

DESIGN AND DEVELOPMENT OF INTERACTION USER
INTERFACE PATTERNS FOR COMPUTER ASSISTED
INSTRUCTION ON TABLET-PC



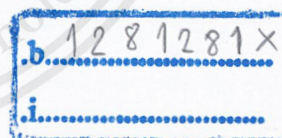
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A PROJECT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENT FOR THE DEGREE OF
BACHELOR OF SCIENCE PROGRAM IN INFORMATION TECHNOLOGY
FACULTY OF INFORMATION TECNOLOGY
KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG

2/2014

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ใบรับรองปริญญาโท ประจำปีการศึกษา 2557

คณะเทคโนโลยีสารสนเทศ

สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง

เรื่อง การออกแบบและพัฒนารูปแบบส่วนติดต่อกับผู้ใช้เชิงปฏิสัมพันธ์
สำหรับบทเรียนคอมพิวเตอร์ช่วยสอนบนแท็บเล็ต-พีซี

DESIGN AND DEVELOPMENT OF INTERACTION USER
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หัวข้อโครงการ	การออกแบบและพัฒนารูปแบบส่วนติดต่อกับผู้ใช้เชิงปฏิสัมพันธ์สำหรับ บทเรียนคอมพิวเตอร์ช่วยสอนบนแท็บเล็ต-พีซี
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บทคัดย่อ

ปัจจุบันแท็บเล็ต-พีซีได้นำมาใช้ในการศึกษา เพื่อเสริมสร้างการเรียนรู้ให้ผู้เรียนมากขึ้น ผู้จัดทำจึงได้เกิดความคิดในการนำเสนอแอปพลิเคชันบทเรียนคอมพิวเตอร์ช่วยสอนบนแท็บเล็ต-พีซี โดยเลือกเนื้อหาในวิชาเคมี เนื่องจากวิชาเคมีมีเนื้อหาที่ยากต่อความเข้าใจจึงทำให้ผู้เรียนเกิดความเบื่อหน่ายในการเรียน ดังนั้นจึงมีแนวคิดที่จะพัฒนาบทเรียนคอมพิวเตอร์ช่วยสอนให้มีความน่าสนใจ โดยเน้นการออกแบบส่วนติดต่อกับผู้ใช้ให้สอดคล้องกับเนื้อหาและเหมาะสมกับการใช้งาน บนพื้นฐานของหลักการการออกแบบส่วนติดต่อกับผู้ใช้ การออกแบบของการเรียนการสอน มีการนำรูปแบบปฏิสัมพันธ์มาช่วยในการออกแบบเพื่อสนับสนุนกระบวนการการเรียนรู้ให้มีประสิทธิภาพ และสร้างแรงจูงใจให้กับผู้เรียนมากยิ่งขึ้น รวมทั้งในส่วนของการประเมินได้นำหลักการประเมินความสามารถในการใช้งานมาใช้ในการวัดประสิทธิภาพของผู้เรียน จากการประเมินพบว่าผู้เรียนมีความพึงพอใจในการใช้งานและบทเรียนคอมพิวเตอร์ช่วยสอนช่วยเสริมสร้างแรงจูงใจในการเรียนมากยิ่งขึ้น

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ABSTRACT

Nowadays, Tablet-PC is used in education in order to enhance the effective of student's learning. We developed the user interface pattern for computer-assisted instruction on the Tablet-PC, and selected the Chemistry course as contents. This subject is a difficult for many learners and makes them feeling bored in the classroom because they do not understand the contents. We focus on the design of the user interface according to the content and the suitability for learner. The principles that we used consists of user interface design and the design of instruction, including the principles of interaction design to support the learning process to be more effective and motivating the learners. The part of evaluation, we used the principles of usability testing to test the satisfaction of the learner. The assessment found that the learners were satisfied to use the system for Chemistry learning, and CAI application has a good response and can motivate learners.

Acknowledgment

Our research achieved the objectives and done well by the assistance of many parties. First, we would like to thanks our advisor, Dr. Manop Phankokkruad for all advices and instructions. Thanks to our parents and siblings who always encourage us. Thanks to all teachers and friends at Faculty of Information Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, for the consultation and the encouragements. Our research cannot complete without all of these helps.

Ganaporn Thongmool
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Chapter 1

INTRODUCTION

1.1 Background

Current technology is growth rapidly. It can be seen from many schools and universities have adopted the new technology to help the study more effective. Meanwhile, the government has promoted the Tablet-PC to the students for using in learning process at schools. We realized the importance of education quality, and want to improve it by using Tablet-PC, thus we got the idea for the design and development of computer-assisted instruction. The study found that Computer Assisted Instruction (CAI) will be measured by the quality of the design and the content development, and the content must be accurate, attractive to use and easily to use for the users [1]. Most CAI developments are being developed on a web-based visualization system [2]. The technology is more advanced, we can develop the CAI on a portable device and the Tablet-PC that easy to carry and convenient to use because it can be accessed anywhere. When we applied CAI on Tablet-PC, it allows students to review lessons by themselves and also support distance learning. Furthermore, the interaction is important in the learning process. There are many types of interaction such as students with teachers, students with learning, learners with content and students with User Interface (UI). This research focused on the interaction between learner with UI, and learner with content. We have the interaction combined with design to enhance the learning process. We intend to study User Interface Design (UID) principles and requirements to develop a prototype of CAI on Tablet-PC. The students can interact with the computer via touch on screen, while the software design and UID is a based on human-centered and focused on human-computer interaction. The purpose of this research is to design appropriate UI for the content of Chemistry subject and determine the usability of CAI application on Tablet-PC.

1.2 Objectives

1. To study the type of content and the corresponding interaction.
2. To design the interactive User Interface for portable devices.
3. To develop Computer Assisted Instruction and Interaction Design for portable devices.

1.3 Scope

1. Design application of Computer Assisted Instruction for Tablet-PC

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2. Emphasize on interactive for Tablet-PC.
3. Design to attract the attention of students and motivation to learn.
4. Focus on human computer interaction and usability of pattern.
5. Content is stored in database format.
6. Select Chemistry course as a case study of CAI content.

1.4 Methodology

To study and develop of such systems for objective and thus determine the limits of operation are as follows

1. Gathering information on the needs of the system and information technology used in the study

- 1.1 Educational requests of users
- 1.2 Related system of the old system.
- 1.3 Study information about the CAI
- 1.4 Learn programming and database management systems.

2. Analysis and design

- 2.1 Analytical overview of the system and modify the internal components.
- 2.2 Overview of system analysis and consider modifying elements inside.
- 2.3 Database design.

3. Developing system

- 3.1 Design user interface to interact.
- 3.2 Develop of interaction design for portable device.

4. To evaluate and improve the system

- 4.1 Overall system is tested and ready to use.
- 4.2 Improve the system to be easy to use for users.

1.5 Expected outcome

1. Increase attention and motivate in the course.
2. Design user interface to interact with student effectively.
3. Interaction pattern helps students to understand the content better.
4. Students have access to the content, not necessarily that convenient to study it in the classroom.

Chapter 2

THEORY AND LITERATURE REVIEW

In this chapter, we present the theory and literature review. We describe the various theories including ISD, UID, Usability Testing and Interaction design, which adopted the design principles to design suitable CAI Chemistry contents on the Tablet-PC. The tools that we used in the development such as Microsoft Visual Studio, Blend for Visual Studio including C # language, Database MySQL and HTML with CSS. Thus we need to study the basic theory and tools in order to be a guideline for the appropriate implementation and easier to develop that will be discussed in the next chapter.

2.1 Computer Assisted Instruction

Currently, technology is being involved in all aspects of our daily life. The policy of the government that aimed to promoted the study that beyond the classroom. CAI is the new technology that uses computer as a medium tool for the presentation instead of teachers in teaching process, which students would be able to learn by themselves.

Nowadays, multimedia presentation helps to increase the learner attractions and encourages the interaction learning with the computer, which including the student understanding assessment that can be done anytime.



(a)

(b)

Figure 2.1: Example of CAI in high school (a) and primary school (b) [3]

Figure 2.1 shows the examples of CAI in English and science subjects that has varies designed. Usually, the application has developed on the website called WBI for support individual learning and comfortably assessment.

2.1.1 Classification of CAI

CAI can be used for the teaching in many forms depend on the purpose of design lessons that want to present the contents. The use of computers to assist in the teaching is divided into two cases. First is a computer assisted teaching, it is the exchange information between teachers via computers. The second is computer assisted learning, which is the interaction between learners and the computer that was used as a tool to presents the contents to the learners, whether they are new or review lessons. The contents are according to requirements of the designer. Typically the CAI development for teaching can be done in various forms that were described below.

1. Tutorials: Program that offers content in various forms, when the students answer the questions. If students answer correctly, the student will learn in the next chapter, but if it is incorrect answer the chapter will be repeated until the answer is correct.
2. Drills and Practice: Exercises should be monitored (Follow up) for the purpose of in the next developing. The procedure and practice in order to enhance the performance of certain actions or skills to understand and the skills they need to enhance the effectiveness of student learning can be used for supplement the classroom or outside the classroom while teaching at any time to practice the skills in problems solving in mathematics, science and technical industry.
3. Simulation: A simulation of the real situation can helps the students study, practice their skills, and learn without risk or cost. It is knowledge contents for students to participate, interact with the happening in the encountered situation.
4. Instructional Games: Bring the games into the lessons because of the sound, light and picture to help to motivate the students to interesting in the lesson and want to learn with their enthusiasm.

