainly restricted to the areas of

mathematics and science, where it is both easier to build and easier to measure learning

outcome improvements (McArthur and Stasz, 1990).

2.3.5 Limitations of ITS

While ITS have been somewhat successful on a small system, several problems must be

overcome before they have widespread impact. Several authors (e.g.; Psotka, Massey,

and Mutter, 1988) have discussed a wide range of limitations on ITS. Most ITS have

focused on subjects taught in typical primary and secondary school level subjects. In this context, probably the most significant limitation of ITS is they can be developed only for a few topic areas (Wenger, 1987). Effective ITS requires virtual omniscience, which means that a complete mastery of the subject area the ITS are to tutor and covered, including an understanding of likely student misconceptions (concept that most student will misunderstanding). Thus, the most successful ITS have been developed for simple procedural skills like solving short problems in mathematics, science and logic.

One of the main difficulties in designing intelligent tutoring systems is the time and cost required. A large team including computer programmers, domain experts and educational theorists, is needed to create just one ITS. Estimates of construction time indicate that 100 hours of development translates into one hour of instruction (Murray, 1992). Clearly there is a need for techniques that will help alleviate these difficulties for instructional development.

2.3.6 The Future of ITS in Malaysia

ITS can considered quite successful to be implemented in the advance country like United States. For example, the F-16 maintenance skills tutor is a successful ITS to be developed for the Air Force department of the country. So, ITS not only useful in the field of education purpose but also on other relevant fields.

In Malaysia however, ITS is still consider very new. Only certain universities have done research on it. The Education Department should take the initial steps to promote the ITS for secondary schools with the help of the Information technology (IT)

sectors. However, ITS can not replace the conventional class at all because of the budget constraints. But the government can implement it in several selected smart schools. For Information Technology developers, they should try to build some ITS web site for the students. Then, they should charge those who use it.

So, with the 2020 vision coming nearer, our government should come out with some fresh idea in educating the students in an interactive way.

2.3.7 Interactive Learning

According to Wen(2000), a system is called interactive if the user can interact with the system and the system can give the corresponding response. In e-learning, pedagogical agent aims to increase understanding and natural communication scheme between user and system under certain conditions. The role of the agent is to assist the learner when he/she is learning through the intelligent system.

2.3.8 Interactive Agent

Interactive agent is also known as pedagogical agent. Interactive agent is a program that acts as a personal assistant to a user dealing with particular computer based application. The role of the interactive is almost same with the "office assistant" in the Microsoft software that aims to assist the end user when using the system. The agent also aims at overcoming static and one way communication in a typical user support module (Lieberman, 1998).

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One of the promising research areas for an intelligent agent is education and training. Such an agent can be used specifically to support and guide the interaction between user and system (Mohd Hassin and Ab. Aziz, 2002). Interactive agent offers great promise for broadening bandwidth of communications between the system and user.

Currently, there are so many e-learning website that contain static text and image and need to be enhanced (Mohd Zaidil Adlha, 2001). In 1998, Forta suggest that dynamic, database oriented, intelligent processing data and email interaction web learning should be developed. With the use of the interactive agent hope to make the users think that learning in an interactive environment is very attractive and effective. Individual learning can also motivate the students that use the system (Shaw, 1999).

Five strategies normally used by the interactive agent to make the learning more effectively:

i.   Disturbing

The agent suddenly prompts out to ask a simple question to the user. This aim to evaluate the understanding of the users and from here can determine the next learning notes that suitable to them.

ii.   Timing

When answering the tutorial questions and if the user answers too fast, the agent will prompt out to advice the user to read and answer carefully.

iii.   Motivational

Agent can acts as motivator. If the user can't answer a question, hints and guideline will be given by the agent. Agent also can act like a human and give motivation to the user.

iv.   Rhetoric

Certain fact can be presented through story telling, analogy making, example and individual opinions. Developer has to determine suitable situation for suitable presenting method.

v.   Negotiate

User can request learning notes that fit their understanding. Example, if users can't understand the notes in the text form, they can request to change it in the form of animation or analogy.

2.4 Delivery Medium

Intelligent tutoring system can be presented in two mediums. The first medium is web based and the second medium is CDROM based. For the proposed system, it will be developed in a web based system.

2.4.1 Web Based Learning

Web based learning (a major subcomponent of the broader term "e-learning") is one of the tools in which education is delivered. In traditional academic institutions, web based learning system are generally house administratively in a "distance education" department along side other at-distance delivery methods such as correspondence, satellite broadcast, two way video conferencing, video tape and CD-ROM/DVD delivery systems (Jackson, 2003). All such systems seek to serve learners at some distance from their learning facilitator. Many such systems attempt to serve learners interacting with the learning source at different chronological times (for example, email). Distance education then is often referred to as those delivery modalities that seek to reduce the barriers of time and to learning, thus the frequently used phrase "anytime, anywhere learning".

The simplest definition of web based learning is the delivery of interactive training or education over the internet or intranet. It is the structured transfer of skill or knowledge that takes place using World Wide Web (WWW) as the distribution channel. The way this interactive learning is designed and implemented varies greatly. A full service learning community offering will likely have to support many approaches to on-line learning design and delivery. Web based learning also defined as:

- Content available anytime, 24 hours, 7 days.
- Content accessible anywhere as long as connect to the internet.
- An environment that is learner–centered, one that is personalized to the individual and customized to the organization.
- Involved some form of technology for delivery.

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- Network (Internet, Local Area Network and Wide Area Network) assisted.

The primitive form of web based started in last decade (R.H Jackson, 2003). As the information age evolves, massive changes that have impact on educational systems are observed in our society. Especially, advances in information technology have played an important role in creating needs for a paradigm shift in education. As Peters(1997) pointed out, new paradigm asked educators to think education a new and organize teaching in different ways. A new approach in redesigning teaching and learning in digital environment has become necessary.

In the web based learning environment, students are asked to develop skills for managing their learning and collaborating with others in a network based knowledge constructing community. The idea of web based learning has been realized to bring wider opportunities to the students in the form of flexible, open and distance learning system. The web based learning environment allows access to education by anyone, from anywhere, anytime and in any mode of their choice.

To create a web based learning environment and thus to provide flexible and open learning, well designed digital resumes and the mechanism for networking people are required. Web based learning is viewed as an innovative approach for adapting to a new education paradigm using the web as the delivery medium.

In recent times, the web has become a very powerful interactive tool for sharing information and ideas among people all over the world. The web, which was released

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into the internet in 1991, can provide students with new learning experiences and opportunities to have an equal access to learn resources through internet. Several characteristics of web based learning have been noted (Gillani, 1997):

- Web based learning extend the boundaries of learning environment. That is, learning can occur in classrooms, at home and in the work place. Time constraints can be overcome. Teaching-learning activities can occur any time in virtual space.

- Web based learning may promote experiential knowledge building activities through social interaction. Since the web supports the use of cooperative learning strategy, students have the potential to discuss various issues with peers and to query experts on a particular issue. Web based learning can be designed for active collaboration and interaction in both synchronous and asynchronous form.

- Access to various type of information has become possible in web based learning. In web based learning environment, information in multimedia mode can be obtained and the presentation of content is in the form of hypermedia that allows students to navigate the internet database in a non-sequential way. The attributes of the web in hypermedia format allow students their choices of the content, resources and media for promoting their understanding and learning. The following table summarizes the differences features traditional learning and web based learning.

Table 2.1: Different features between traditional learning and web based learning (Relan, 1997)

	Traditional Learning	Web Based Learning

Main source of information	Teacher and textbook	Various resources on internet
Format of information	Text	Multimedia
Presentation format	Linear	Multimedia
Interaction type	Synchronous	Asynchronous
Interaction space	Time/space bound classroom	Networked world
Instructional emphasis	Acquiring knowledge	Building knowledge
Objectives	Specific, predefined	General, negotiable

There are several advantages of web based learning:

- Reduces travel time and cost for off-campus students.

- Class work can be scheduled around work and family.

- Students may have the option to select learning materials that meets their level of knowledge and interests.

- Students can study anywhere as long as there is a connection to the internet.

- Self paced learning modules allow students to work at their own pace.

- E-learning can accommodate different learning styles and facilitate learning through a variety of activities.

- Develops knowledge of the internet and computers skills that will help learners through but their lives and careers.

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- Successfully completing online or computer based courses builds self-knowledge and self-confidence and encourages students to take responsibility for their learning.
- Data (learning materials) can be easily modified, updated, shared and accessed by users.
- Personal computer, WebTV, Personal Digital Assistant (PDA) and Wireless Application Protocol (WAP) can access to the internet because they all use the same protocol that is TCP/IP.

Disadvantages of web based learning:

- Learners with low motivation or bad study habits may fall behind.
- Learners may feel isolated from the instructor and classmates.
- Slow internet connections (normal speed for home user – 56k) may make accessing course materials frustrating.
- Managing computer files and online software can sometimes seem complex and difficult for students with beginner level of computer skills.
- Hands-on or lab work is difficult to simulate a virtual classroom.
- Web based learning is delivering information and not teaching the learners.

2.4.2 CD ROM Based Learning

Unlike the completely web based learning, these distance learning programs provide you with software which is CD-ROM based, so that you can work even without web access. Many of the materials are on the computer rather than using books for everything.

When compared to instructor-led programs, the features and benefits of CD-ROM training include all those shared by other types of technology based training:

- Highly interactive.
- Increase retention rates.
- Reduced costs.

If compared with web based learning, the benefits of CD-ROM learning largely come from the fact that CD-ROM usually provide a more engaging learning experience, with text, audio, video and animations all used to convey information. Typically a graphic will be displayed along with bulleted text as an audio narration provides the primary content. Video clips can be used to show human behaviors or complex operations. The use of multiple media means that learning is optimized for all three learning styles: auditory, kinesthetic and visual.

However, CD-ROM based learning still have several disadvantages:

- Lack of peer to peer learning opportunities if compared with instructor led delivery.
- Content of the CD-ROM difficult to be updated or changed. Manufacturer has to come up with a new edition and this increase the production cost and time consuming is higher.

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2.5 Multimedia

The term multimedia describes a number of diverse technologies that allow visual and audio media to be taken and combined in new ways for the purpose of communicating. Applications include entertainment, education and advertising. Multimedia often refers to a computer technology. Nearly every personal computer that developed today is capable of multimedia because they include a CD ROM drive, graphic and sound card. But the term multimedia also describes a number of dedicated media appliances, from digital VCRs and interactive television, to advanced wireless devices, to public television screens. The definition of multimedia will continue to expand as technology evolves and new applications are invented.

Multimedia has more than one concurrent presentation medium (example, in CD ROM or a website). Although images are a different medium than text, multimedia is typically used to mean the combinations of text, sound and motion video. Some people might say that the addition of animated images (example, animated GIF on the web) produces multimedia, but it has typically meant one of the following:

- Text and sound.

- Text, sound and animated graphic images.

- Text, sound and video images.

- Video and sound.

- Multiple display areas, images or presentations presented concurrently.

- In live situations, the use of a speaker or actors and "props" together with sound, images and motion video.

Multimedia can arguably be distinguished from traditional motion pictures or movies both by the scale of the production (multimedia is usually smaller and less expensive) and by the possibility of audience interactivity or involvement (interactive multimedia). Interactive elements can include voice command, mouse manipulation, text entry, touch screen, video capture of the user, or live participation.

Multimedia tends to imply sophistication (relatively more expense) in both production and presentation than simple text and images. Multimedia presentations are possible in many contexts, including the web, CD ROMs and live theater. Since any web site can be viewed as a multimedia presentation, however any tool that helps develop a site in multimedia form can be classified as multimedia software and the cost can be less than standard video productions. Currently, examples of popular multimedia player are MPEG, Quicktime and Shockwave.

Multimedia today is primarily used for education and corporate training. "Distance learning" enables information and instructional materials to be accessed exactly as needed, at a time and place convenient for the learners, more costs-effectively than in a traditional classroom, and in a structure best suited to individual educational needs. As available bandwidth increments, computing costs continue to fall, and efficiencies of scale proliferate, a wider range of applications is expected to develop.

Table 2.2: Currently existing teaching and learning technology and limitations (Ellis, 1997).

Technology	Limitation
Satellite Showing	- Poor tutor control - Contents limitation - Poor interaction between tutor and learner - Lack of multimedia communication
Video conferencing through computer	- Poor tutor control - Contents limitation - Lack of multimedia communication - Limitation on the number of learners
CD ROM based learning	- Manufacturing cost is high - Exercise accomplishing rate is low without the guidance from tutor - No interaction among learners

2.6 Existing System Review

Currently, there are so many website that offer web based learning for the internet user. Here are a few web based learning website that have some parts and concepts that similar to this project system.

2.6.1 Case Study 1

The F-16 Maintenance Skills Tutor.

- Used by the Air force department of United Stated.
- Many experience technicians retire leaving fewer people to train novices.
- Cognitive task analysis techniques to capture troubleshooting strategies used by experts and novices.
- ITS takes the results of the cognitive task analysis to provide a practice environment for working authentic troubleshooting problems while coaching the student with hints and feedback.

Comments:

- Reduce learning time because this type of tutor for 20 hours is equivalent to 3.5 to 4 years of experience on the flight line.
- This system shows ITS not only can successfully be implemented in the field of education but also in the army department.

2.6.2 Case Study 2

LISP Tutor

- Developed by researchers of Carnegie Mellon University in the mid-1980s.

- Teach computer programming skills to college students.

- In one controlled experiment, students who used the ITS scored 43 percent higher on the final exam than a control group that received traditional instruction.

- When given complex programming problems, the control group required 30 percent more time to solve these problems compared to the ITS students.

Comments:

- Students that learn through ITS can have a higher level of understanding on the topics learnt.

- Students can solve the given questions faster than those use the traditional learning.

2.6.3 Case Study 3

URL:www.tutor.com.my
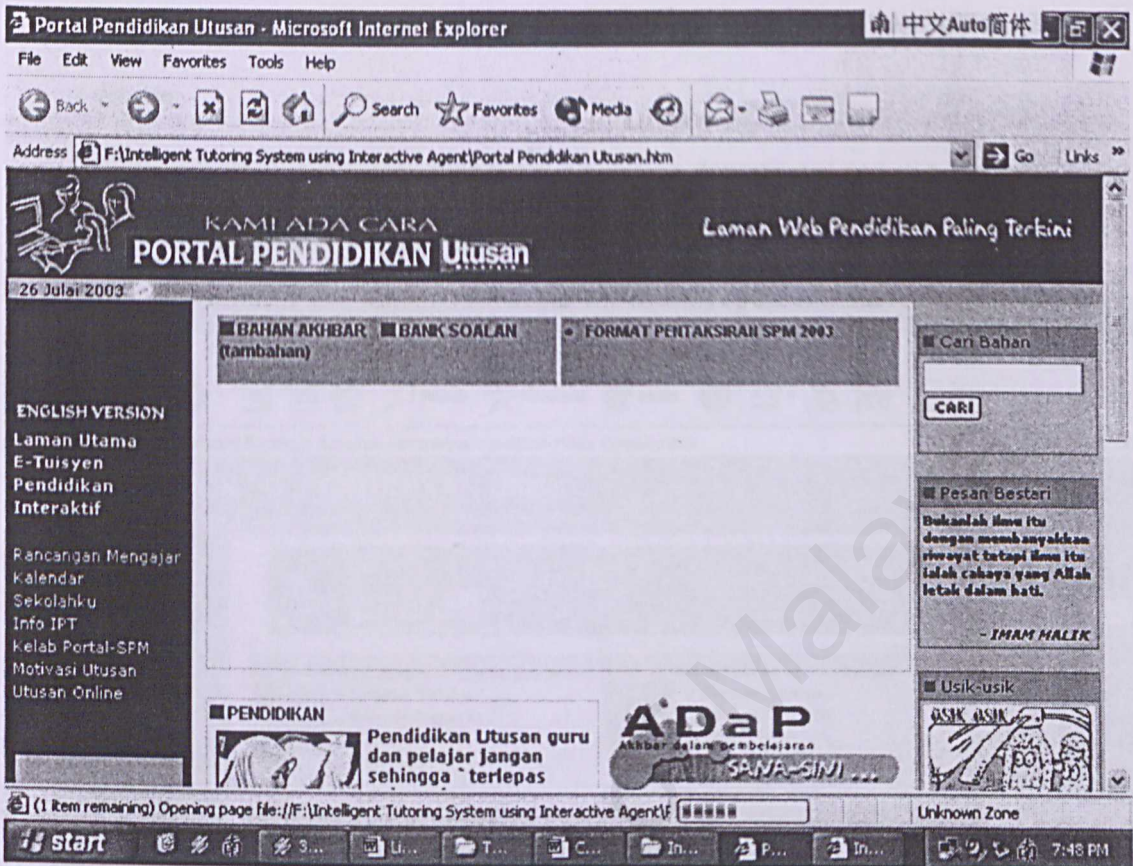
Figure 2.2: Screen shot for www.tutor.com.my

- A complete and intelligent tutoring web based learning website for Malaysians.

- Suitable for UPSR, PMR, SPM and STPM candidates.

- Consists of two parts – e-tuition and interactive.

- User can become three roles – teacher, students or parents.

- Syllabus, notes, exercise, reference, exam questions are ready for the users.

- For interactive section, there is a forum for the users to discuss amongthemselves

  regarding their academic's problems.

- E-lab that demonstrates physics' experiments using flash animation.

- Don't have any helping wizard (agent) to help the learners. Learners have to solve the exercise themselves or discuss with others members through the web forum.

- Government departments especially education department can use the website as a means of communication with the community and parents
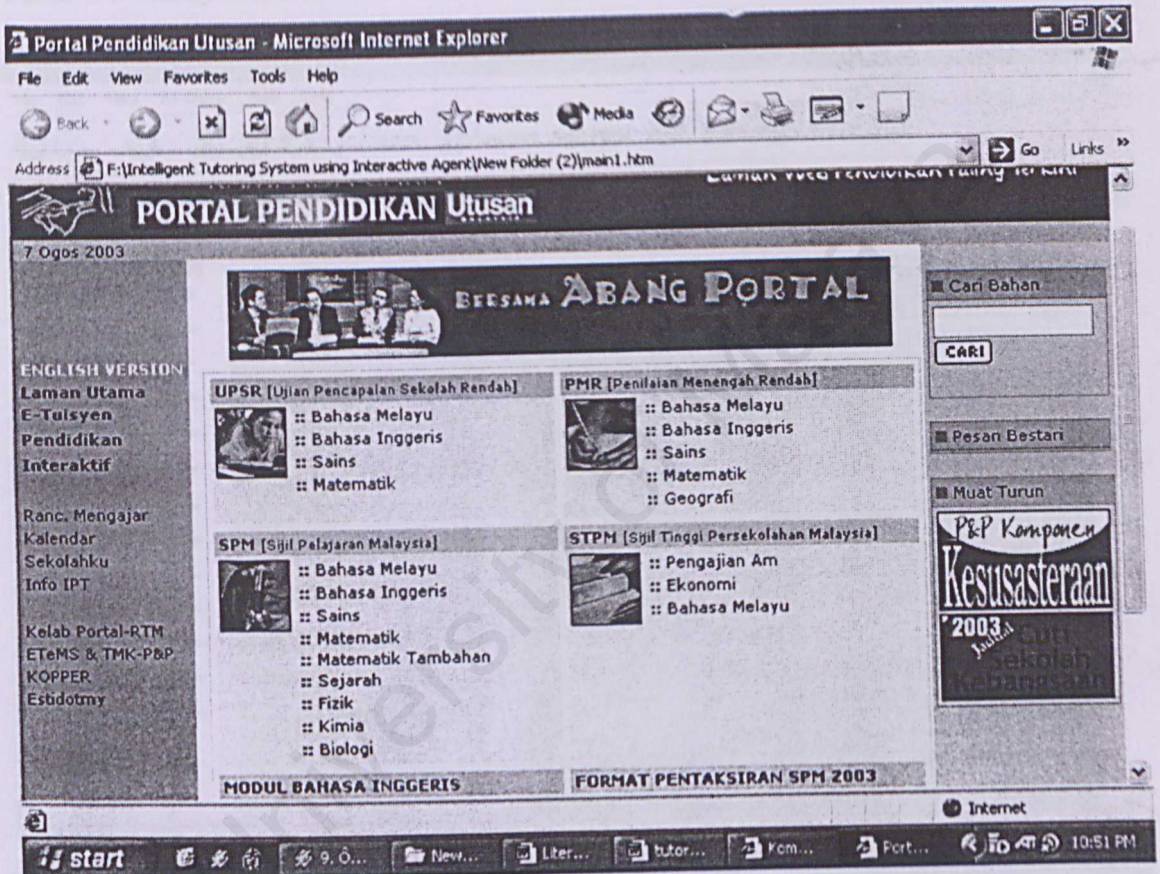
Figure 2.3 Screen shot for www.tutor.com.my

Comments:

- No interactive agent.

- Users learn by themselves without the help of any agent/tutor.

- Learning materials are in static form and this make the users to give up easily because the style of learning is just like reading from reference books.

2.6.4 Case Study 4

URL: www.easymaths.com
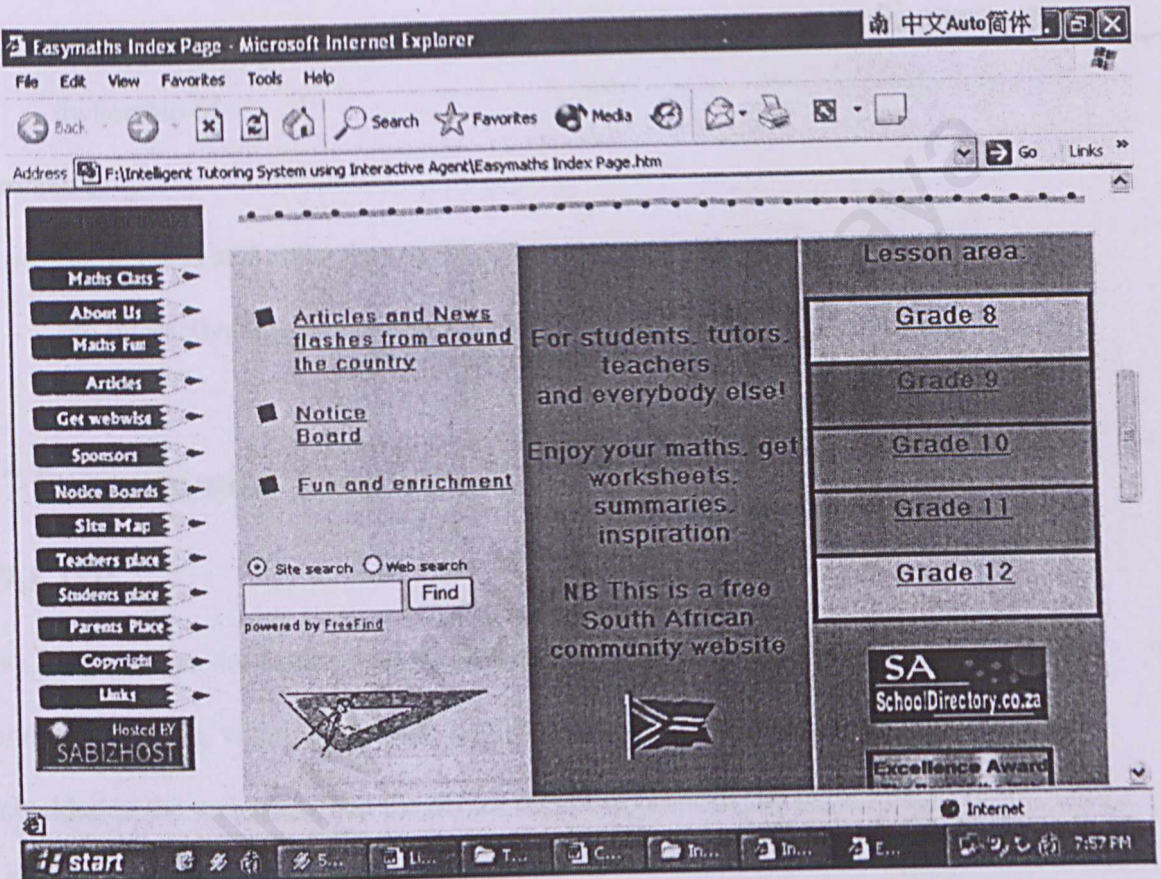
Figure 2.4: Screen shot for www.easymaths.com

- Created by mathematics web association (Easymaths), a non profit organization (NGO) aims to make mathematics resources available to all via the internet.

- Suitable for secondary students.

- Involve teachers, students or parents.

- A forum for teachers and students to interact among themselves.

- Users can access to mathematic worksheets, lessons, examination, study skills support, fun articles and activities, counseling services and a notice board and monitored forum.

- Parents get support and information on all mathematic issue that help them to give their children the necessary support.

- It is an open web accessible to every member of the community to take ownership of.

Comments:

- Static notes and make the users boring.

- No interactive agent.

2.7 Programming Language Review

2.7.1 JSP

Java Server Pages are tightly integrated with Java Servlets. It's a way of creating a Java Servlet on the fly, where each page becomes it's own servlet. Java code fragments are embedded in the web page, and the server compiles them on the fly.

2.7.2 ASP

ASP is integrated into Microsoft Web Servers and as a consequence is widely used. ASP is easy to learn. More efficient than CGI because it runs as a service and can take advantage of multithreaded architectures.

It is an open, compile-free application environment in which can combine HTML, scripts and reusable Active X server components to create dynamic and powerful web-based business solutions.

ASP enables server-side scripting for Internet Information Server (IIS) with native support for both VBScript and JavaScript.

However, the drawback for ASP is it requires adopting Microsoft as the platform and webbing server.

2.7.3 ASP.NET

ASP 3.0 is the latest version of ASP, but there will never be an ASP 4.0 version. ASP .NET is the next generation ASP, but it's not an upgraded version of ASP. ASP .NET is an entirely new paradigm for server-side ASP scripting. ASP .NET is a part of the new .NET (dotnet) Framework. Microsoft spent three years rewriting ASP.NET from the ground up, and ASP .NET is not fully backward compatible with ASP 3.0.

The .NET Framework is the infrastructure for the new Microsoft .NET Platform. The .NET Framework is a common environment for building, deploying, and running Web applications and Web Services.

The .NET Framework contains a common language runtime and common class libraries - like ADO .NET, ASP .NET and Windows Forms - to provide advanced standard services that can be integrated into a variety of computer systems.

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v) Memory management for .NET applications is much more sophisticated, meaning that a badly behaved .NET component is extremely unlikely to crash other components running in the same process.

vi) ASP.NET, the replacement for ASP, offers compiled web pages (making processing of web requests much more efficient) and includes a large number of pre-written components that can generate commonly used HTML form and user-interface items for you (the so-called *server controls*).

vii) Components are wrapped up in a new unit called an *assembly*, which is highly self-describing, making installation and use of components very easy.

2.8 Database Management System Review

2.8.1 Microsoft SQL Server 2000

Microsoft SQL Server 2000 is a modern, full-featured SQL database designed for small or midsize organizations. Its complete set of tools, high-end engine features, and robust analysis capabilities provide most of what other corporations could offer only in their Enterprise Edition databases, all at a reasonable price. In addition, SQL Server 2000 is amazingly easy to use, yet still powerful enough to crank through hundreds of complex transactions per second without choking. Customer needs and requirements have driven significant product innovations in ease of use, reliability and scalability and data warehousing. SQL Server 2000 runs on Windows NT 4.0 or Windows 2000.

Automatic memory tuning is not especially important on a dedicated database server machine. But on a server that has to run other applications like a mail server and

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Web server at the same time as a database, dynamic memory sizing makes a huge different to system usability. SQL server's unmatched auto-tuning features also mean that it is extremely suitable for organizations that do not have database administrators on staff. With SQL Server 2000, a part time or beginner administrator is all it takes to manage the database effectively.

2.8.2 Oracle 8i

Oracle is the world's leading vendor of database software. Oracle's ability to have all data and documents stored in a small number of high-performance databases benefits customers by centralizing all their data, making information management and access easier, more reliable and less expensive. The ground-breaking capabilities of Oracle 8i's Internet File System (IFS) provides a single, easy to use data management interface for all data types, thus minimizing customer's reliance on a proprietary operating system. Oracle is an open solution and it supports all kind of platform.

Oracle uses a Java-based utility that provides everything needs to get a pre-tuned and pre-configured Oracle 8i database up and running. Oracle Enterprise Manager provides a single integrated management console for central administration of multiple servers. It also contains some advance functionality for tuning and diagnosing the database, and managing complex change in the database environment. Oracle's advanced security features allow for enforced granular privileges, advanced auditing, enhanced access control, secure distributed processing and replication, and the ability to use additional external authentication mechanisms.

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2.8.3 Microsoft Access 2000

Microsoft Access is the most popular Relational Database Management System (RDBMS). With Access, database administrator can design and use databases very much quicker, as it provides a very user-friendly interface. Furthermore, tables, forms, queries and reports can be generated just at the snap of a finger by using the set of wizards that come with this software. All this makes Access an excellent all in one database tool for creating standalone database applications

2.9 Chapter Summary

This chapter is regarding all the researches that done mainly to gain information for this project. All the information gathered includes the concept and fact on intelligent tutoring system and pedagogical agent. Review also has been done on the existing system, development methodologies and web development tools.

Research on intelligent tutoring system concepts is to have a better understanding on the requirement of this project. The definition of intelligent tutoring system and also the pedagogical agent also have to understand first. Research on the existing system is to understand how the system works and also their benefits and drawbacks. The weaknesses of the past system will be review and overcome.

As for the development methodologies, this review of literature focuses mainly on five development models that are the Waterfall model, V-shape model, prototyping, Incremental model and Spiral model. Each modal has its own features, which are different from various resources.

The technology tools that going to build a web based system also be reviewed. Example, research is done on ASP, ASP.NET and for data base is Microsoft SQL Server. All the development technologies and programming languages chosen for this project will be mention in next chapter.

University of Malaya

CHAPTER 3: METHODOLOGY

3.1 Introduction

A collection of procedures, techniques, tools and documentation aids that help system developers to develop and implement a complete information system is called methodology.

Methodology consists of a set of phases that also include a set of sub phases. These phases guide the developers to choose the technique at various stages and assist them to plan, manage, control and evaluate the system project.

Currently, there are so many process models in software engineering. For small project, Waterfall model and V model are usually used. Meanwhile for large project, incremental and spiral model are normally used.

Normally, the system developers will decide to use which type of process model.

3.2 Modeling the Process and Life Cycle

3.2.1 What is a process?

A process is a series of steps involving activities, constraints and resources that produce an intended output of some kind. A process usually involves a set of tools and techniques and has the following characteristics:

- The process prescribes all of the major process activities.

- The process uses resources, subject to a set of constraints (such as schedule) and produces intermediate and final product.

- The process may be composed of sub-process that is linked in some way.

- The process may be defined as a hierarchy of processes, organized so that each sub-process has its' own process model.
- Each process activity has entry and exit criteria, so that we know when the activity begins and end.
- The activities are organized in a sequence, so that it is clear when one activity is performed relative to the other activities.
- Every process has a set of guiding principles that explain the goals of each activity.
- Constraints or controls may apply to an activity, resource or product. When the process involves the building of some product, it is referred as a life cycle. A life cycle usually involves the following stages:
  - requirements analysis and definition
  - system design
  - program design
  - writing the programs (program implementation)
  - unit testing
  - integration testing
  - system testing
  - system delivery
  - maintenance

Below are the reasons for modeling a process:

- It forms a common understanding of the activities, resources and constraints involve in a system development.