5. Discovery: To build the opportunity for the students to learn from their experience as much as possible by submitting problems and let the students try to solve them. The program will provide the information to help the students discover the clues until they find the best solution.
6. Problem-Solving: This is the idea to allow the students practice their decision by let them consider a set of criteria. The criteria in Problem-Solving can be divided into two types, the program allows the students to write their own answer and the program already has a part of answer to help learner solve the problems. Thus, the computer will helps the learners to figure out the problem and find the correct answer.
7. Testing: Computer programs for testing does not only use to improve the quality of the tests or only use for student knowledge measurements, but it also gives teachers a sense of freedom from the binding regulations on testing as well.

Accordingly, we developed the CAI for the students that used classification principles and contents design to create appropriated contents for the lesson. This method helps students to review the lesson even they are outside the classroom, in order to test their knowledge according to the studying. The CAI compose with the design that useful for knowledge testing such as quiz or finding the best solution, and also including the student assessment after testing.

2.2 Windows 8 Application

The new features of Windows 8 focus on a portable device and improve the user interface for a simplicity of usage. Especially, these changes included Metro design language. There are updated application of all time with live tiles and integrated anti-virus program. The applications access was done easily with Live Tile to choose the program immediately. The difference comparison details between Tablet-PC and mouse as shows in the following table 2.1:

TABLE 2.1: Common Windows 8 Touch Gestures

ACTION	TABLET	PC/MOUSE
Display the Charm Bar.	Swipe your finger from the right to the center of a screen.	The move to the top right corner of the screen.
List of all running applications, or switch to the application.	Swipe your finger from the left and then back	Move the mouse to the top left of the screen and then move the mouse down.
Show the next application, use Alt + Tab.	Move to the left side of the screen to the center.	Move the mouse to the top-left of the screen.
Close the running Windows Store application.	Drop from the top of the screen for Windows Store application to the bottom of the screen.	The mouse to the top side of the screen until you sees a hand to click and hold with a drag to the bottom of the screen.
Display additional application Menu or the context menu.	Scroll to the top of the screen or a little of the screen to view the applications that are running.	Right-click the mouse.
Perform a zoom operation	Move your fingers Bring together or spread apart.	Press Ctrl + mouse scroll roller.

This research used Windows 8 to develop CAI application for Tablet-PC. We focus on Metro Application which is new interesting features that is a challenging of developer. From previously discussed, Live Tile is suit for use the program by the touch screen because the fingers can take it quickly.

2.3 Development Tools

Development tools are the program that relate to the CAI application design and development. We choose Microsoft Visual Studio and Blend for Visual Studio as our developing tools.

2.3.1 Microsoft Visual Studio

Microsoft Visual Studio is Microsoft's program to develop the Integrated Development Environment (IDE) which means a collection of every tools and features that necessary for developing applications, combined together in one place. Whether it is designed to run the code for functionality testing, find and fix errors, distribute the program, etc. This is a set of tools that have been developed to assist software applications developers to meet the challenge of creating innovative solutions. This tool can help the developers in a matter of problem solving and a complex of Smartphone web browser. Currently, Visual studio supports several programming languages such as VB.NET, C++, C#, including XML / XSLT, HTML / XHTML, JavaScript and CSS. This research used Microsoft Visual Studio and C# program for develop CAI application for Tablet-PC.

2.3.2 Blend for Visual Studio

Blend for Visual Studio is a set of tools for design including Visual Studio that can be used to build visually Windows Store apps by JavaScript, VB, C#, or VB, Blend includes a suite of XAML tools that help to work fast such as in control Creation, prototyping that have a relationship with the sample data by creating a new platform or share information with other applications. This tool can help in the design modification efficiency of XAML better and faster as following.

1. Design a custom layout: A custom designed using tools to help control and support functions.
2. Create and style controls: Design and create by using a drag and drop on the surface of the properties in the UI.

3. Create and edit control templates: Using a prototype tools for editing and creating prototypes based on a custom that can be recovered through the project by adding to the library so that it can be reused again.
4. Create and edit data templates: Create templates to define the information displayed.
5. Behavior to help increase interactivity: Added the ability to response on the screen and modify reasonably.
6. Edit XAML markup: Besides editing XAML by using the tools without code operates. It can be modified by changing the markup XAML so effectively, quickly and easily. This research used Blend for Visual Studio program for develop CAI application for Tablet-PC.

We used Microsoft visual studio with Blend for Visual studio to design the elements of the appearance CAI that are suitable for the learners based on the principles, and writing the code in order to work on the touch screen and perform in various formats such as user control for achieve a visual animation.

2.3.3 C# Programming Language

C# language is a programming language that suitable for beginners who are interested in computer programming. That was developed from C++ and object-oriented programming. Using Visual Studio is a tool that facilitates the development of a computer program. The advantages of the C# language are combined the various advantages of Java, C and C++ together as following:

Written in simple language, uncomplicated and simple. The Java language like C and C++ language.

1. A language that was built for the development of computer programs under the .NET Framework means the user can use the system hardware or Operating System.
2. A strong language because the language is to fix some bugs of the Java language C, C++ and C# language is a perfect model of object-oriented programming.

We use C# programming language which is used in the Visual Blend program to design and develop the application.

2.4 Chemistry

Chemistry is a branch of science that studies the composition, structure, properties and changes of matter. In the beginning the studies of elementary particles, atoms and molecules to initials basis in the transition to a more difficult with regard to various chemical reactions. Sometimes the chemistry is often known as a center of science, because there is a link of physics to biology. Generally, study Chemical properties of electrons in chemical reactions and energy in various forms such as oxidation reactions, the transformation of materials, polymers and chemical content.



Figure 2.2: Molecules of Salt [4]

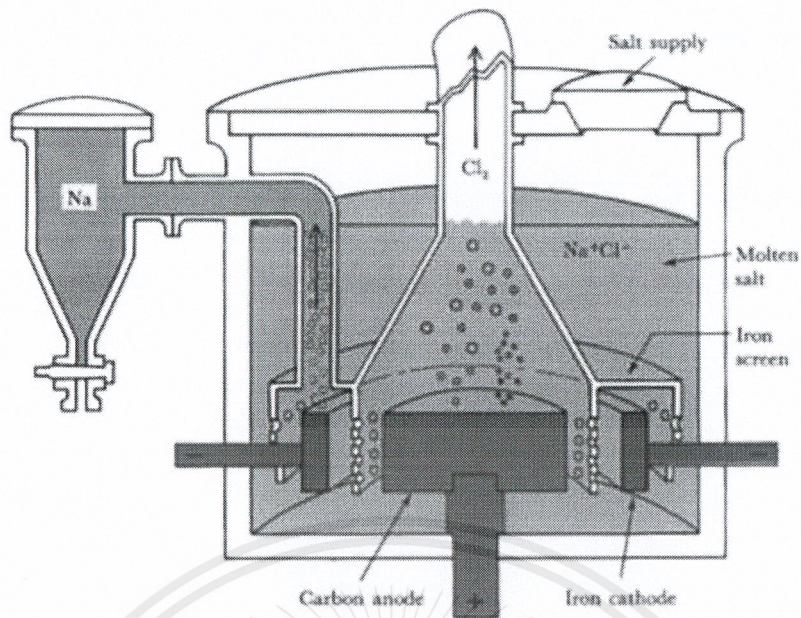


Figure 2.3: Example of Electrolysis of Experiment [4]

Figure 2.2 shows the catching molecules of salt that Sodium and Chloride surrounding each other. And figure 2.3 shows the example of electrolysis of the experiment. This trial separates the atom of sodium and chloride apart with the electricity. Sodium will run to the negative charge and Chloride would run for a positive charge. From the student interviews, we found the Chemistry is the most difficult subjects in science because the content is difficult to understand. So we selected the content of Chemistry to use as the lesson for the Computer Assisted Instruction.

2.5 Database

Database is a group of information that were collected with a mutual relationship, that users are able to access information to manage and update information easily, the research has brought MySQL with phpMyAdmin to manage data in the application which stated as following.

2.5.1 MySQL

MySQL is a Relational Database Management System (RDBMS) that uses a database to store, search, sort, and retrieve data. MySQL is a popular for using on Web Application that can provide multiple users to access data at the same time, quick and manage user to access data appropriately, safe and stable working for applied to all platform.

This research use MySQL for the collection and management of chemical content in various formats such as text, images or tables to be able to run displayed on the application easily.