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- To find inconsistencies, redundancies and omissions in the process and in its constituent parts. As these problems are noted and corrected, the process becomes more effective and focused on building the final product

- The model should reflect the goals of development, such as building high quality system, finding faults early in development, and meeting required budget and schedule constraints

Every development model includes system requirements as input and a delivered product as output.

3.2.2 Proposed Development Model

The methodology that selected to develop the system is Waterfall model. In this model, each development stage has to be completed before proceeding to the next phase. For example, in the first stage all the requirements are elicited, analyzed and documented before designing the system. The Waterfall model offers the benefit of a structured development, in addition to good visibility and proper documentation for each development stage.

The following diagram gives a visual layout of the waterfall method which will represent the project system development processes. Each stage must be completed before moving on to the next. Testing is done in each stage and the developer may go back to the previous stage to correct any errors.

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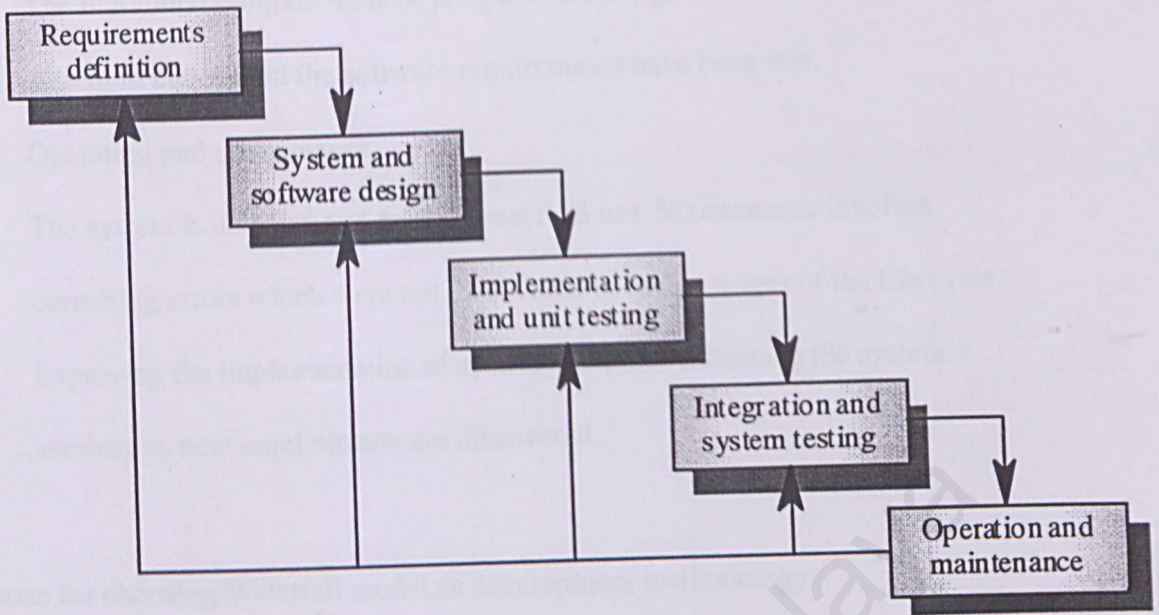
Figure 3.1: Project Development Methodology – Waterfall Model (Ian Sommerville, page 45, 2000)

The five stages of Waterfall model:

1. Requirements analysis and definition.

    The system's services, constraints and goals are established by consultation with

    system users.

2. System and software design

    The system design process partitions the requirements to either hardware or

    software systems and establish an overall system architecture.

3. Implementation and unit testing

    The software design is realized as a set of programs or program units. Each unit

    are verified to meet its' specification.

4. Integration and system testing

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The individual program units or programs are integrated and tested as a complete system to ensure that the software requirements have been met.

5. Operation and maintenance

The system is installed and put into practical use. Maintenance involves correcting errors which were not discovered in earlier stages of the life cycle, improving the implementation of system units and enhancing the system's services as new requirements are discovered.

Reasons for choosing Waterfall model as development methodology:

- Waterfall model is simplicity, which means that it is simple and easy to understand.

- Next phase only starts when the previous phase has finished. This means that the each phase can be fully focused and no need to think the next phase until the current phase has finished.

- Testing is performed in every stage. So it is flexible to go back to the previous if some error occurs or something has been missed out. Offers backward feature

3.3 Requirements Process

Capturing the necessary requirements before developing a system is important. A requirement is a feature of the system or a description of something the system the system is capable of doing in order to fulfill the system's purpose (Pfleeger 1998). The requirements were gathered for this system through research on the internet and

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reference books, analysis of the surveys' results conducted and also review on the existing system.

3.4 Requirements Elicitation

To determine the users' needs, a variety of techniques must be used. Requirements are divided into three main categories:

a) Requirements that absolutely must be met.

b) Requirements that highly desirable but not necessary.

c) Requirements that possible but couldn't be eliminated.

3.5 Delivery Medium

Online delivery would be the delivery medium for the system. There are four main issues namely speed of access, distance, updating, 'unlimited' size of the data space that can be provided online

The speed with which the system potential users can access the application is unpredictable because it depends on the access speed of the internet.

Online delivery allows people from all over the world to access the application anytime. All they need is a connection to the internet. This method overcomes the barrier of time and space. It also provides huge data space that can potentially be presented to the user.

3.6 Information Gathering Methods

Method of gathering information about the system that is going to be developed is important to understand the domain of the system and also its requirements. There are a certain number of methods that are commonly used in gathering-information such as collecting hard data like written documents or reports, interviewing, using questionnaires, observation and sampling.

As for this project, the main data sources are normally from the internet. Four methods are used in order to gather information – internet surfing, books and references, survey and interview and discussions with supervisor.

3.6.1 Internet Surfing

Through the Internet, I can collect some idea from the similar system and some interesting web design. Besides, I also get a lot of information on distributed system, development tools and technologies, programming languages, database, project methodology, and also client-server computing knowledge. The result from this research has been elaborated in detail in Chapter 2.

3.6.2 Books and References

Book and references are used to get the information that needed to develop the system. This including information from information system references, development tools references, programming references and database references. By referring to the seniors' past thesis also gain a lot of priceless information about how the project should be done, what need to be done for the report and many others.

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3.6.3 Survey

By doing survey on the existing system, the weak points and disadvantages can be discovered from the existing system. From there, rectification and modifying can be done on the existing so that the drawbacks will not be repeating for the system that is going to be designed. Questionnaire has be done on the students from University of Malaya and also students that will take the chemistry paper from Cochrane Road School (CRS). Views regarding students learning from the web are taken from the teacher being interview.
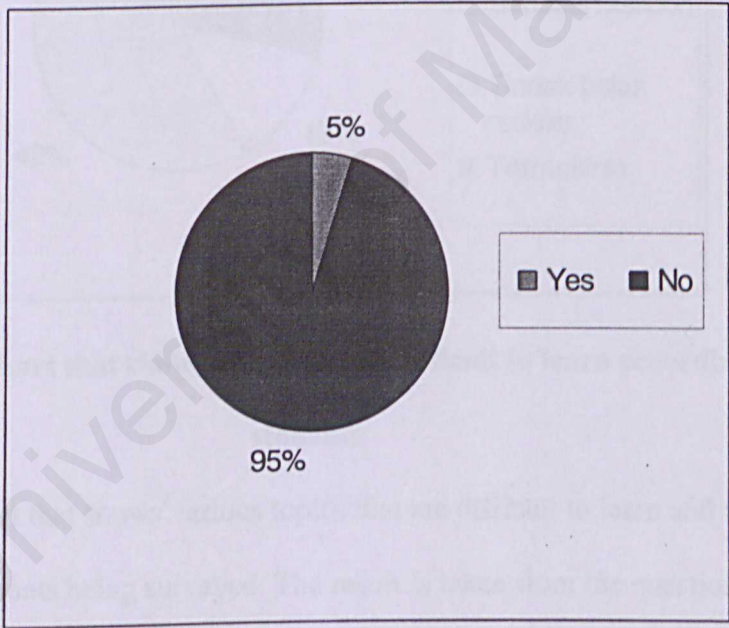

Figure 3.2: Pie chart shows percentage of students that use office assistant in Microsoft products for help.

Figure 3.2 shows the percentage of students that use the office assistant in Microsoft software for help. The result of this pie chart is generated form the survey done on 38 students from University of Malaya. However, from the survey done, only 5% of

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students who give the answer "Yes" that is equal to 2 students use the helping wizard when they don't know how to use certain functions while the others who answer "No" don't use the helping wizard. The reasons given by those who don't use the helping wizard are the helping wizard can't help them while others say it's better for them to refer it to their friends instead of the helping wizard.
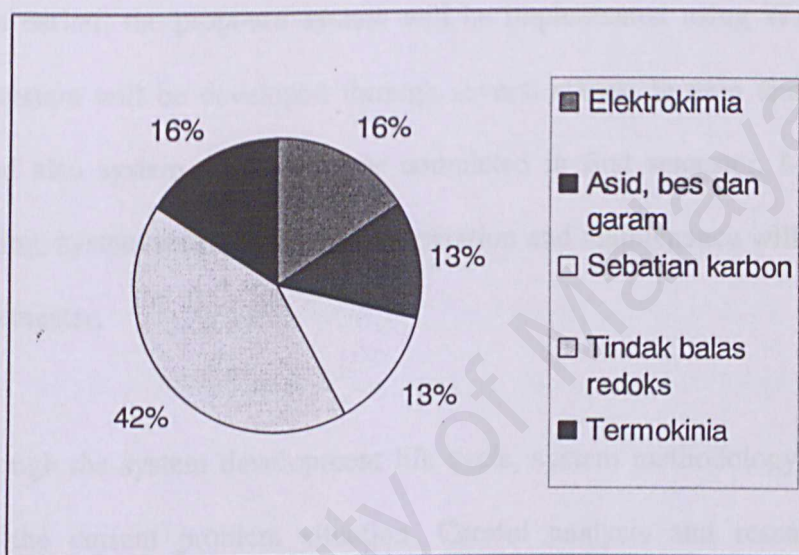
Figure 3.3 Pie Chart that shows topics that is difficult to learn according to the students

Figure 3.3 is pie chart that shows various topics that are difficult to learn and understand according to the students being surveyed. The result is taken from the questionnaire done on 40 form five students from CRS. From the chart, we can conclude that around 16 students out of 40 say that "Tindak Balas Redoks" is the hardest topic among the given topics.

3.6.4 Discussion with Supervisor

Consistently discussion with supervisor has been practiced from time to time in order to get help and advices during the development of the project.

3.7 Chapter Summary

As mention earlier, the proposed system will be implemented using Waterfall model. Thus, the system will be developed through several stages. System and requirements analysis and also system design will be completed in first semester. Meanwhile, for system coding, system testing and system operation and maintenance will be completed in second semester.

Through the system development life cycle, system methodology is adopted to understand the current problem situation. Careful analysis and research has been conducted to determine the feasibility of the system and what is required of it. The system requirements are identified, translated into design and finally implemented via coding. The finished system is evaluated to meet the system objectives and requirements specification.

The next chapter will discuss on the software and hardware requirements, functional and non-functional requirements for the proposed system.

CHAPTER 4: SYSTEM ANALYSIS

4.1 Introduction

The definition of system analysis is a systematic investigation of a real or planned system to determine the functions of the system and how they relate to each other and to any other system. Depending on the context and the constraints of the package, developers should be able to clarity the interactive multimedia project rationale, to define the program scope and to set up methods of evaluation by creating a preliminary analysis.

Typical constraints in the design of an intelligent tutoring system include:

- Media configuration and performance, e.g. developers might have multi-platform development strategy aimed at producing a good multimedia application.
- For the publishing market, or a tailored approach for a specific purpose – a teaching and learning tool.
- The availability of expertise about the project.
- The budget and the deadline.
- How the learning materials should be presented to the users.S

The look and feel, interface and functionality of existing interactive multimedia applications should be evaluated. It often helps to make a chart of comparative features of existing applications. Looking at those applications will reveal the puzzle that multimedia design and production represents. Production is always governed by the delivery requirements, hardware limitations, storage capacities and the speed of the programs that present the information. All the existing products analyzed will

demonstrate the tradeoffs the developers had to deal with in order to bring the project and memory limitations have all been juggled to create the best applications for the investment.

4.2 Objectives of System Analysis

- To identify what are actually needed by the proposed user.
- To identify the major modules to be included in this package.
- To acquire knowledge on how this web package will be developed with the current new emerging techniques.

4.3 Development of System Analysis

The analysis on the development tools for the package had been done in this stage. After reviewing and analyzing the requirements, the tools for developing the system are identify. These tools include the entire platform and development software. Besides considering the suitability of the tools to fulfill the requirements, the tools used must be able to interact to each other. Following are the development tools used in the development process.

4.4 Development Software

4.4.1 Selected Programming Language

With **ASP.NET** the pages are compiled common language code executing on the server. This allows for advantages and forces some changes in the traditional ASP programming.

Advantages of **ASP.NET**

> It has a rich set of libraries
>
> It's open-standard friendly
>
> Its code is compiled natively
>
> Performance - 28 times faster
>
> Productivity - One third the code

4.4.2 Selected Database Server

Microsoft SQL Server 2000 works well with databases of any size. It contains all the user-friendly features, works more efficiently and has the ability of handling hundreds of transactions simultaneously without affecting performance. Therefore, SQL Server 2000 will be chosen to act as the database management software for the development of the system.

Advantages of SQL Server 2000:

> It is able to handle a large amount of data during transaction and is capable to support more than 5 simultaneous users.
>
> Most viable solution to accommodate the vast storage requirements.

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> SQL Server can be queried and updated via Web browsers through tight integration with IIS

> Scalability and high performance

4.4.3 Selected Operating System

The operating system that selected to develop this system is **Microsoft Windows XP**. Windows XP is the latest version of operating system Microsoft Corporation has even produced after the latest edition of Microsoft Windows Server 2003. One of the key features of Windows XP that make every pc users use this platform is more stable and reliable than the previous version (Windows 2000). Also, key enhancement also inherited from Windows 2000:

- Application compatibility technologies

- Shutdown Event Tracker

- Control of unresponsive applications

- Windows Installer

- Auto Update, Dynamic Update, and Windows Update

- Shadow Copy Integration

- Last Known Good Configuration

- Automated System Recovery

4.4.4 File Transfer Protocol (FTP)

It is used to upload the system into the internet platform.

Acknowledgement

As with any thesis, this one wouldn't have been possible without the contributions of many people in 1 way or another. I would like to take this opportunity to express my gratitude to the following parties:

Firstly, I would like to thank my supervisor, Ms Norisma Idris and moderator Dr. Rukaini Haji Abdullah who has been given me precious guidance throughout the development of Echem. Their advices and critical comments allowed me to more creative and analytical when designing the system of Echem.

Next, I would like to thank my course mates who gladly shared their knowledge and experiences. The discussions held allowed us to realize the weaknesses and strength of each others' system. With that, we are able to improve the weakness and improve the quality of our system.

Lastly, I would like to thank my family and friends for giving me support and encouragement. Without their motivation and encouraging words, this proposal wouldn't have been made possible.

Thank you.

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4.4.5 Macromedia Flash

Macromedia flash allows user to create a web experience that is more attractive, more compelling and compatible with more browsers than any other web solution. Dynamic HTML, Java and other advanced web design format aren't reliable alternatives since they are either not compatible or inconsistent with different browsers. With macromedia flash player's pervasive penetration, wide availability, scalable vectors, animation, sound and more, macromedia flash sites provide the high production quality that attracts visitors and brings them back to your site. Since macromedia flash is free of limiting design capability of more traditional web display options, it lets the user clearly and exactly expresses the brand and company identity.