2.5.2 phpMyAdmin

phpMyAdmin is coordinated interfaces with MySQL client that was used for a directly database management through a web browser and running on a MySQL database web server which has an ability to create a database, table or other function in order to retrieve the data using the SQL language, e.g. insert data into the database, manage the table, delete information in the database and modify the information in the database [5] that shown in figure 2.4

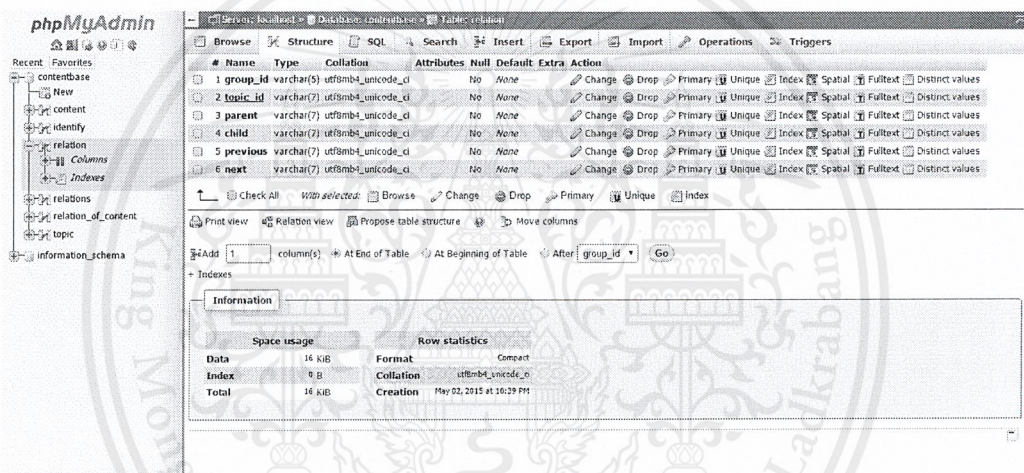


Figure 2.4: Example of phpMyAdmin

In this research, we used phpMyAdmin to help the collecting data in different segments in order to call in the form of table, figure and text. The design of the database that is the important for application smooth in the next step. Moreover, the changes of data can be solved by using a section of data without group_id complicate. This can help to work comfortably and saves more time.

2.5.3 HTML

HTML (Hypertext Markup Language) is a primary language that was used to write the Webpage Markup by using the tag to manage the control of display image, table or other objects form. In each of Tag, an attribute can be involved in the data management tag for more details. That can do this with a text editor program such as Notepad,

Notepad++ or used a special accommodate program tools for creating Webpage such a Dreamweaver and testing on a web browser [6]

2.5.4 CSS

CSS (Cascading Style Sheets) is the language that was used to define the format display that to be used with HTML. It is usually used for defining data structures, but CSS is used to format the output. For examples, the colorful characters, backgrounds, borders, spacing, etc., which can set the pattern that displayed in the same package. Thus, the modification or update the appearance can be done so easily and do not be modify in each the HTML tag [7].

We use HTML and CSS for creating a Webpage, which is used to determine the structure for the format of the content. And CSS to help decoration. To present the content in the form of tables and equations that are run by the database and CSS that helps to reduce HTML code and can edit content quickly. CSS can take the form Inline or Embedded. Inline is to write CSS code in Tag HTML.

2.6 Tablet-PC

Tablet-PC is a personal computer with a touch screen instead of mouse to operate and portable wireless by itself, as an internal system network. Size of screen about 5-10 inches. The different of features depending on model or price. This a smaller than notebook but bigger than smartphone.

At present, typically found tablet that the same slate style, like Amazon's Kindle Fire, Apple's iPad or Microsoft's Surface. Different type form of the Tablet-PC, following;

1. Convertible Tablet-PC: The screen can be rotated 180 degrees, folding screen up – down and a hardware keyboard or digital pen that can help in writing on the screen.
2. Hybrid Tablet-PC: Looks like a typical notebook but can be separated to just slate. Sometimes was called convertible Tablet-PC.
3. Rugged Tablet-PC: Designed to compatible with the bad environment. Making look durable and protection jolting great of the hard drives.
4. Slate Tablet-PC: The Tablet-PC are light weight and easy to carry, with just the screen and no keyboard [8]

Nowadays, Technology is progressing in the development of information technology for users to apply in the organization. The government has brought the Tablet-PC into education to enhance learning for students. We see the importance of education with the Tablet-PC. Therefore, we have chosen to develop CAI Application on Tablet-PC To help the student can access learning anywhere CAI application to which that can enhance learning with understanding and enjoying the application, which is different from the book because it is boring and incomprehensible.

2.7 Instructional System Design Principles

ISD is planning to manage the instruction systems. To achieve efficiency and effectiveness. The principle of student-centered in learning. The fundamental solution to help the students understand the lessons easily, According to 5 items.

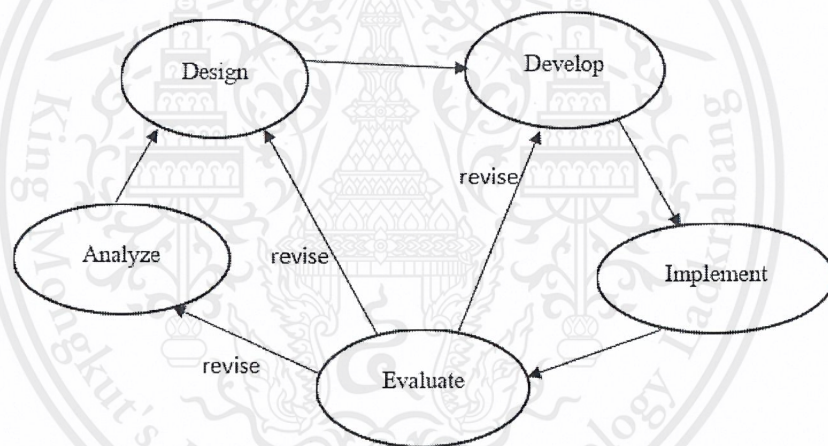


Figure 2.5: ISD Model

From the Figure 2.5, The ISD process is divided into 5 phases; analysis, design, developing, implementation and evaluation also known as ADDIE.

Firstly, an analysis phase studies the environment and describes the objectives. The design phase defines the learning objectives, and students need to learn. The development phase builds the products that were developed in the design phase. In an implementation phase, the content is developed and allows the instructional designer to examine all materials. Finally, an evaluation phase is to determine the performers and learning process achieved the desired results [9] [10].

2.8 User Interface Design Principles

User Interface Design is the design of the interface between humans and computer. Which gathers related information to the development process designed to work efficiently. Elements of the UI is shown in figure 2.6 which consists of hardware and software. Hardware is input and output devices. The software is the part of the software relate to the display and control or assign conditions to interact with the user.

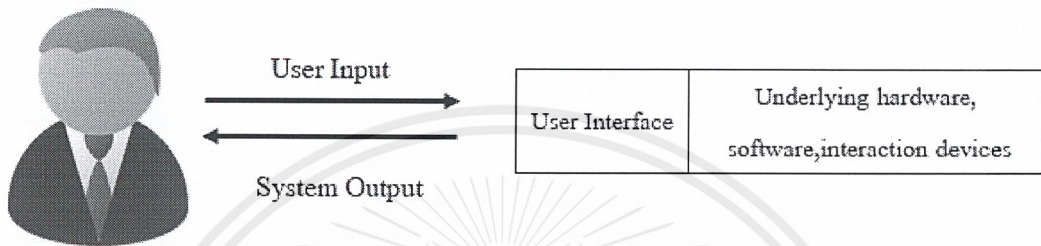


Figure 2.6: Interact between user and computer

With HCI principles to help in study and analysis of the interaction between humans and computers. So that the system can meet the needs of a better. There are several phases and processes in the user interface design [11]. UID processes are as following seven processes.

1. Requirements gathering: Gathers the requirements of the user to be working on the system to achieve the goals and potential.
2. Design in a graphic user interfaces: Designed by the sense that the actual shows on the GUI screen can be during the development period or from problems arising from used by the results of the tests.
3. Usability testing: The testing prototype in a real situation, by users, are shown in the between testing in order to guide the search for a program error and bring the program to develop a more complete.
4. User and task analysis: To collect additional data offside for help in the analysis of the educational potential, from the reaction of users and interviewed. Then be designed to assist in support the development of programs to achieve the goal.
5. Usability inspection: The evaluation checks the UI, usability testing and evaluation for the problem of the program. That is the analysis of the problems in designing UI and the instructions from those who have experienced the system.

6. Information architecture: Development of the process and planning to work the system.
7. Prototyping: Develop the prototype of wireframes, either design on paper or on a screen in order to show a different feelings.

This research, we select UID principles to focus on CAI application for Tablet-PC the following three steps are:

1. Select the instructional activity that supports cognitive processes of students.
2. Select the UI component of each the patterns.
3. Develop the UI patterns.

The purpose of the UID is to improve a quality of user interface design of CAI in a Tablet-PC. The principle includes a consistency, direct manipulation, feedback, metaphor, aesthetic integrity and use control [12]. Users can recognize working for application pattern, use it easily from the past experience and can touch directly on a screen instead of device control via the handle.

2.9 Usability

Usability is a measure of the ability to uses, may be a measurement of impression or experiences. The objective is to response satisfaction of users as much as possible and can be measured by following 5 items [13];

1. Learnability: Can be easy learning without relying on the manual to use.
2. Efficiency: Users can access easily. As quickly and accuracy.
3. Memorability: A simple remember operation contributes to the experience of using in the next time.
4. Errors: Error to a minimum as possible. Because all the development would be a mistake.
5. Satisfaction: Users were satisfied with the application. Happy when they return to work again.

Due to the development focuses on Tablet-PC, assessment is vary from the general usability evaluation, we specified the usability evaluation of CAI according to guidelines, which consist of ease of use, simplicity, navigation, visibility, textual information, and cognitive issue.