4.4.6 Adobe Photoshop 6.0

It has been used to design and modify the graphical picture that is needed for the package. Most of the pictures are scanned then do some design using this software and pasted it into the system. Adobe Photoshop 6.0 is suitable software to modify and improve the quality of the pictures and figures.

4.5 Hardware Used and Relational Delivery Platform

- Intel Pentium Processor 2.40 GHz
- 526MB of DDR RAM
- Seagate Hard Disk with capacity of 40GB
- Lexmark X75 Printer + Scanner
- Operating system – Windows 98 or above

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- Screen resolution – 800 by 600 pixels

- Number of color on the screen – 256 and above

- Sound handling – 8 bit and above

- Access to online systems (local network)

- Speed of network connection – 56k

4.6 Run -Time Requirements

4.6.1 Hardware Requirements

To better performance for this package, users' computer should have the following basic

requirement. There are:

- Processor with speed or 256Mhz or better

- Minimum capacity of 32MB RAM

- 56 kb/s modem

- 16 bit sound card

- Standard computer peripheral

4.6.2 Software Requirements

To host and run the package, the users' computer needs to have the following support

software:

- Internet browser (Microsoft Internet Explorer or Netscape)

- Authorware web player

- Notepad

- DDL support system

4.7 Functional Requirements

Functional requirements are statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. It also describes an interaction between the system and its environment. The following are a number of functional requirements for the proposed learning package:

- The user can learn several important SPM level chemistry subject through the web site.

- The user can evaluate their understanding on the topic learnt by trying to solve the tutorial questions after each chapter.

- The user can go to others learning package web site through the link inside the web site.

Overall there are four main modules in the system. Each module provides several functions:

4.7.1 Pedagogical Agent

The user will be assisted by the helping wizard during the learning session.

4.7.2 Learning Module

The students will learn about chemistry concepts in the form of note regarding on each chapter the module is present. This module stores all the notes.

4.7.3 Tutorial Module

The student can try to solve a tutorial set for each chapter to evaluate their understanding
on that chapter.

4.7.4 Administrator Module

This module enables the administrator to upload or update new information (learning
materials) to the system

4.8 Non-functional Requirements

Non-functional requirements, as the name suggest, are those requirements which are not
directly concerned with the specific functions delivered by the system. It describes a
restriction on the system that limits our choice for constructing a solution to the problem.
These constraints usually narrow our selection of language, platform or implementation
techniques or tools. However, the solution is made at the design, after the requirements
have been specified.

4.8.1 User Friendliness

The system is required to have a very user friendly interface because much of the users
are students who are non-technical users.

4.8.2 Interactivity

The pedagogical agent is ready to help the users throughout the whole learning session.
This agent will add the interactivity of the web site and make it less boring for the users
to learn the subject.

4.8.3 Flexibility

The application should have the capability to take advantage of new techniques and resource. Thus it can be implemented in changing environment. The modules within the system should be easy to manage. This will make the maintenance and enhancement works simpler and not time consuming.

4.8.4 Usability

This web package should be developed in such a way it is easy to use. Human interfaces need to be intuitive and consistent with other modules in the environment and within themselves. Furthermore, the web package should be able to guide the student to understand well about the lesson and performs as important references for examination.

4.9 Chapter Summary

System analysis is important to make sure what hardware and software are needed to develop this proposed system. Functional and non-functional requirement and determined at this chapter. Functional requirement shows what services the system will provide to the users once the system is under operation. The next chapter will discuss the design of the system.
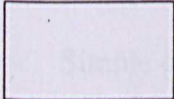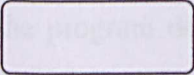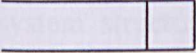
Chapter 5: SYSTEM DESIGN

5.1 Introduction

Design is the creative process of transforming the problem into a solution, the description of a solution is also called design (Pleeger, 1998).

A system model is a representation of an in-place or proposed system that describes the data flow throughout the structure. The model describes the points where data or information enters a system and the process where it will be processed, as well as the actions taken and the points where the data will be an output. Design diagrams include Data Flow Diagram (DFD), structured charts, decision trees and other items.

For Echem, Data Flow Diagram is used to represent the input and output of data and processes in the system. Data Flow Diagram shows how the data flow into the system, how they are transformed and how they leave the system. It also depicts the functios that transform the data flow. Table 5.1 shows Data Flow Diagram consists of four basic symbols

Table 5.1: Symbols for Data Flow Diagram

Symbols	Name	Description
	Entity	An external entity that can send data or receive data from the system. Interacts with the system but considered as outside of the boundaries of the system.
		Used to show the

		movement of data from an origin to a destination with the head of arrow pointing towards the destination.
——————▶	Flow of data	
▢	Process	It represents the transformation or processing of information within a system
▭	Data store	Shows a repository for data that allows addition or retrieval of data.

5.2 Designing for Echem

The design of Echem is based on all the information gathered which has been explained in chapter two, literature review. The content of the system is designed based on the requirements of the end users. The benefits and drawbacks of the existing systems are reviewed and taken into considerations when designing Echem. Basically these are characteristics of Echem.

- Simple and instructions are easy to understand.

- User friendly.

- Topics that important and according to the latest syllabus.

- Well organized.

Echem will be developed using Bahasa Melayu as the main language since the reference

books and examination questions are using this language. A pedagogical agent that acts

as the helping wizard will appear on every site to guide and assist and users.

5.3 Program Design

In the program design, there will be presented structured chart, context diagram, data

flow diagram, and entity relationship diagram and interface design.

5.3.1 Structured Chart

The system structure is based on the functionality modules. It is a graphical model

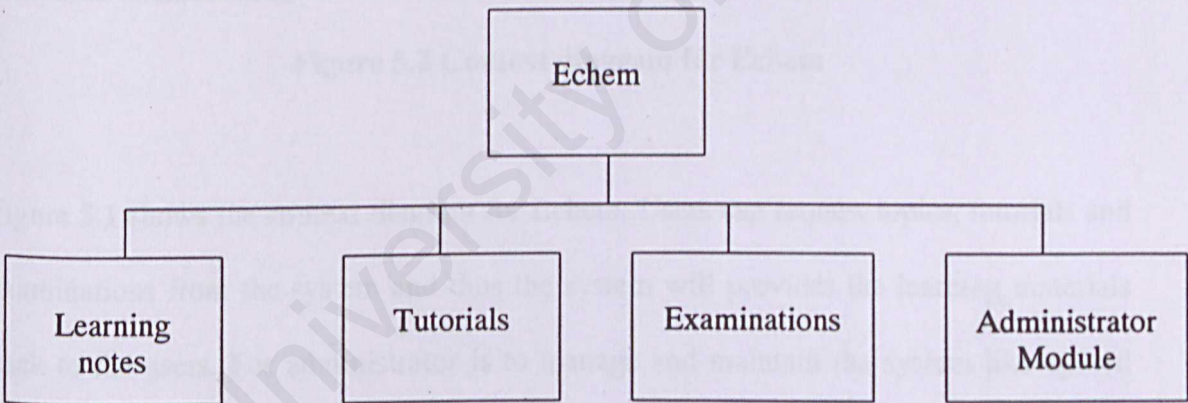showing the hierarchy of program modules in a structured design.

Figure 5.1 Structured Charts for Echem

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5.3.2 Context Diagram

Context diagram is an overview, which includes basic inputs, the general system and the

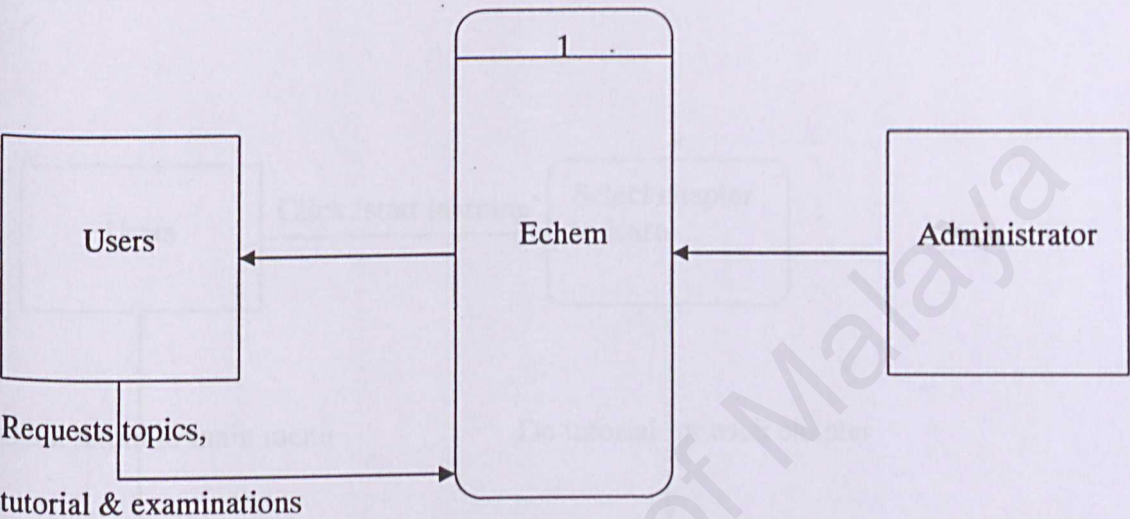outputs. This diagram helps the systems analyst grasp basic data movement.

Figure 5.2 Context diagram for Echem

Figure 5.1 shows the context diagram for Echem. Users can request topics, tutorials and

examinations from the system and thus the system will provides the learning materials

back to the users. For administrator is to manage and maintain the system like upload

new learning materials to the system.

5.3.3 Data Flow Diagram

Data flow diagram is used to represent the input and output of data and processes in the system. Data flow diagram shows how the data flow into the system, how they are transformed and how they leave the system. It also depicts the functions that transform the data flow.
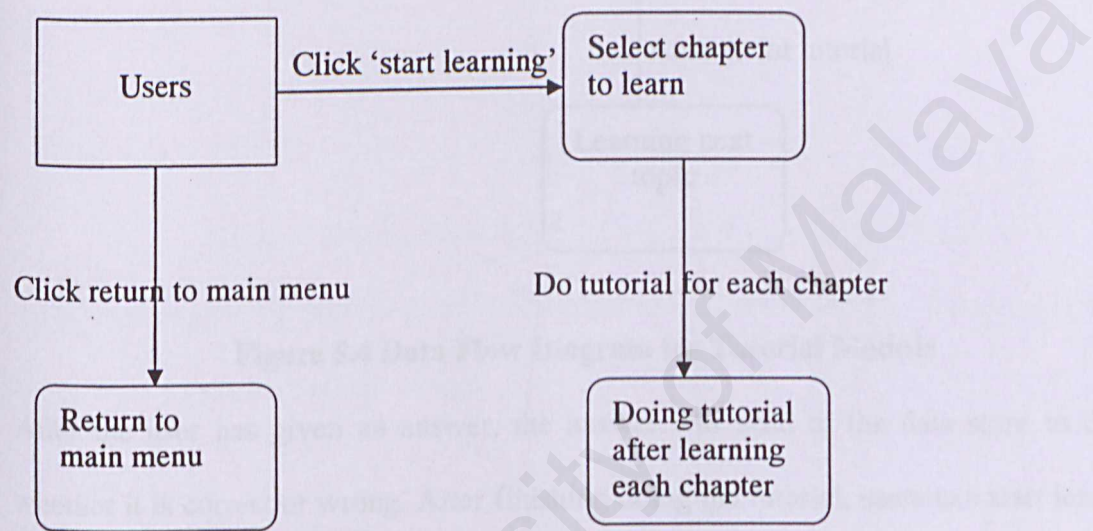
Figure 5.3 Data Flow Diagram for Learning Module

Users can select the topic they want to learn. After learning each chapter, users can try the tutorial questions. Then, users can click to return to the main menu.
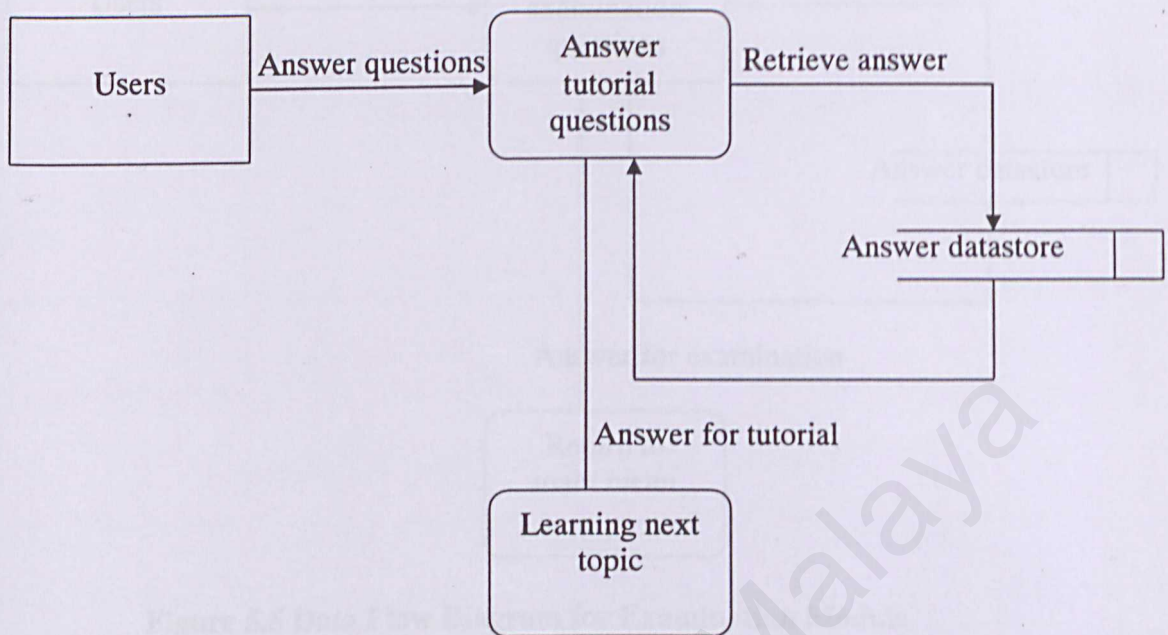
Figure 5.4 Data Flow Diagram for Tutorial Module

After the user has given an answer, the answer will send to the data store to check whether it is correct or wrong. After finishing doing the tutorial, users can start learning next topic.
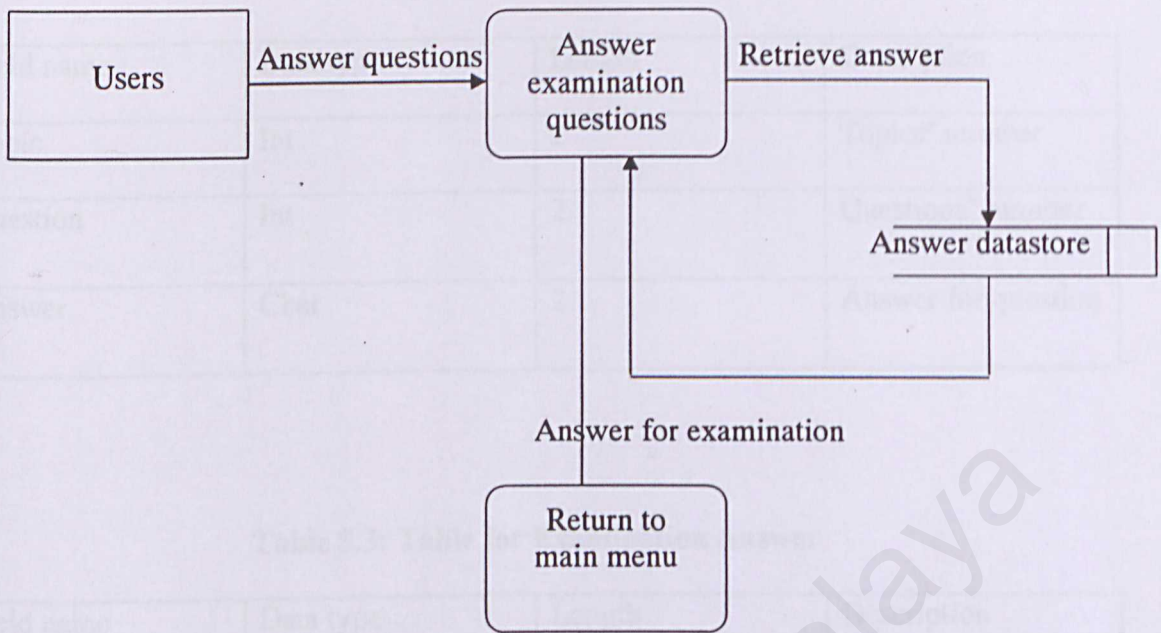
Figure 5.5 Data Flow Diagram for Examination Module

Answers that given by the users will be verified in the data store. Then it will send back to the users together with the results.

5.4 Database Design

Database is a large store of computerizes data. It keeps all the important data inside computer or server. The advantages of using database are:

- Easy of data storage

- Easy of data retrieval

- Save cost

- Save storage space

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Table 5.2: Table for Tutorial Answer

Field name	Data type	Length	Description
Topic	Int	2	Topics' number
Question	Int	2	Questions' number
Answer	Char	2	Answer for question

Table 5.3: Table for Examination Answer
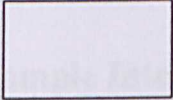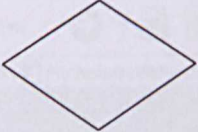
Field name	Data type	Length	Description
Set	Int	2	Set's number
Question	Int	2	Questions' number
Answer	Char	2	Answer for question

5.4.1 Entity Relational

Entity relationship (E-R) diagram are used to help model the database. It helps identifying the major entities in a database and the relationship among them. The following is the notation of E-R diagram.

Table 5.4: Notation of E-R Diagram

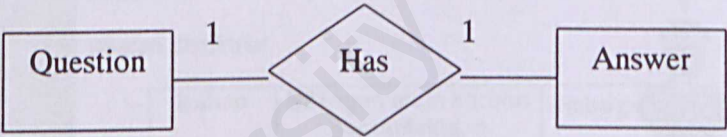| Symbol	Name	Description
	Entity	Any object or event about
	Relational	Relationships are association between entities

Figure 5.6: E-R diagram for questions' answer

- One question has one answer.

- One answer is for one question.

5.5 System Interface

5.5.1 What is interface?

The user interface is the front-end of the software. A software interface is the part of an application that the users see and interact with. It is related to, but not the same as the

underlying structure, architecture and code that marks the software works. The interface includes the screens, windows, controls, menus, metaphors, online help, documentation and training. Anything the user sees and interacts with is part of the interface. Well designed interfaces reduce errors, training time, cost and at the same time make people more productive.

5.5.2 Sample Interface

Figure 5.7 Sample Interface for Echem
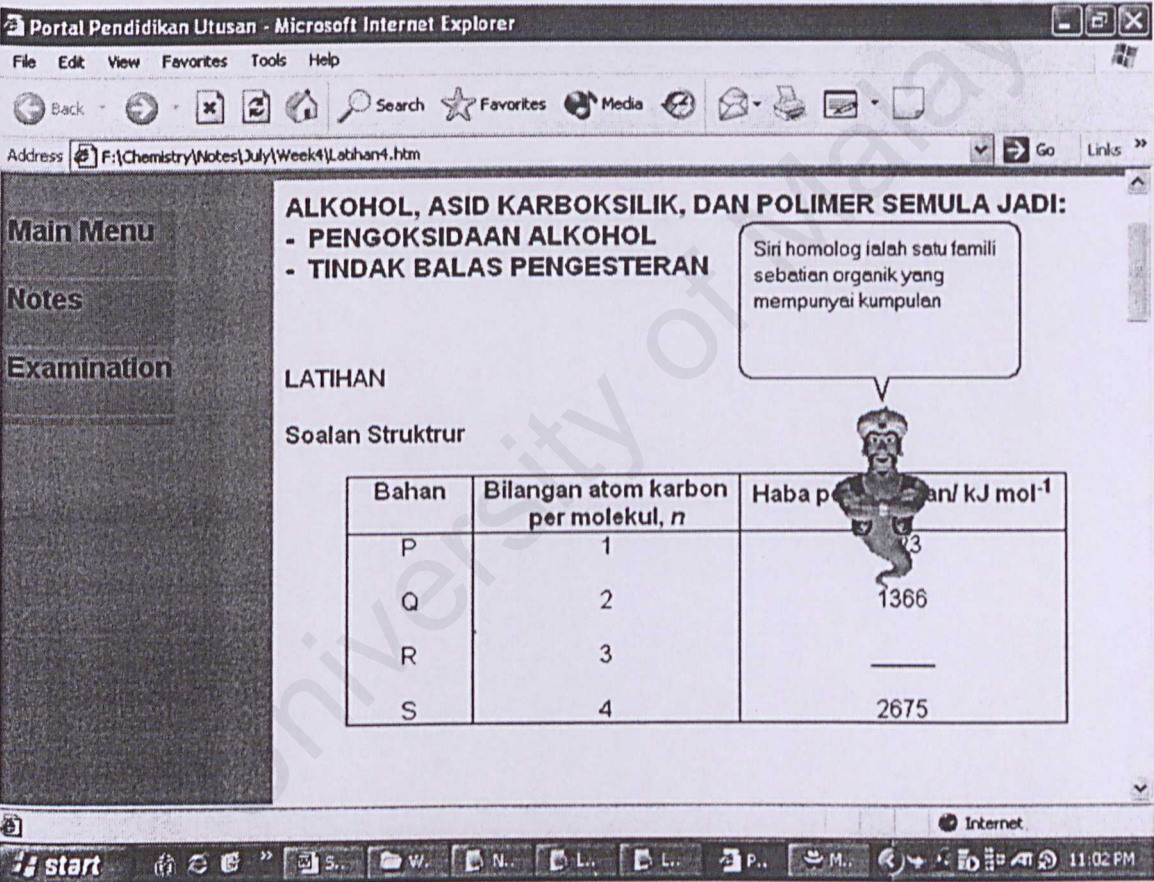
5.6 Chapter Summary

System design forms the fundamental architecture for a system. Structured chart, context diagram and data flow diagram have to be planned carefully before the system is implemented. Structured chart shows the module in the system. Context diagram shows all entity that will use the system. Data flow diagram shows the flow of data aming the related process

Chapter 6: SYSTEM IMPLEMENTATION

6.1 Introduction

System implementation is the construction of the system and the delivery of that system

into 'production'. System implementation includes building and testing the system,

which is also called the construction phase. Construction phase of the system involves

the conversion of the system requirements and designs into program codes. The primary

goal of this phase is the production of a simple, clear source code with internal

documentation that will ease the processes of verification, debugging, testing,

modification and further enhancements.

6.2 Developing Environment

Using suitable hardware and software will speed up the system development and it

performance. The hardware and software tools used to develop the entire system are as

follow:

6.2.1 Hardware Requirements

- Intel Pentium Processor 2.40 GHz

- 526MB of DDR RAM

- Seagate Hard Disk with capacity of 40GB

- Lexmark X75 Printer + Scanner

- Operating system – Windows 98 or above

- Screen resolution – 800 by 600 pixels

- Number of color on the screen – 256 and above

6.2.2 Operating System

Microsoft Windows XP Professional is used as the operating system during the development phase.

6.2.3 Web Server

Internet Information System (IIS) is used in this system, as it can be located from the Microsoft Windows XP

6.2.4 Program Coding

HTML is used in program coding as it is a commonly used standard language on the Web. VB.Net is used for the server side while for the client side the VB script is used. This is because the Dot Net Framework can support multiple scripts such as VB Script, Java Script and so. Java script is used for some client side scripting because a vast majority of browsers support it.

6.2.5 Browser

Echem is best viewed with the Internet Explorer version 5.0 or later version.

6.2.6 Upload Tool

Echem is uploaded into the local host that resides in the IIS server. This is because its configuration is much easier if compare to uploading the system into the World Wide Web.

6.3 Program Coding

Program development is the process of creating the programs needed to satisfy an information system's processing requirements, which involves program coding. Coding the program is the process of writing program instructions that will implement the program design specifications. Microsoft Visual Studio .Net is used in the coding process.

Coding is the process of writing the program instructions that implement the program design. Design specification must be translated into a machine-readable format. The program must be written carefully to meet the specifications stated before.

6.4 Coding Principles

Coding is a process that translates a detail design representations of software into a programming language realization. Notes that the coding section just involving the build of interactive application part and for creating a web page, which is implemented by using the DOT NET framework. The following coding principles were applied during the implementation of Echem:

- Coding conventions

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Coding conventions such as program labeling, naming conventions, comments and indentation should be adhered to.

- Readability

    Codes should be easy to understand. Adherence to coding conventions such as naming conventions and indentation contribute to program readability.

- Maintainability

    Codes should be easily revised or corrected. To facilitate maintenance, code should be readable, modular and as general as possible.

- Robustness

    The codes should be able to handle cases of user error by responding appropriately, perhaps with a diagnostic error, message and system failure shouldn't result.

6.5 Coding

The design of the system must be translated into a form that can be understood or run by the machine. The code generation steps perform this task. ITS interactive modules were written using ASP.Net framework.

6.6 Development of ITS Interactive Module

ITS interactive module follows a modular design partitioning. The system is divided into

modules is a simple part with self-contained functions and interface, so that the complete

design of the system can be accomplished by:

- Designing a set of modules
- Specifying how modules communicate with each other

This approach makes both the design and implementing easy and efficient.

6.6.1 Client Side Code

Below is the code needed to call the Microsoft Agent, Merlin into Echem.

```
<OBJECT id="AgentControl" codeBase="#VERSION=2,0,0,0" height="0" width="0" classid="CLSID:D45FD31B-5C6E-11D1-
9EC1-00C04FD7081F" VIEWASTEXT>
</OBJECT>
<OBJECT id="L&amp;HTruVoice" codeBase="#VERSION=6,0,0,0" height="0" width="0" data="data:application/x-
oleobject;base64,boTyuDbO0BGsgwDAT9I1dQADAAAAAAAAAAAAAA=="
classid="CLSID:B8F2846E-CE36-11D0-AC83-00C04FD97575" VIEWASTEXT>
</OBJECT>
```

The following code used to determine if the character, Merlin is installed in the client

computer or not.

```
Sub AgentMain()
    On Error Resume Next

    If Not AgentInstalled() Then
        Exit Sub
    End If

    AgentControl.Connected = True
```

```
MerlinLoaded = LoadLocalAgent(MerlinID, MerlinACS)


If Not MerlinLoaded Then

        MerlinLoaded = LoadLocalAgent(MerlinID, "")

End If


If MerlinLoaded Then

    Call SetCharObj

End If


    Call CheckLoadStatus

End Sub
```

The following code is used to hide the character

```
Sub AgentControl_DblClick(ByVal CharacterID, ByVal Button, ByVal Shift, ByVal X, ByVal Y)

    On Error Resume Next

    Merlin.StopAll
    If Not MerlinID.HasOtherClients Then
      If Merlin.Visible Then
        Set HideReq = Merlin.Hide()
      Else
        AgentControl.Characters.Unload MerlinID
      End If
    End If
End Sub
```

The following code used to show the agent, Merlin.

```
Sub cmdButton_OnClick()
        on Error Resume Next
        Call InitAgentCommands
        Merlin.Show
End Sub
```

For the system to invoke the agent, the following VB script language is used.

```
<SCRIPT language="VBScript" event="onClick" for="cmdClickMe">
                    onClick=AgentIntro1()
</SCRIPT>
```

6.7 Module Implementation

6.7.1 Agent module

This module control the behaviors and teaching method of the Microsoft agent, Merlin. This module aims to provide assistance to the learners through out the learning session. Example, the Microsoft agent will check each answers that inputted by the learners.

6.7.2 Learning Module

The students will learn about chemistry concepts in the form of note regarding on each chapter the module is present. This module stores all the notes. There will a Microsoft agent that will assist the learner during the learning session. If the learners don't understand some particular subject, then they can request for another slides of notes which will be explained in another way can probably easier for them to understand. Tips and hints also provided by the agent through out the learning session.

6.7.3 Tutorial Module

The student can try to solve a tutorial set for each chapter to evaluate their understanding on that chapter. Each question has the assistance of the agent that will provide tips and hints to the learners.

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6.7.4 Administrator Module

Administrator can edit the web page, uploading the new notes and modify the agent behavior.

6.8 Chapter Summary

This chapter describes the approaches used in writing codes, scripts languages used to enhance the whole web pages system and algorithms used in implementing the system. The design of the algorithm is important to make sure a stable system to be developed and minimized the problems occur in future enhancement. Error checking is important as well to make sure that the system runs smoothly and without showing unnecessary error messages.

Chapter 7: SYSTEM TESTING

7.1 Introduction

Testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. Testing is a process of executing a program with the intent of finding an error. A program must be thoroughly tested to ensure it functions correctly before the program is started. Verification and validation can be obtained through testing process. The objectives of testing are as below:

- Testing is a process of executing a program with the intent of finding an error.
- A good test case is one that has a high probability of finding an undiscovered error.
- A successful test is one that uncovers an as yet undiscovered error.
- To ensure software reliability and quality.

7.2 Testing Techniques

Choosing an appropriate testing technique is important before testing is done. Each technique provides a mechanism that can help to ensure the completeness of testing and provide the highest like hood for uncovering errors in software (Pressman, 2001). Two main testing techniques are used namely the White Box Testing and the Black Box Testing.

7.2.1 White-Box Testing

White-Box Testing, also known as glass-box testing, is a testing technique which uses the control structure of the procedural design to derive test cases. By using this technique, the developer can ensure (Pressman, 2001):

- All independent paths within a module have been exercised at least once
- Exercise all logical decisions on their true and false sides.
- Execute all loops at their boundaries and within their operational bounds
- Exercise internal data structures to ensure their validity

The main purpose of this technique is to ensure that all detail and often-left unnoticed errors are taken care off. Furthermore, it also helps to ensure the developed system is operated according to the specifications stated earlier.

7.2.2 Black-Box Testing

Black-Box testing focuses on the functional requirements of the software. This testing technique also enables the software engineer to derive sets of input conditions that will fully exercise all functional requirements of the system. It is used to show that the software functions are operational concisely. The objectives of black-box testing are to uncover errors in:

- Incorrect or missing function
- Interface error
- Performance errors
- Initialization and termination errors (Pressman 2001)

Black-box testing is not an alternative to white-box technique. It complements white-box testing and is likely to uncover a different class of errors. Black-box testing usually to be applied during later stages of testing which is different from the white-box testing which is performed early in the testing process.

7.3 Types of Testing

The testing process is performed throughout the development of Echem. Testing strategies conducted are unit testing, integration testing and system testing. Unit testing is implemented by testing each program. Next, different modules are integrated together and tested in integration testing. Finally, the system test is conducted and this is a testing of the entire system in an attempt to exercise all processing situations.

Validation testing is done using various tests. Validation is accomplished by executing a real-life function. For example, under the unit testing, the testing of a single program, or unit of code by the developer of the unit, validates whether the software is perform as designed. (Perry 2000)

7.3.1 Unit testing

Unit testing focuses on the smallest unit of software design which is the software component or module (Pressman 2001). Unit testing tests individual components to ensure that they operate correctly. These components include functions and subroutines. Each component is tested independently without other system components.

The unit testing includes:

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- Testing the interface to ensure that the information flows properly into and out of the program unit.

- Testing all error handling paths.