1. Ease of use: students easy to use the CAI without any instructional manual.

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2. Navigation: The CAI application should be clear and easy to understand.
3. Simplicity: the quality of application easy to understand or use, Visibility is all about how clearly the user sees the state of the interface and all the possible actions.
4. Textual information: CAI application must be decreasing text data and bring the media. Such as image, table in order to help stimulate teaching for the users to learn better.
5. Cognitive issue: the CAI application helps the user understand and remember content more easily than traditional classes.

2.10 Interaction Design

Interaction design is a design to interact with the environment and to develop software In order to display on the screen. By being created from images, audio or animation. Which can be divided into five stages dimensions, including [14]

1. One-dimension is a text, word or single character was designed to concise meaning.
2. Two-dimension is a show that visually, such as photographs or paintings in the form of diagrams or icons.
3. Three-dimension is the space that can allow users to access elements around the object. This is shown in the shapes. Able to provide more information than in 2D.
4. Four-dimension is a content with the change all the time under the time limit, such as audio, video or animation.
5. Five-dimension is to determine the behavioral interaction between the user and the screen interface.

This must be taken into account the principles of the three terms following.

1. Goal-oriented design: The most important in a priority with satisfaction and a requirement of the user, which a challenging due to must understand the concept of a user.
2. Personas: Design based on the user goals that were designed following the opinion of users.
3. Cognitive dimensions: Because there must understand a specialized vocabulary in order to bring a quality Analyzers of its design.

4. Affective interaction design: All the design of must consider the importance of design to affect the response in every sense, is it animation or icons to help users understand the communication. Including color and character to the effective recognition of the users.

We have adopted the principle in each dimension analyzed and designed to appropriate the content. In order to help better understanding of the lessons. The Design Analysis of the content in each dimension that was considered by the four steps to meet the target satisfaction, quality and efficiency of use for end-users even more.

2.11 Literature Review

2.11.1 Application of UID principles

Seraj and Chui [15] described to study user interface design principles and requirements of mobile devices as a tool for a purpose learning. Designed and developed prototype to learn with a user interface for a small screen and limited ability to use. Which a focus on the design of an appropriate device by using Adobe flash CS and Dijkstra Algorithm principle for the user interface is easy to use and interact. Support and encourage the student to interest in learning.

Donovan et al [16] described to design for a new energy model. The new step in the graphic design. The prediction of the possibility to recognize, check the alignment and segmentation hierarchy, optimized for a variety of screen design. The target is a bigger size or improve existing designs using automated tools to help improve the design for professional designers and Beginners designers.

Luo Dan [17] described Graphic is caused by the combination of technology and art. Which has analyzed the concept of the computer graphics design software. The purpose of the graphic design was planned from the edge of the surface, color, texture to the composition according to the idea and using computer graphics is to use the software in the design of computer-based graphic designer to design the creative. Which can be categorized into 4 categories: Image processing software, graphics software, Workgroup Edition software, and other related software.

2.11.2 Interaction patterns

Chieh et al [18] described to create a new design to a prototype to help install new media and interactive design. The development of web-based visualization systems has to share experiences and communicate with specialists in other fields. During the design of web 2.0 the adapting to allow users to share their design on the phone. At the same time, it can be used to design interactive tools to become as easy, can develop by themselves and have a prototype tools language for a perfect interactive.

Ye and Chen [19] described Adopting Cloud be used for solutions E-learning to work together and support learning to be suitable for learning. Designed E-learning system with the content in the field of architectural integration of the campus network. And the service of high quality by focusing on cloud with the content formal and informal, to help the students' ability to learn by themselves as effectively as the main objective of e-learning for learning support knowledge sharing throughout life.

Yonghe et al [20] described the model works by the technical analysis of the discussion, the aim is to design and develop tools that automate the process of monitoring is to learn to work together. By design, it brings the assumptions relating to sources of data and processes to make the content analysis.

2.11.3 CAI and E-learning

Kiatruangkrai et al [21] described with the design and development Content for E-commerce that has the ability to communicate by sending instant messages. Which developed using HTML CSS and PHP language with Ajax is by the development of the front and back. It is necessary to focus on the use of the administrator to use drag and drop or the common intended for those purchases.

Chien Chou [22] described with communication from the perspective of teaching. Computer-based media for distance-education by focusing on the use of more convenient. Including the performance of interactive functionality to be used for measurement and evaluation the instruction for promoting a better understanding of the interaction model designed instructional.

Chapter 3

Analysis and Design

This research study design and develop a CAI for Tablet-PC with an emphasis on interactive design. We developed the application for present Chemistry which applied the interaction pattern in the design for CAI to support the course in order to give the effective learning and motivating the students. It was tested with the learner and evaluate satisfied with usability testing principles. The method of operation are as follows.

3.1 Problem Definition

Nowadays, Tablet-PC can be used as a tool of teaching and learning in schools and universities to enhance learning. The study found that bringing Tablet-PC to help make the grade as a tool to teach them a little better. We have adopted the principle of Human-Computer Interaction principles and User Interfaces Design to improve the design to be based on the principles of usability and regardless of its use in different environments. That, the goal of interactive and easy to use, attractive. Due to the content of chemistry are relatively difficult to understand.

For this reason, the development of CAI in Chemistry on the mobile device is the most challenging of ISD model and software engineering, we have to design the UI patterns which relevant to the learning content. Afterward, the UI patterns and CAI should be evaluated the usability from end user for test effective in using the application on Tablet-PC.

3.2 System Requirement

System requirement is a requirement of the specification which the system is expected to be it can be divided into two categories; Functional Requirement and Non-Functional Requirement.

3.2.1 Functional Requirement

- 1) System can display content of Atoms.
- 2) System can display content of Molecules.
- 3) System can display content of Ions.
- 4) System can support the user to interaction.
- 5) System can support the user to input of content in the part of calculation.
- 6) System can support the user to animations.

3.2.2 Non-Functional Requirement

- 1) Simplicity.
- 2) Cognitive issue.
- 3) Ease of use.
- 4) Textual information.

3.3 System Design

3.3.1 System Architecture

System structure, we have analyzed and designed selecting data storage and then put them in a database due to organize and update information easily. The information in the database to retrieve data to connect be displayed on screen Tablet-PC. The architecture is shown in Figure 3.1

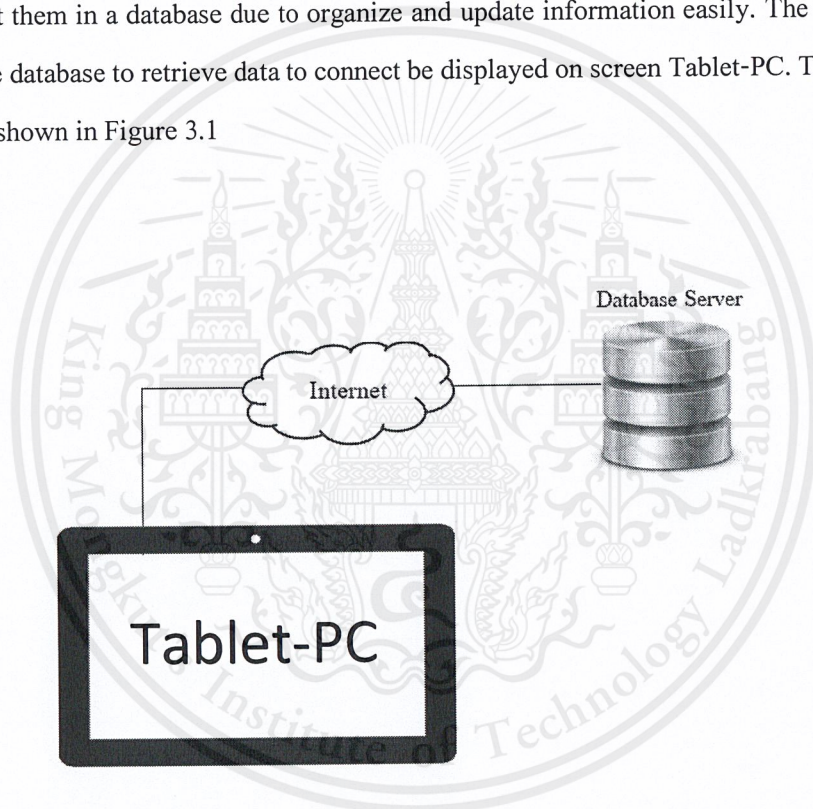


Figure 3.1: System Architecture

3.3.2 ER-Diagram

ER-diagram shows the relationship between the structures of the database. There are three tables in this database as shown in the figure 3.3, such as Contents, Topic and Relations.