- Make sure that all independent paths in a control structure are tested at least once.

i. **Unit testing case example on the tutorial questions**

Table 7.1: Testing on the tutorial module

Number	Test Procedure	Output/Error	Analysis
1	Insert an correct answer	Agent able to prompt out and give some speech	No error is detected
2	Insert an wrong answer	Agent able to prompt out and give some speech	No error is detected

ii. Testing on the Echem

Since Echem is a web based system, it has to test using internet explorer. Firstly, open an internet explorer browser, and then type the URL address on the browser. The required web page will emerge on the browser.

7.3.2 Performance Testing

System testing is a series of different tests whose main purpose is to fully exercise the computer-based system. Although each test has a different purpose, all work

to verify that system elements have been properly integrated and perform allocated functions. (Pressman 2001)

For this project, two types of system testing are used. There are function testing and performance testing.

I. Function testing

System testing begins with function testing. It is actually can be done before the entire system is constructed since we can test one function at a time. Function testing is based on the system functional requirements, so the test cases for function testing are developed from the requirements document. The tutorial module is being tested using this type of testing to determine whether the system performs as required.

II. Performance testing

The purpose of this testing is to test the run-time performance of software within the context of an integrated system. It requires both hardware and software instrumentation.

7.3.4 Acceptance Testing

Acceptance testing, or known as alpha testing is the final stage of testing. During this stage, the system is tested before being accepted by the user for operational use. Acceptance testing reveals errors and omissions in the system requirements definition because the acceptance testing involves testing from the user. During the acceptance testing, the functionality of the system is demonstrated to the user and the users may experience the systems handle on.

7.4 Summary

System testing is important to ensure that the system executes accurately to the specification and fulfil the users' requirements. The main objective of software testing is to uncover errors and it is considered a critical element of software quality assurance. Approaches taken to achieve the objective are unit, integrated and system testing. Each testing approach plays an important role in ensuring that the system works accurately, is complete and reliable.

Chapter 8: SYSTEM EVALUATION

8.1 Introduction

System evaluation is a process of evaluating the developed system to identify the system's strengths and limitation as well as future enhancements. It also enables the developer to evaluate the knowledge gained, problems encountered and solutions to problem encountered during the development of the system.

8.2 Problems encountered and their solutions

During the development of Echem, various problems were encountered. The following are some of the major problems faced and the approaches taken to solve them from the beginning through the end of the system development process.

8.2.1 Inexperience in using Programming Language

As VB.Net script is one of the language for ASP.Net, most of the coding is done using VB.Net. Since this programming language was not taught before as well as with no prior knowledge of the Dot Net Framework, to organize the structure and codes during the coding process was a difficult task. To overcome this problem, much time was spent in learning and grasping the new language. Besides that, surfing the Internet for related materials and reading the reference books were also some of the approaches taken to solve the problem. Discussions with course mates who are experienced in using the framework were a great help.

8.2.2 Difficulties in choosing a Programming Language and tools

There are many software tools available in the market for developing web-based systems and choosing a suitable tool was a critical process as the lack adequate knowledge of these languages. The web based programming language is different from the normal stand-alone language. However, since ASP.Net is the latest web developing tool so it has been chosen to develop Echem

8.2.3 Lack of Time

Due to lack of time, some specifications proposed before failed to be developed during the tune frame given. These functions are suggested in the enhancement part.

8.2.4 Difficulty in defining the terms 'intelligence'

Since this term intelligence is so wide and abstract in the A.I field, it is quite hard to apply this concept into the system. However, based on my opinion on the article that i have gathered, i still able to apply but not 100%.

8.3 System Strength

Followings are the features and strengths that can be found in Echem:

- **Web enabled**

    The system was based on the web technology. It was using the client-server approach that allowed processing load to be shared between the client and the server, thus reducing the burden on the server and allow it to provide better

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service. Since it is web-enabled, user can access it online easily without the need to install the stand-alone application.

- **Simplicity of user interface**

  The graphic interface design of the system was designed to let the users feel comfortable and easy-to-use. The GUI ensured user friendliness. Thus, the users should find it easy to use.

- **Scalability**

  Hardware and applications could be easily added to the existing system without influence the existing applications. This was because the system was not hardware-dependent.

- **Existing of the Microsoft agent**

  The emergence of the agent can help to navigate and providing useful information to the users on how to use the system effectively.

8.4 System Limitations

Due to time constraints and other factors, this system will no doubt contain some omissions or inaccuracies. In future, the system can be further improved and enhanced to increase its features and functions. Some limitations of Echem are as follows:

8.4.1 Needless to login to the system

Since Echem is a web based learning package, so no personal data is taken from the learners. Any one can use the system as long as they have connection to the

internet. However, login module is needed if any personal data is going to be taken from the users.

8.4.2 Browser limitations

Since some of the coding part in the client side is developed using VB Script, it means that it can only support Internet Explorer 5.0 or above but not Netscape communicator.

8.4.2 Limitation of Microsoft Agent

Since the Microsoft agent is a text to speech program, so it can't be used with the database. This means all the code that written inside the agent part will be hard coded and thus can't be update dynamically.

8.5 Future Enhancements

Future enhancement can be done to make the system more advance and easy to use. There are some suggestions for future enhancements that could extend after developed the system.

8.5.1 Extent the Ability of Browser

As stated Echem, requires Internet Explorer 4.0 or above for execution since some of the coding in the client side is written using VB Script and thus only support the Internet Explorer browser. In future, this system can be turned to fulfill other browser

requirements such as Netscape Navigator for execution. This is because Netscape has a sizeable share in the browser market besides Internet Explore and Netscape has a lot of users in the world.

8.5.2 Other Language Support

Future enhancement for this system will include other language support. Nowadays it only has 'Bahasa Malaysia' as the main language. This will enable information to be displayed in different languages such as English. This will broaden the usage of the system since some students like to study using the 'Bahasa Inggeris'.

8.5.3 Enhance the ability Microsoft agent

As mention earlier, the current agent can't process the text that inputted by the learner, so in the future it can be enhance using the Natural Language Processing (NLP). By doing so, then it is much easier to input the domain knowledge into the agent and the agent can act like other NLP machine such as Eliza.

8.6 Knowledge Gained

Through the development of Echem, much knowledge and experience was gained. From this project, a clearer picture of the requirements of an analyst programmer was gained. A successful programmer must be self-disciplined, self-independence, self-motivated and with an analytical mind who is able to manage and coordinate innumerable project resources, including other people such as communicate with the supervisor.

8.6.1 The importance of all phases in SDLC

System analysis is an important phase in the system development life cycle (SDLC). This phase captures user requirements and the goal of the system. If this phase is not defined accurately, it will cause faulty to the system development and later progress. With a complete and thorough system analysis, the system that is developed will fulfill all the requirements and achieve its goal.

8.6.2 Importance to follow the schedule

As already done in the first semester for the schedule, it is important to make sure that development phase is followed as already planed earlier. Else the system will not able to be completed in the desired date.

8.6.2 Development tools

After completing this system using the Dot Net Framework, I have a much deeper knowledge on using the VB.Net, VB Script and Java Script. This knowledge certainly helps me a lot when I start working in the future.

8.7 Review on goal

At the final stage of the project, the expectation and objective are been review.

8.7.1 Expectation achieved

Overall, the system had fulfilled the expectation as stated in the earlier chapter. The basic foundation of the system was designed and implemented. However, much can still be done on the enhancement part.

8.7.2 Objectives achieved

The system is a web based learning package, thus it can promote the online studying purpose to the Malaysia's students. Besides that, intelligence concept was applied to the system and the Microsoft agent is act as the assistant that will help the learners through out the learning process.

8.8 Conclusion

Overall, this system certainly fulfills and achieves the requirements and specifications as stated in the 3183 report. Intelligence Tutoring System is a multimedia web learning package that teaches the chemistry subject for the form five candidates. Hopefully the education department could put much research on the development of ITS because it certainly has better effect than the current traditional classroom.

A lot of research and studies was done during literature review in order to gain the information needed for the development of this project. The information gathered includes defining the terms of intelligence from various articles that I gathered. Besides that, the scope and the syllabus of the current chemistry also have been review.

Throughout the development of this system, a lot of knowledge was gained such as knowledge in setting up the IIS server, Internet technologies, and others. Programming in ASP, HTML, VBScript, JavaScript and Visual Basic proved to be a valuable

experience. The core of the ASP technology is the implementation of object-oriented technology. As such, the object-oriented programming skill has also improved.

So, after completely the system, I really have a wonderful experience. It gives me the much needed confidence when I really developing a system for my company in the future.

Appendix

Questionnaire on students from University of Malaya

Name:
School/ Faculty/ University:

1. Have you heard about Intelligent Tutoring System before?
   A-Yes
   B-No

2. Do you use internet to study before (e-learning)?
   A-Yes
   B-No

 *If yes, please specify the subject you learn:_____

5. If you don't understand on certain part of a subject, would you refer it to your teacher?
   A-Yes
   B-No

6. When you are using Microsoft Words and if you don't know how to user certain functions, would you refer it to the helping wizard (office assistant)?
   A-Yes
   B-No

* If no, please give the reasons
_____

Questionnaire on students from CRS

Name:
School:

1. Have you heard about e-learning (learning through internet) before?
   A-Yes
   B-No

2. Do you use internet to study before?
   A-Yes
   B-No

   *If yes, please specify the subject you learn: _____

3. Do you think chemistry form five is a difficult subject to learn and master?
   A-Yes
   B-No

   *If yes, please give some reasons:
   _____

4. Below is some topic for the chemistry, can you sort it out from the easier topic to the difficult topic according to your view?
   1-easy, 2-average, 3-hard, 4-harder, 5-difficult to learn and understand

   a. Elektrokimia ☐

   b. Asid, Bes dan Garam ☐

   c. Sebatian karbon ☐

   d. Tindak Balas Redoks ☐

   e. Termokimia ☐

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Domain study on ITS

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Existing system

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Echem - User Manual

List of Figures

Chapter 1: Introduction

This is the user manual that provide to the users to help navigate through the system, Echem. Every major function of Echem will be described in this manual.

Echem is a web based Intelligence Tutoring System (ITS) that teaches the subject of chemistry for the form five students. The major module of Echem consists of the agent module, learning module and tutoring module.

1.1 Hardware and software requirements

The requirements of this application are:

i. Hardware requirements

- ❏ 486DX/66 MHz or higher processor (Pentium or higher processor recommended)

- ❏ At least 64 MB of RAM for Windows 2000/ Windows NT.

- ❏ At least 1GB of available disk space.

- ❏ VGA 800x600 or higher-resolution screen supported by Microsoft Windows.

- ❏ A Keyboard, and a mouse or other suitable pointing device.

- ❏ Speaker.

- ❏ Modem

ii Software requirements

- ❏ Windows 98/ME/2000/XPoperating system

- ❏ Internet Explorer 5.0 as web browser to view the web page.

The suitability of the tools being selected is solely based on the compatibility issues being taken into consideration during the design phase. Hence, the selection of the tools is deemed the most suitable to run the system as a web based system.

Chapter 2: Getting Started

Before are some steps that should be performed by the users before they start using Echem to study:

1. Connection to the internet.
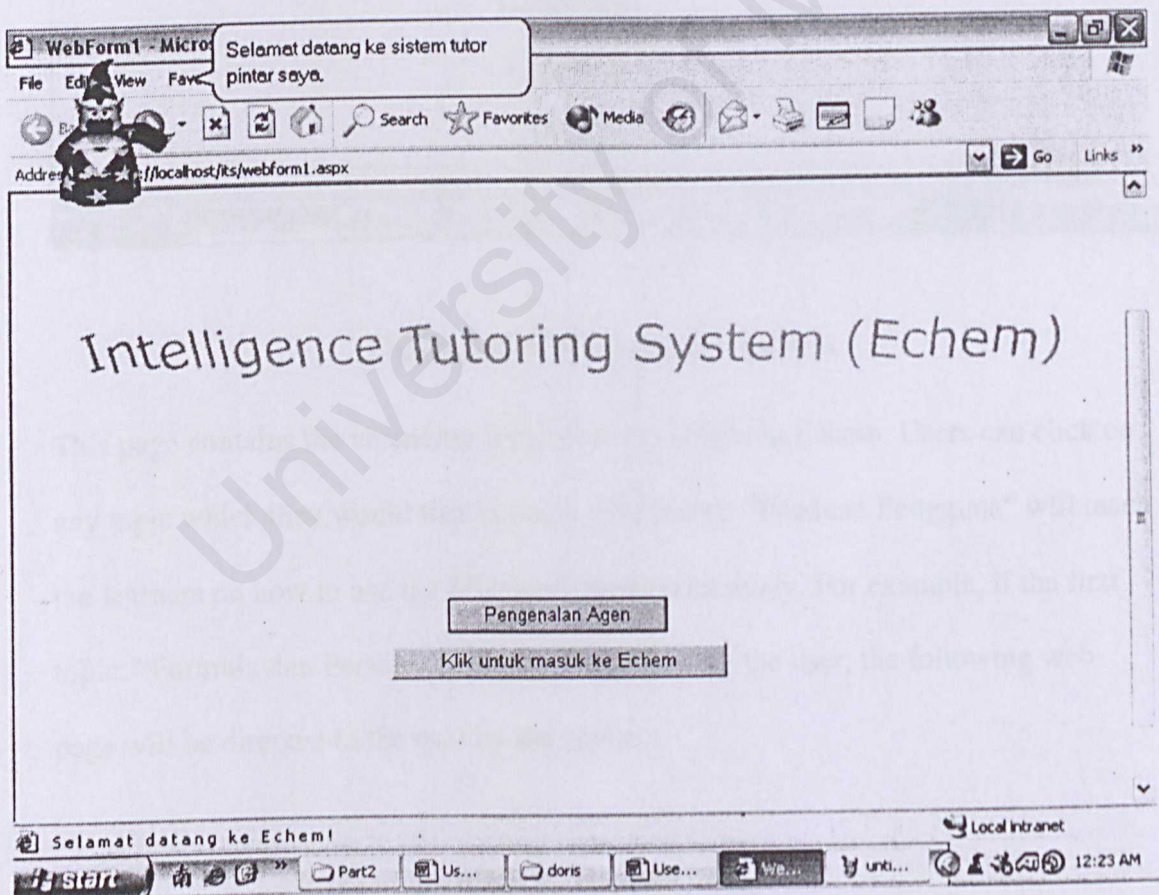
2. Insert the URL of Echem

3. The main page of Echem will be showed as follow:

Figure 2-1: Main page of Echem

From the main page, the users can start learning by clicking the button "Klik untuk masuk ke

Echem". The following screen shot shows the desired web page when the button is clicked.
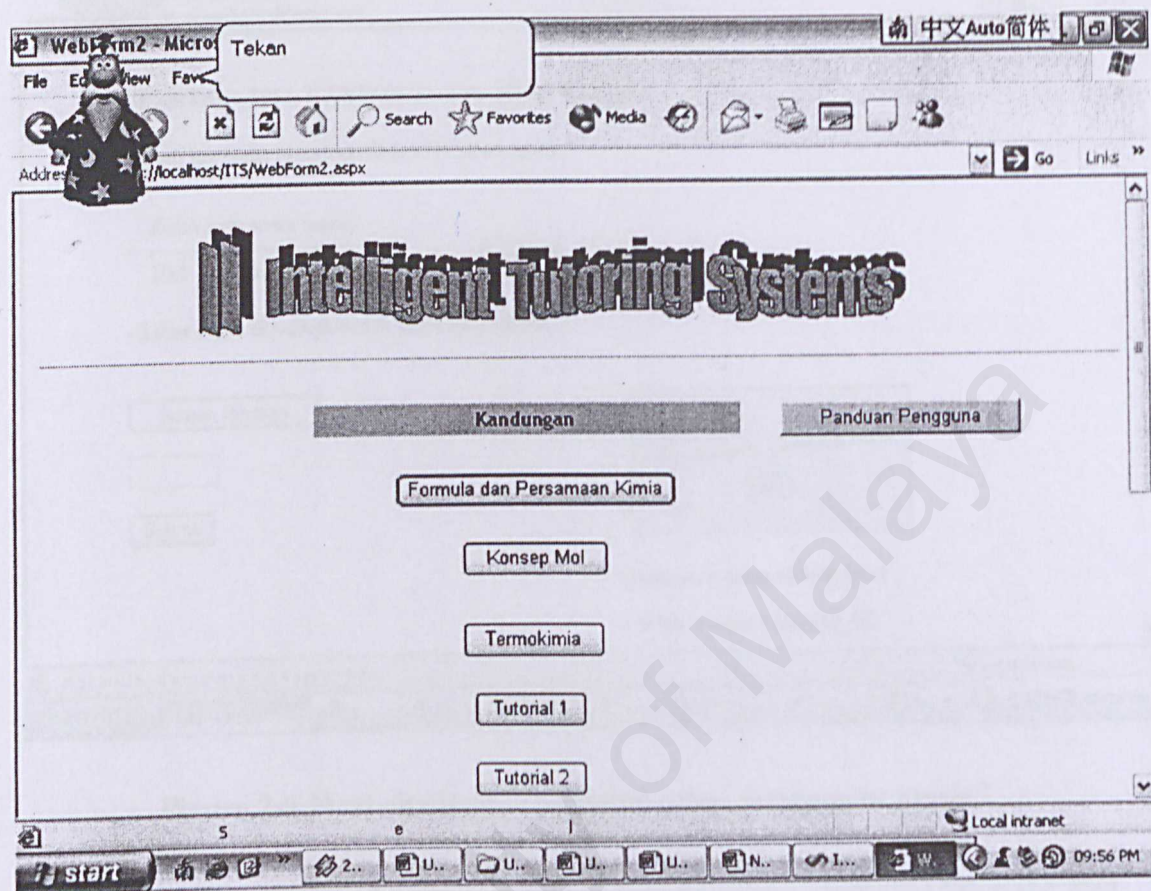

Figure 2-2 Content page of Echem

This page contains the chemistry topic that was taught in Echem. Users can click on

any topic which they would like to study. The button "Panduan Pengguna" will teach

the learners on how to use the Microsoft agent effectively. For example, if the first

topic, "Formula dan Persamaan Kimia" is clicked by the user, the following web

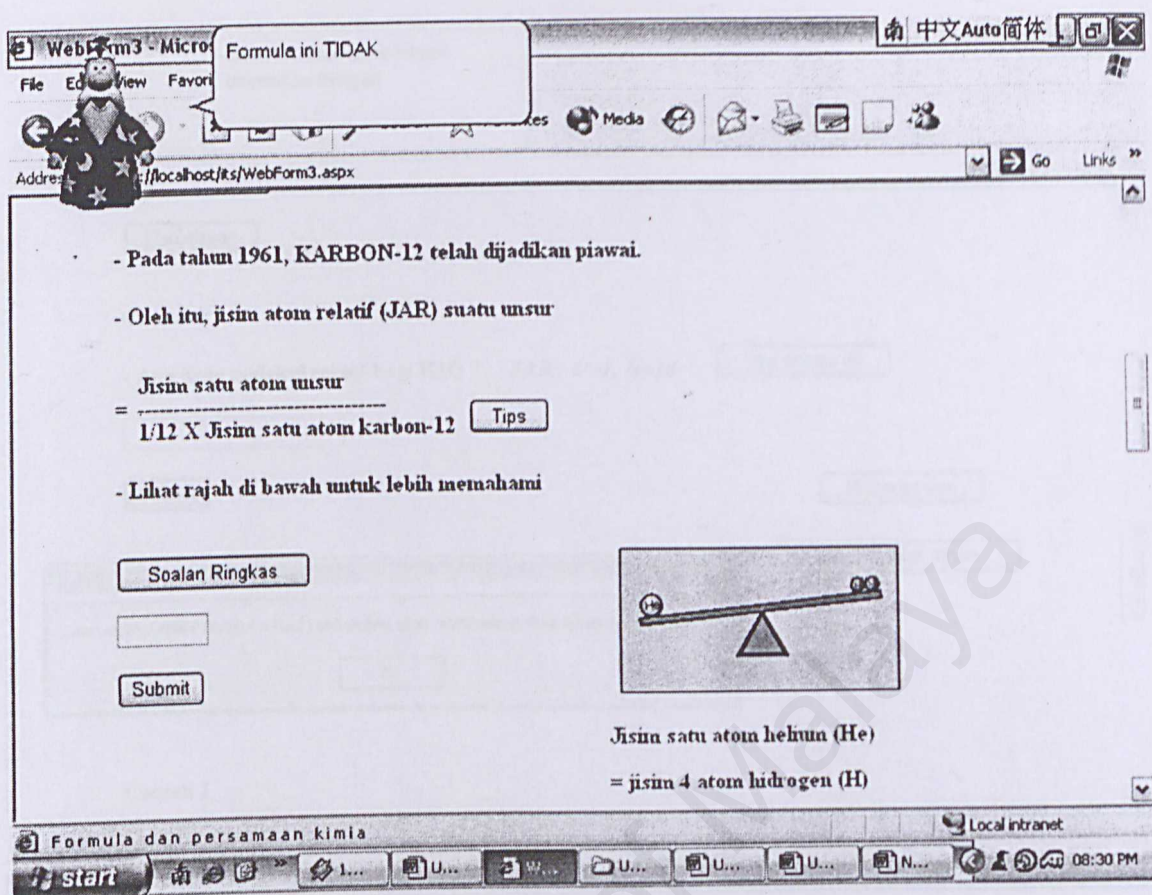page will be directed to the user by the agent.

Figure 2-3 First chapters – "Formula dan persamaan kimia"

The notes will be displayed using text based. The Microsoft agent will assist the user

along the learning process.

Following is the explanation on each of the button in this page.

Tips – the Microsoft agent will provide the addition tips to the user.

Soalan ringkas – the Microsoft agent will ask a question to the user.

Submit – user needs to press this button after insert the answer in the text box.

Below is the tutorial part for the same chapter when the user scrolls down the web
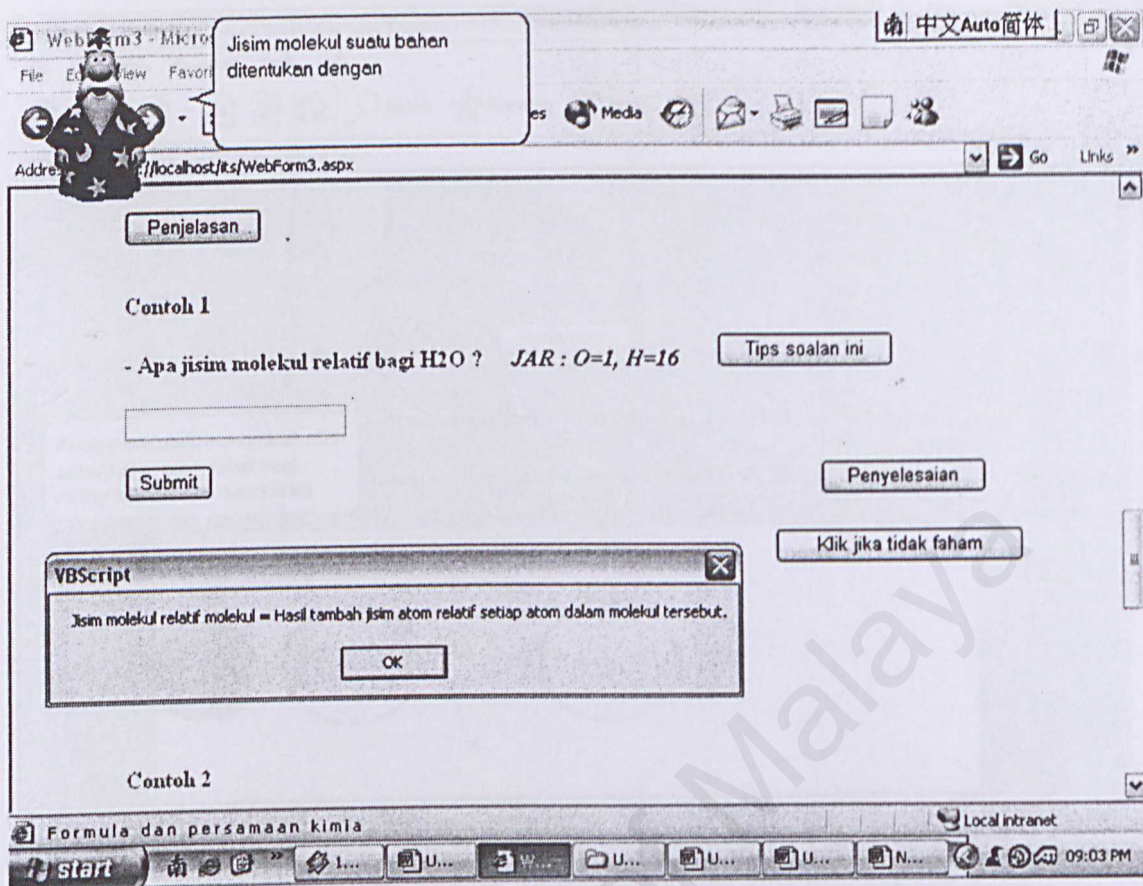
page.

Figure 2-4 Tutorial part for the first chapter "Formula dan persamaan kimia"

Following is the explanation on each of the button for this part.

Tips soalan ini – a message box will be prompted out to provide the formula to the user.

Penyelesaian – take the user to the solution page of the question. If the user clicks it before input any answer then the agent will prompt out to ask the user to insert an answer. Figure 2-5 shows this page.

Klik jika tidak faham – the agent will take the user to the page where further explanation to the user when they don't understand the question. Figure 2-6 shows this page.
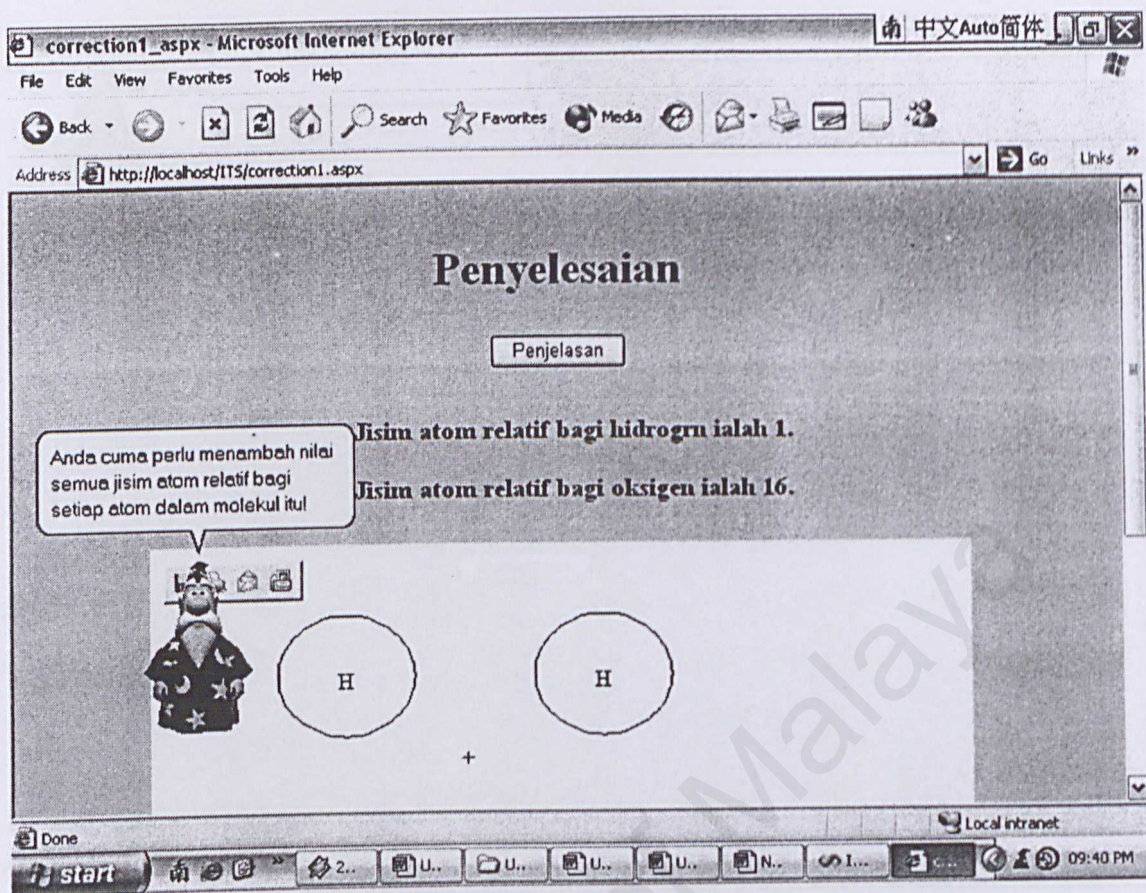
5

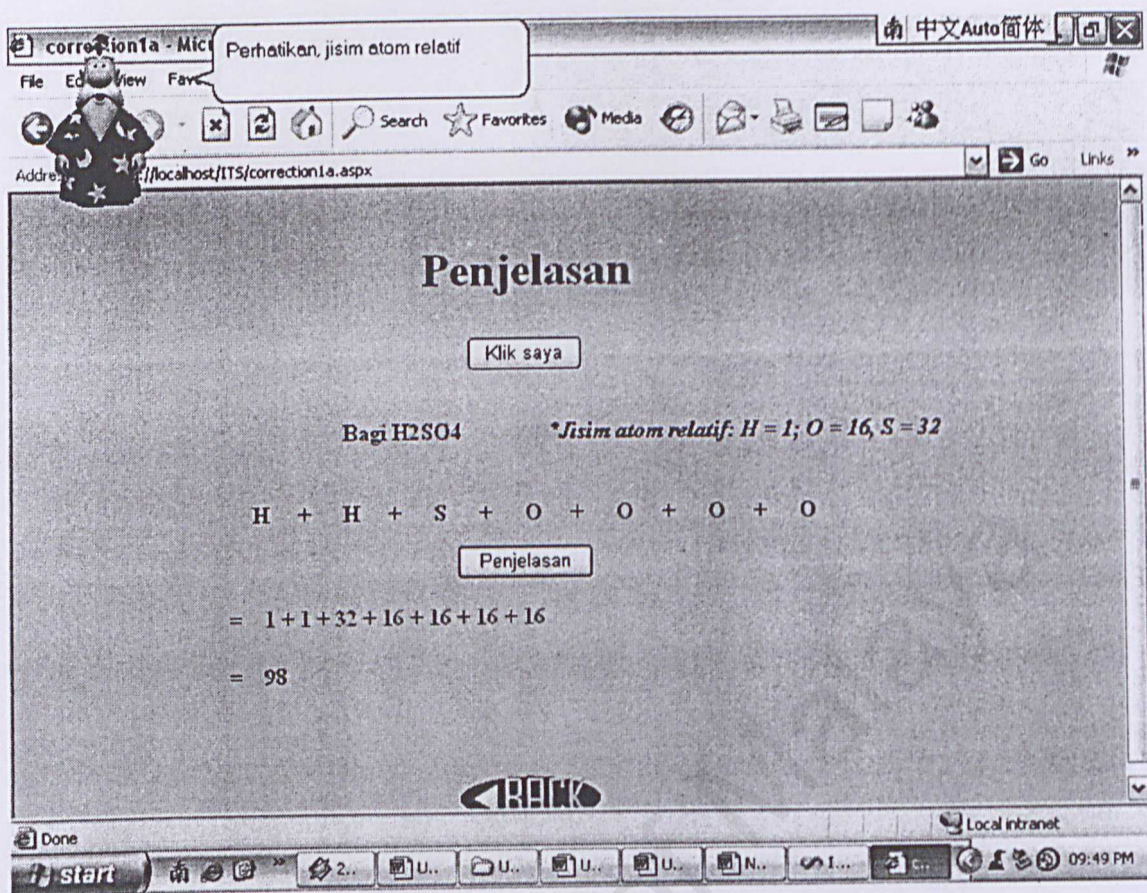**Figure 2-5 First chapters – Button "Penyelesaian" is clicked**

After the button "Bijak" is clicked, user will go back to the previous page which is the chapter "Penentuan Rumus Kimia".