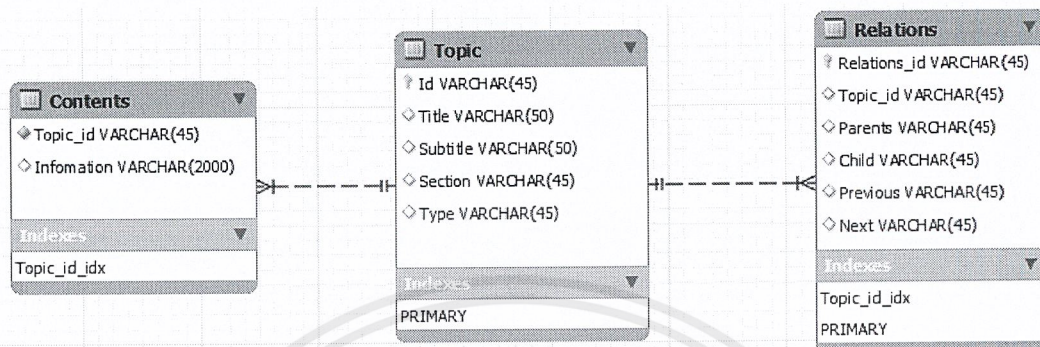


Figure 3.2: ER-Diagram

3.3.3 Class Diagram

The class diagram of application shown in the figure 3.2. There are 13 classes consists of MainPage, AtomsPage, MoleculesPage, IonsPage, QuizPage, TheStructureOfAtomsPage, IsotopePage, TheStructureOfMolecules, ForcesBetweenMoleculesPage, MoleculesAndMolesPage, CommonIonsPage, IonsInSolutionPage and GaseousIonsPage. Mostly classes have navigation, swipe and show content. Example of MainPage class, AtomsPage class, MoleculesPage class and IonsPage class consists of navigation to subtopic for each topic. Showcontent class are represent content each subtopic. The part of Swipe class is navigation to previous topic, next topics, previous subtopic and next subtopic which are mappings between content hierarchy and touch navigation.

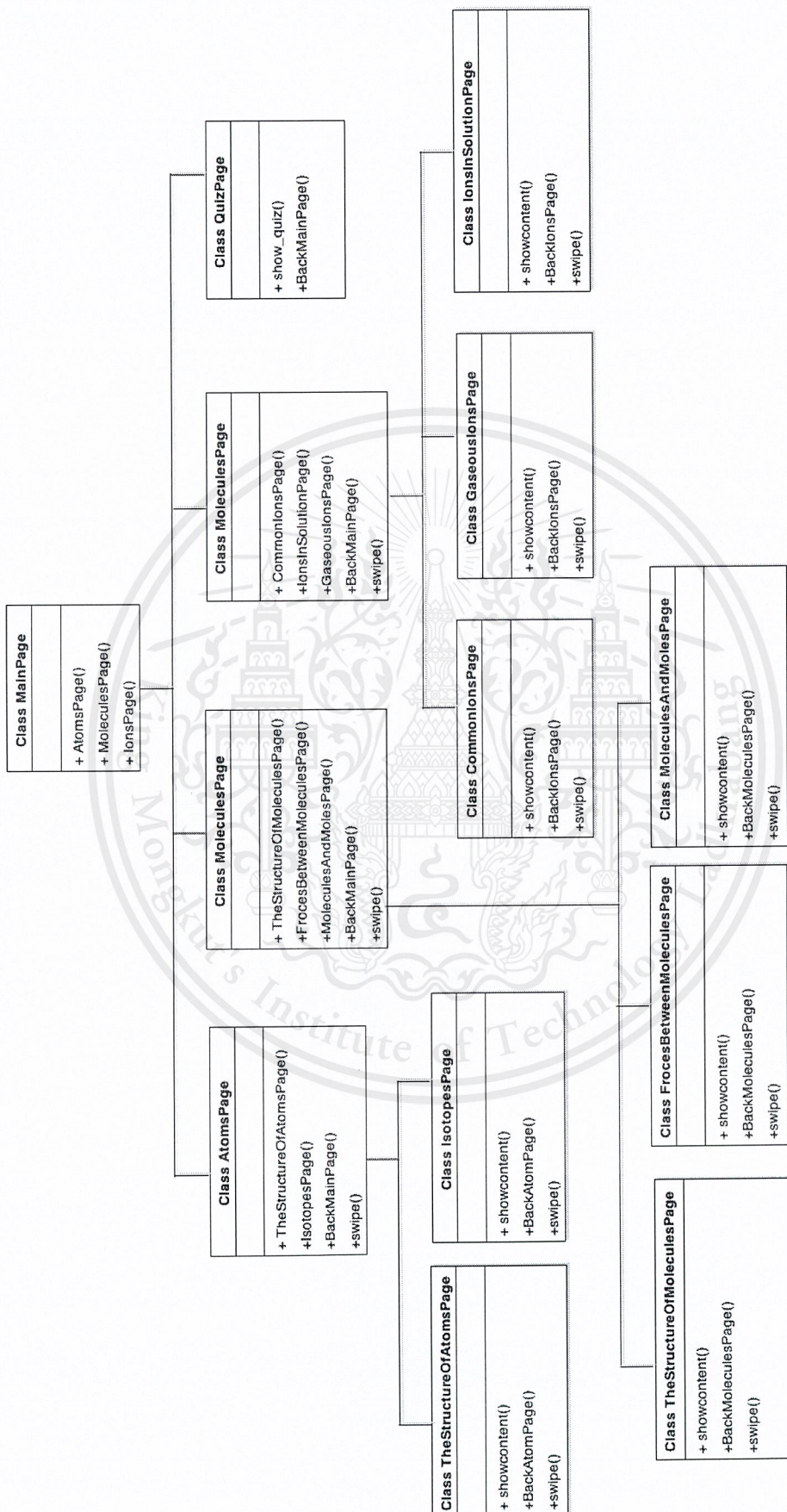


Figure 3.3: Class Diagram

3.3.4 Activity Diagram

A diagram of the overall operation of the program and swipe in different direction as shown in Figure 3.4-3.5

For example, the activity of accessing content. First, choose a topic then choose a subtopic. The system will check whether it is a photo or not. If so, it appears the user control in that part of the show but if not, it will check that a table or something. If so, it appears Table.html to show. But if not, will check that into the equation. If so, it will show equation.html. If not, it displays the content normal.

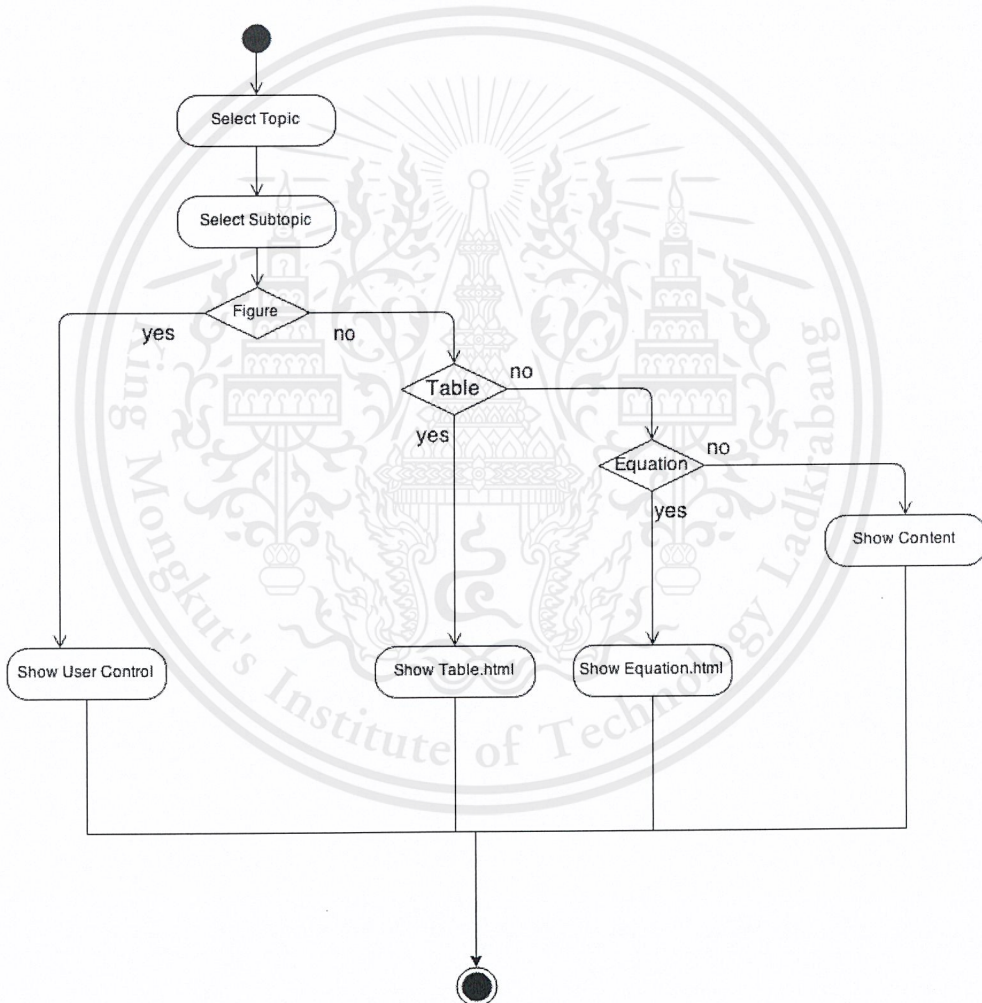


Figure 3.4: Activity Diagram of CAI

Activity for swipe, swipe left. If so, check to show the content of next subtopic, if not check to swipe right or not. If yes will show the content of previous subtopic, If not, it will check that or not swipe top. If yes show a content of next topic. If not, it will show the content of a previous topic.

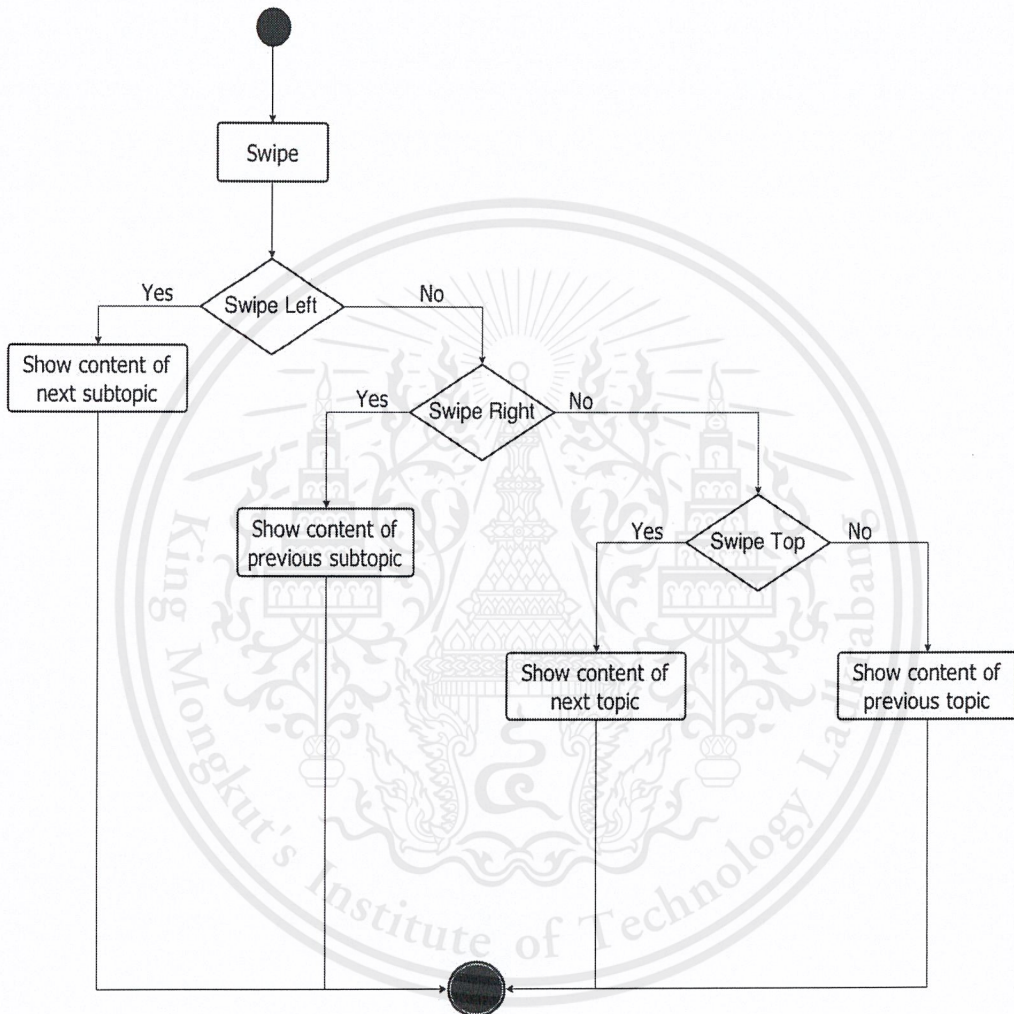


Figure 3.5: Activity Diagram of Swipe

3.4 UID Patterns

From the study of UID principles we can design the component contents such as text, image, table, equation, navigation, input, interaction, animation and calculation. We divide a three-step model for UID Patterns.

1. Select the instructional activity that supports cognitive processes of students.

We select Chemistry course as a case study of CAI content. Figure 3-6 shows the content hierarchy of Atoms, Molecules and Ions topics, which is a part of all contents. It contains three major atoms, molecules, and ions topics that we classified into levels as depicted in Figure 3-6. The first level consists of three major topics, meanwhile the second level of consist of sub-topics such as the Structure of Atom, Isotopes, the Structure of Molecules, Force between Molecules, Ion in Solution, Common Ions and Gaseous Ions

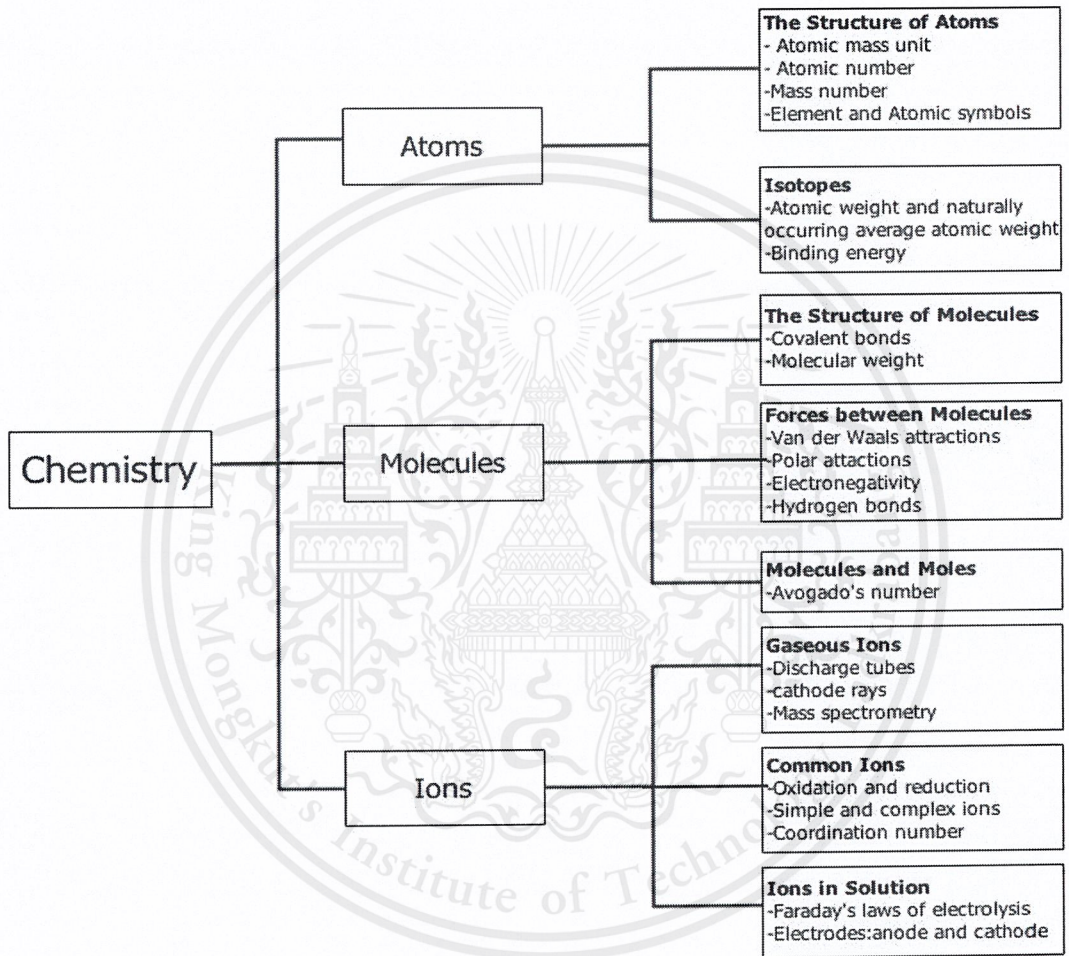


Figure 3.6: A part of content hierarchy of the Chemistry course

Table 3.1: Analysis of UI pattern of the content hierarchy in the level one and two

contents	Components of content									
	Text	Image	Navigation	Calculation	Input	equation	Table	Animation		
1. Atom			Yes							
2. Molecules			Yes							
3. Ions			Yes							
1.1 Structure of Atoms	Yes	Yes	Yes				Yes		Yes	
1.2 Isotopes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	
2.1 Molecules Structure	Yes	Yes	Yes				Yes		Yes	
2.2 Forces between molecules	Yes	yes	Yes				Yes		Yes	
2.3 Molecules and moles	Yes		Yes							
3.1 Gaseous Ions	Yes	Yes	Yes				Yes		Yes	
3.2 Common Ions	Yes	Yes	Yes			Yes	Yes		Yes	
3.3 Ions in solution	Yes	Yes	Yes			Yes	Yes		Yes	

2. Select the UI component of each patterns.

We analysis UI pattern of the content hierarchy in the level one and two as shown in table 3-1. We classify component of content such as text, image, Navigation, calculation, input, table and animation.

3. Develop the UI patterns.

We develop the UI patterns by the signification of the user interface leads to the design of CAI, which is based on a cognitive and instructional design approach, we propose the UI design patterns that are the processes of selecting interface elements and features based on their ability to deliver support for the cognitive processes involved in the instructional activities facilitated by the CAI application [21].

We used to Balsamiq Mockups program for template designing before implementation which shows the interaction of user in various patterns.