After finish learning in first chapter, user can go back to the student page to select the second chapter they would like to learn. For example, if chapter 2, "Konsep" was the subject, the following page will be displayed to them.

Figure 2-6 First chapters – "Klik jika tidak faham"

After the button "Back" is clicked, it will go back to the previous page, which is chapter 1 "Persamaan Kimia dan Mol".

After finish learning the first chapter, users can go back to the content page to select the second chapter that they would like to learn. For example, if chapter 2, "Konsep mol" is selected, the following page will be directed to them.
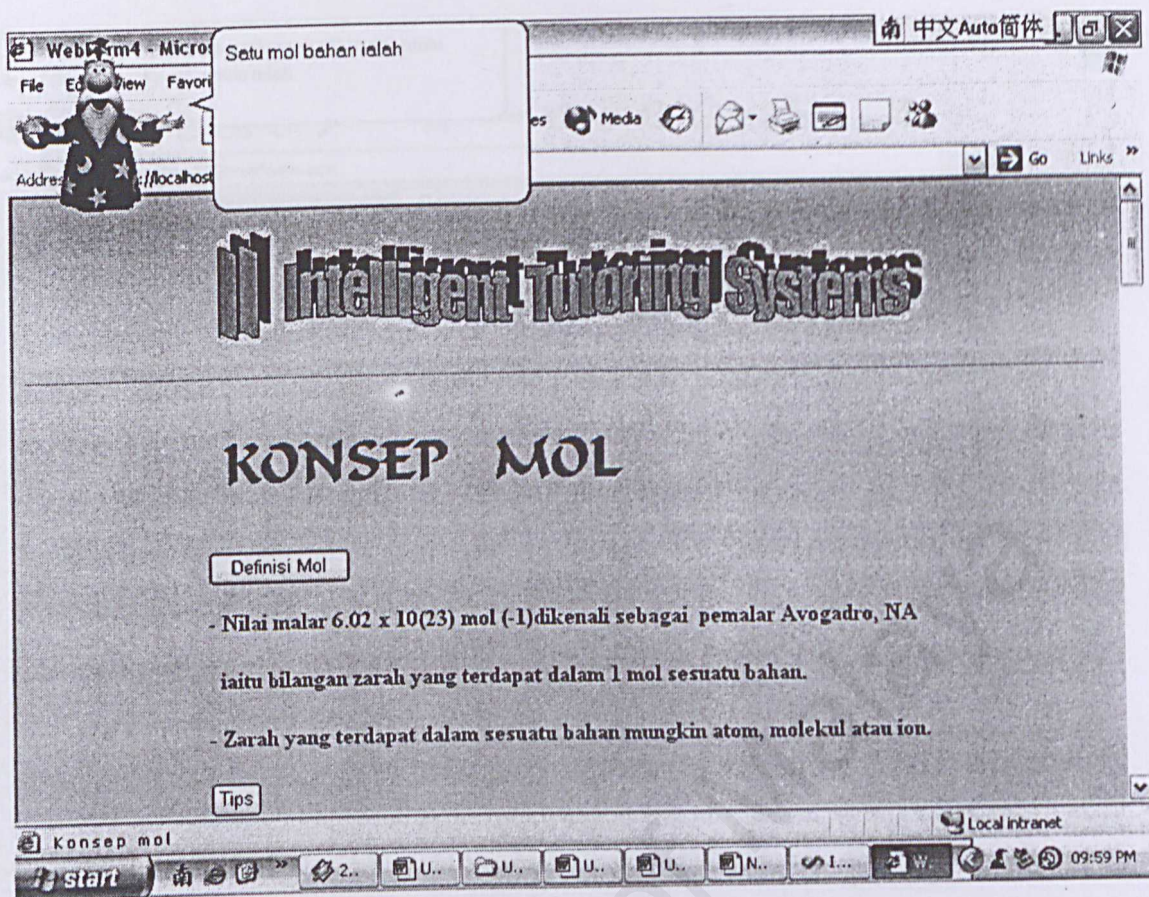
Figure 2-7 Second chapters – "Konsep mol"

As usual, the earlier part of the page will display all the notes in the text form. As the user scroll down the page the following part as shown in figure 2-8 will be shown.
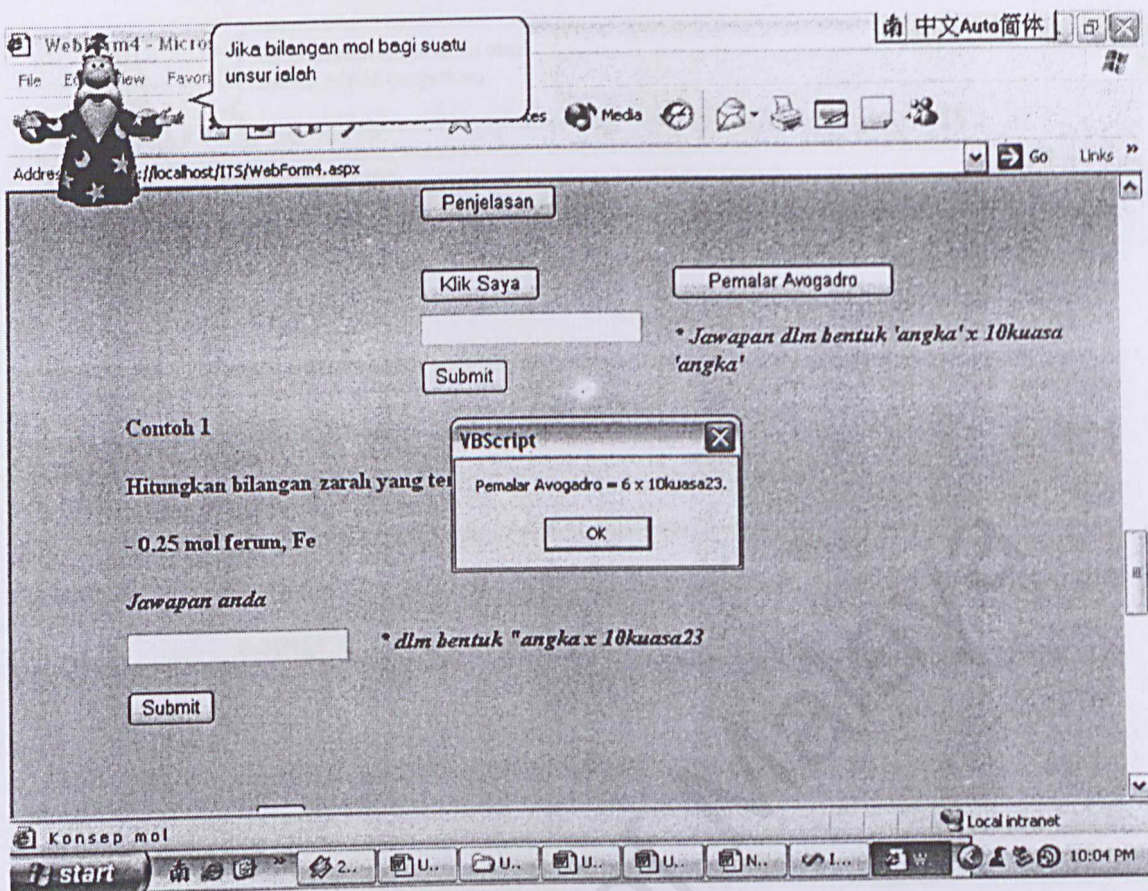
Figure 2-8 Tutorial part for the second chapter "Konsep mol"

The following explain the function of each button in this part.

Pemalar Avogadro – Display the value of pemalar Avogadro

Klik Saya – the Microsoft agent will pop out to ask the user a question.

Penjelasan – Explain to the user on what the question want from the users.

Submit – Users has to click it after they have entered a value in the text box.

Then, the users can go back to the content page and if they select the third topic to learn. The following web page will be directed to them.
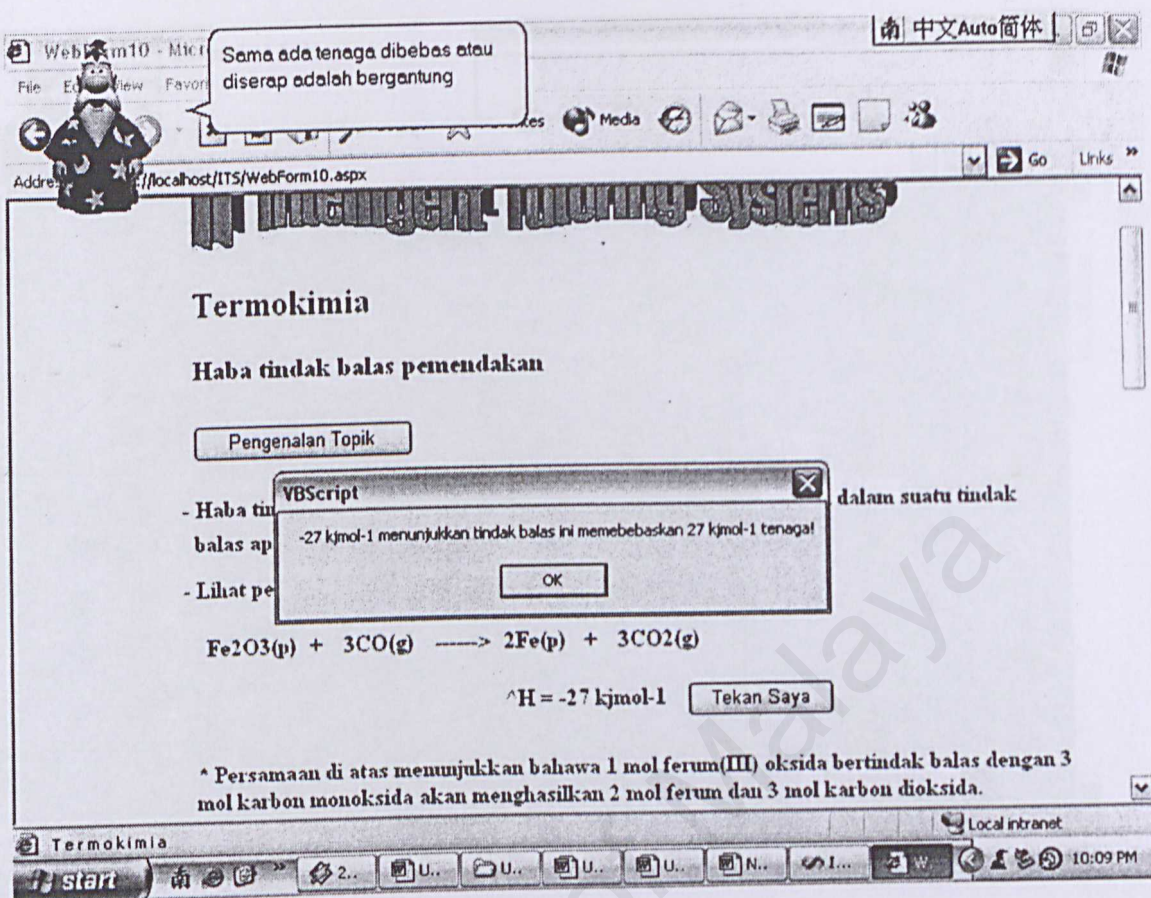
Figure 2-9 Third chapter – "Termokimia"

The following is the function of each button.

Pengenalan topic – the Microsoft agent will tell the user what is this topic about.

Tekan saya – the message box will provide the explanation to the user.

After learning all chapters, the users can click the "Tutorial 1" button to answer some

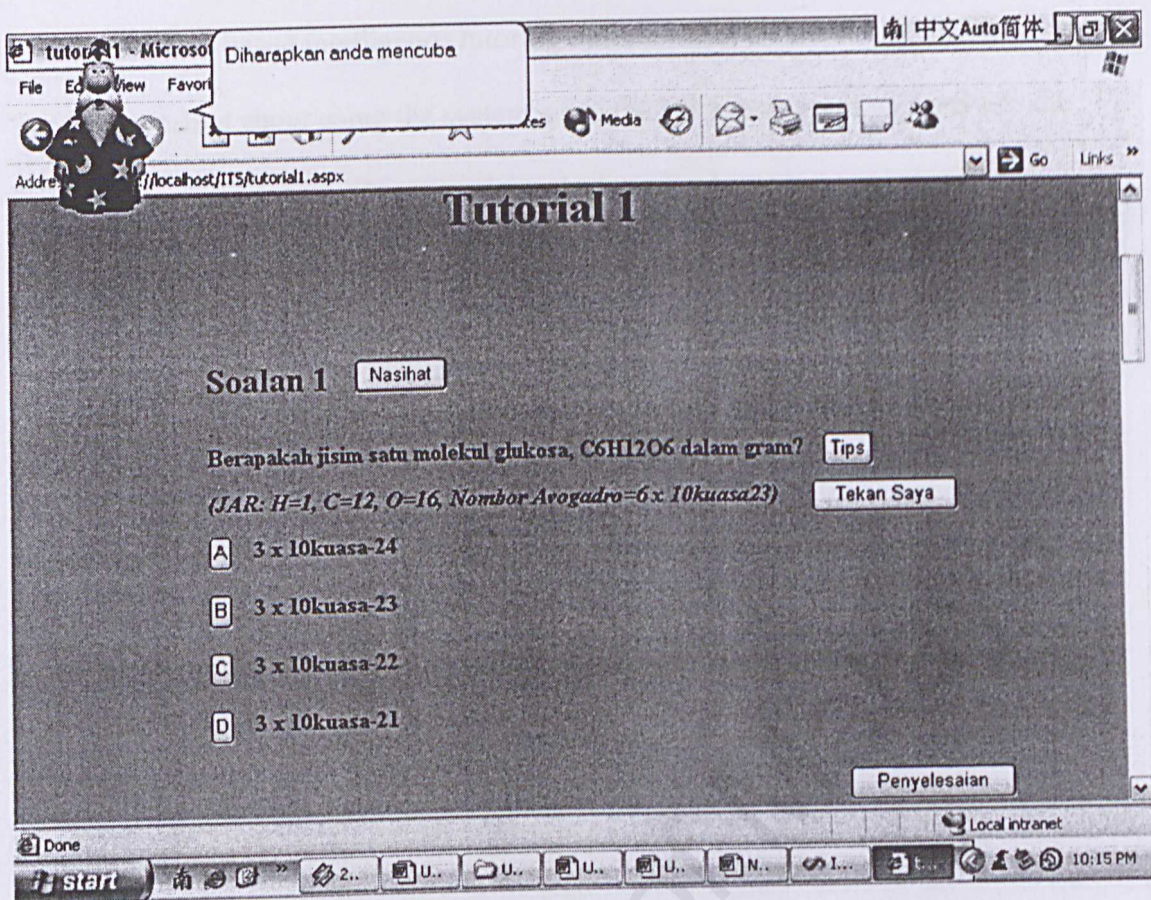question just as figure 2-10 shows.

Figure 2-10 Tutorial 1

The following will shows the function of this page.

Nasihat – the Microsoft agent will advice the students not to click the answer before

they try the question.

Tips – the necessary hints will be provided to the users.

Penyelesaian – answer of the question. The agent will make sure that the users answer

the question before they allow entering this page.

A, B, C, D – users need to click any one of the answer given.

Echem is a web based intelligence tutoring system using interactive agent. Thus the user need not worried about using the system since the Microsoft agent will provide the necessary assistance to the learners along the learning process.