3.1 The screen shows the page of navigation for choosing the topics to be present in the next pages.

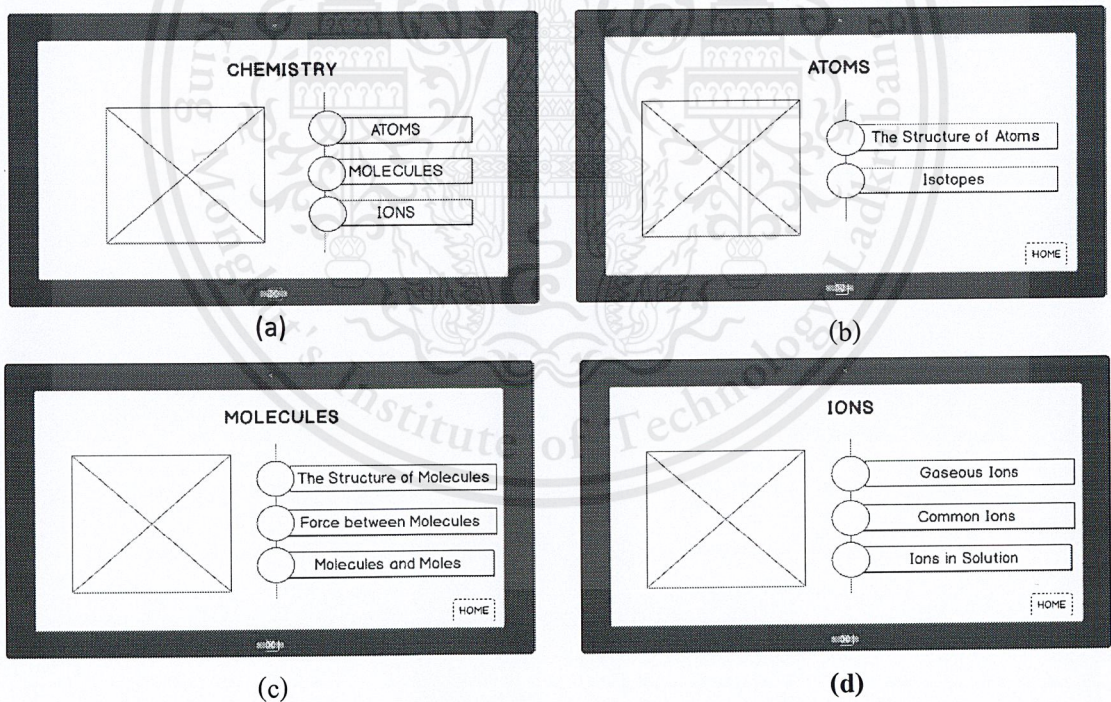


Figure 3.7: The screen shows the navigation patterns.

3.2 The screen shows interact in various forms relating to the content. The component of content include text, figure, animation, etc.

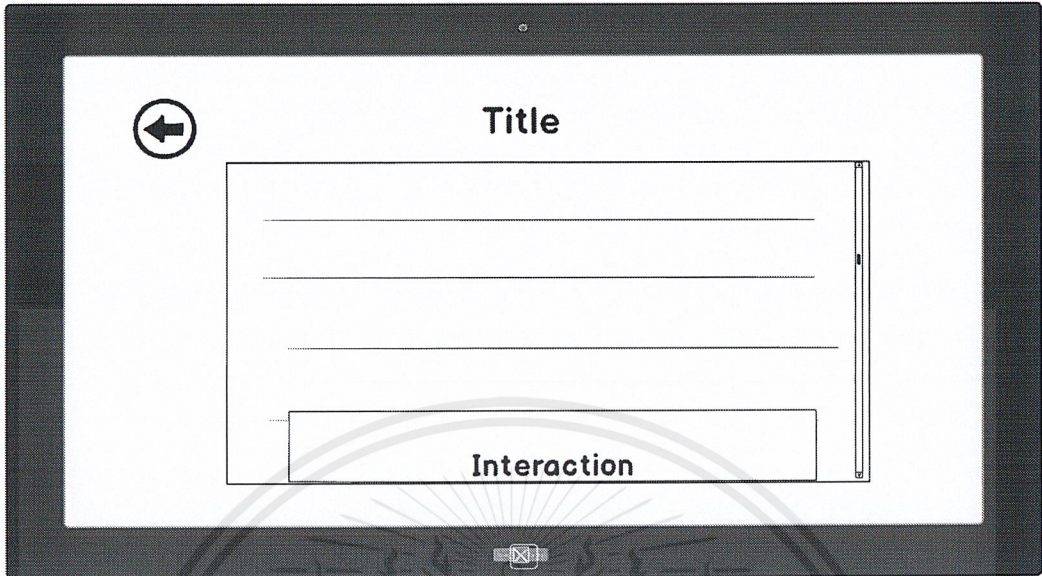


Figure 3.8: The screen show pictures and captions related content.

3.3 The screen shows choosing the data to be input and displays them in the calculations forms.

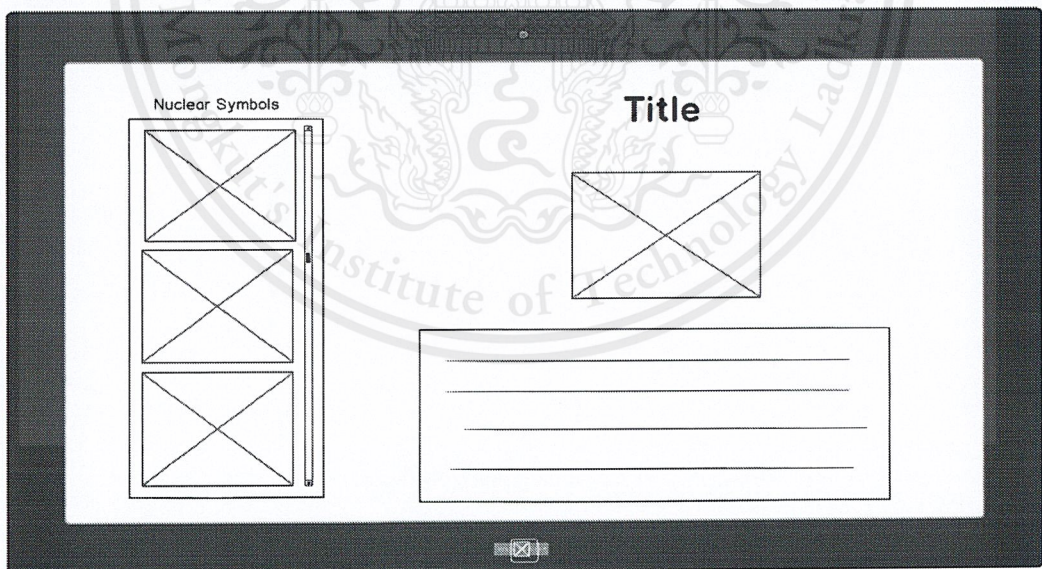


Figure 3.9: The screen shows calculations pattern.

3.5 Interaction Design

In the part of the interaction design, we focus on the interaction between learner and content and also interaction between learner and interface. From the studying, we found that the interaction between the learner and the content helps learner to be more attention in learning than traditional learning. Therefore the design interactions are important and effect to efficiently learning. Before the design, we analyzed the interaction patterns suitable to create interaction followed by the type of content and design for appropriate content. The example of interaction design is shown in Table 3.2

Table 3.2: Design of interaction.

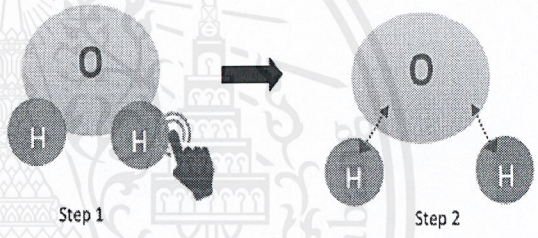
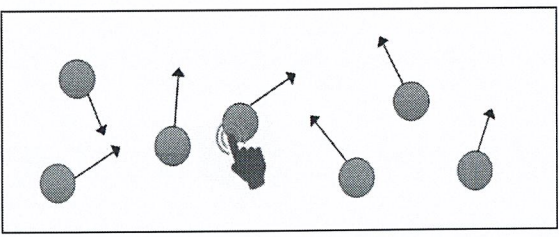
Interaction patterns	type of interaction
<p>1. The structure of molecules: to design the molecules of hydrogen (H) could movement in and out from the molecule of oxygen (O) which following to the fact movement of molecules. This interaction is shown when user is tap on the signature of touch screen.</p>	
<p>2. The state of molecules: to design based on the forces between molecules and the movement of molecules for three state of matter such as solid, liquid and gas.</p> <p>2.1 The state of gas: gas molecules move freely through space and each of molecules is freedom each other. Interaction design is following to fact of movement for gas when user is tap on the signature of touch screen.</p>	

Table 3.2: Design of interaction. (Continue)

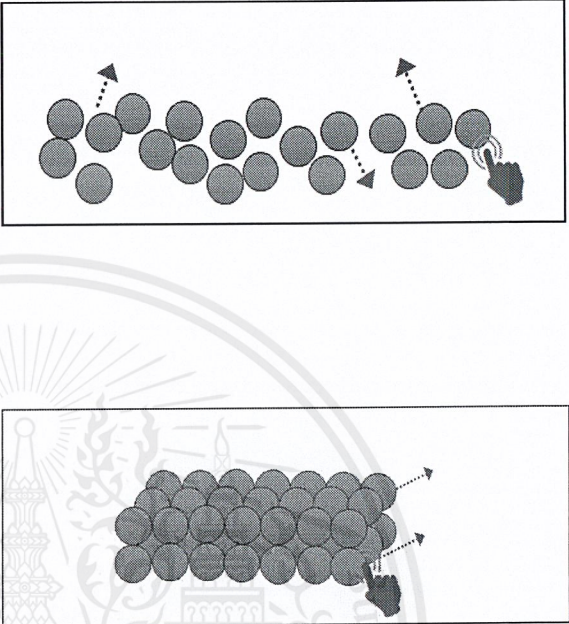
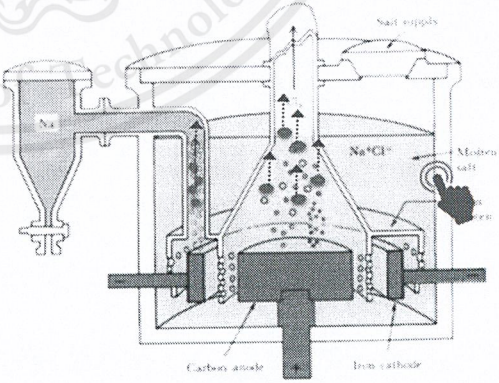
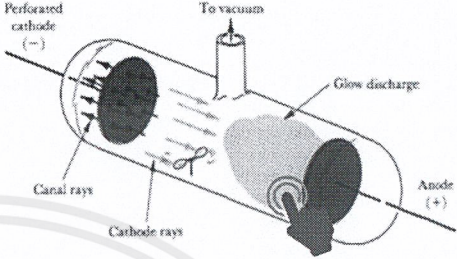
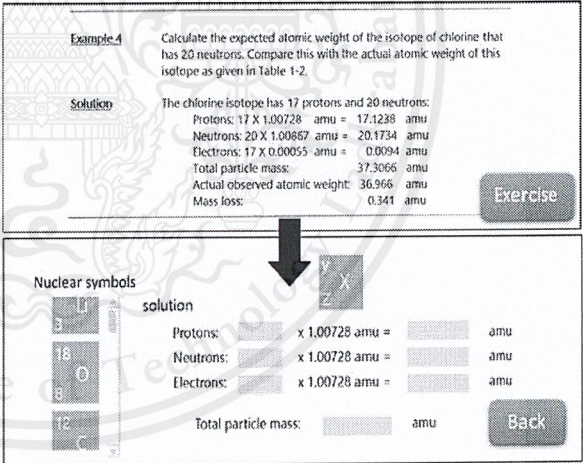
Descriptions	Figure of interaction
<p>2.2 The state of liquid: liquid molecules move freely through space, but each of molecules contacts each other. Interaction design is following to fact of movement for liquid when user is tap on the signature of touch screen.</p> <p>2.3 The state of solid: solid molecules are fixed shape and volume. Interaction design is following to the fact movement for solid when user is tap on the signature of touch screen.</p>	
<p>3. The experiments: to design focus on the actual reaction happen in an experiment so that users visualize.</p> <p>3.1 The electrolysis experiment is testing for electrical conductivity of the solution. The figure shows the reaction occur of the sodium and chlorine.</p>	

Table 3.2: Design of interaction. (Continue)

Descriptions	Figure of interaction
<p>3.2 A Crookes tube: This experiment is what happens if increase the voltage in a Crookes tube containing gas at low pressure. The figure shows the breakdown of gas molecules into positive ions and electron. The interaction design the movement of cathode and anode rays which shown the movement when tap on the touchscreen symbols.</p>	
<p>4. Calculation: For learner doing exercises immediately after seeing the example by tapping on exercise button, as shown in the figure. The user can choose nuclear symbols and can calculate the proton newton or electron. This design is good for the users to measure their understanding of the course.</p>	

The Interaction Design are termed the suitability of content and the virtualization. For example, Experiments and the movement of objects. From the design of UI patterns and interaction designs, we have designed it to develop further in the next chapter.

Chapter 4

RESULTS AND EVALUATION

In this chapter presents the operating results in the development of content CAI application of chemistry, according to the analysis and design in the previous chapter. The interaction is shown the interaction with users in various forms of CAI application.

4.1 Implementation

By considering the relation between contents and UID principle, we divide a three-step model for UID patterns which have discussed in the previous chapter. Furthermore, we designed of the interaction in order to help the students have the effective learning and also motivating of the course. Then, we conduct the implementation by installing the CAI application on the Windows 8 Tablet PC. We implement with Microsoft Visual Studio which is developing by C# language and XAML and also use Blend for Visual studio is design layout which following the UI patterns and the design of interaction did .execution in the previous chapter.

4.2 Results

We implement the CAI application from UI patterns for Chemistry designed. We focus on how well users can learn and use the CAI to achieve their goals. It also refers to how satisfied users are with that process. Example of an implementation with Microsoft Visual Studio is shown in Figure4.1-4.6:

1. Navigation are designed for simplicity in order to access topics or sub-topics is easy to understand.

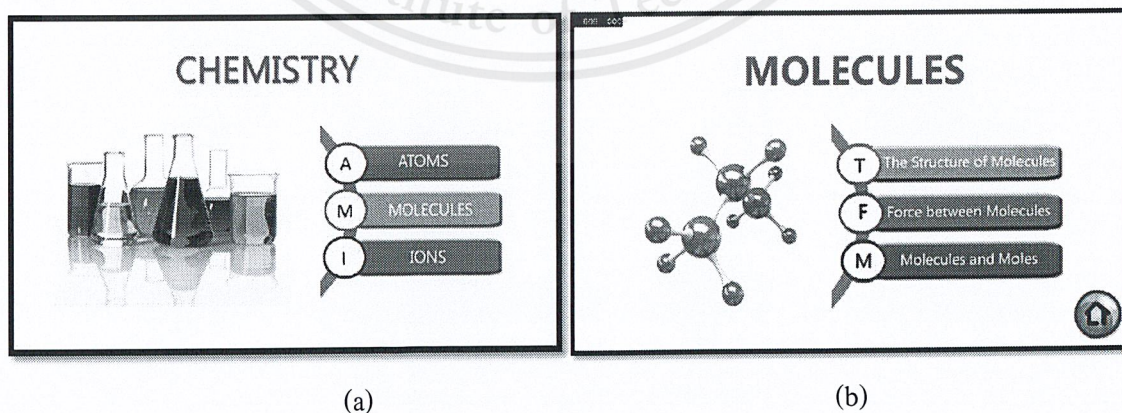


Figure 4.1: Example of navigation

- The calculation: Learners can interact with the instruction by answering questions, input text in order to get results in the tablet or shows an animation. Which helps learners easily understand and remember, it is better than general text.

The screenshot shows an interactive application titled "Isotopes". At the top left, there is a back arrow icon and the text "018 001". The main title "Isotopes" is centered. Below the title, there is a paragraph of text: "Due to the definition of the scale of atomic mass units, the mass of one carbon-12 atom is exactly 12 amu. Hence 0.0990 amu of mass has disappeared in the process of building the atom from its particles."

On the left side, there are three element cards: Lithium (Li) with atomic number 7 and mass number 3, Oxygen (O) with atomic number 8 and mass number 18, and Carbon (C) with atomic number 12 and mass number 12. In the center, there is a "solution" section with a table for calculating the mass of an atom:

	Y	X	Z
Protons:	<input type="text"/>	x 1.00728 amu =	<input type="text"/> amu
Neutrons:	<input type="text"/>	x 1.00726 amu =	<input type="text"/> amu
Electrons:	<input type="text"/>	x 1.00728 amu =	<input type="text"/> amu
Total particle mass:	<input type="text"/>		amu

Below the table, there is a "BACK" button. At the bottom, there is a paragraph of text: "Each isotope of an element is characterized by an atomic number (total number of protons), a mass number (total number of protons and neutrons), and an atomic weight (mass of atom in atomic mass units). Since mass losses upon formation of an atom are small, the mass number is usually the same as the atomic weight rounded to the nearest integer. (For example, the atomic weight of..."

Figure 4.2: Example of calculation

- The interaction pattern: the experiments designed focus on the actually creation happen in the experiment so that users visualize is shown in figure 4.3

The screenshot shows an interactive application titled "Gaseous Ions". At the top left, there is a back arrow icon and the text "010 008". The main title "Gaseous Ions" is centered. Below the title, there is a diagram of Millikan's oil-drop experiment. The diagram shows a rectangular chamber with two horizontal parallel plates. An "Oil spray" nozzle is at the top right, releasing "Oil droplets" into the chamber. An "Oil drop" is shown falling between the plates. On the left, "x rays, + or -" are shown entering the chamber. At the bottom, "Condenser plates and battery" are shown, connected to the plates. A battery symbol is also visible.

Below the diagram, there is a caption: "Figure 1-13 Millikan's oil-drop experiment. Tiny droplets of oil are introduced between two plates that can be given an electrostatic charge. A drop of oil is allowed to fall freely through the air, and its path is monitored. The radius of the drop is..."

Figure 4.3: Example of animation in the interaction

4. The textual information is brought into the table is divided information for easier understanding than a long explanation.

009 001

Forces between Molecules

Table 1-3: Melting and Boiling points of some simple molecular substances

Substance	Molecular formula	T _m (°C)	T _b (°C)
Gases			
Hydrogen	H ₂	-252.8	-252.8
Oxygen	O ₂	-218.4	-183.0
Methane	CH ₄	-182.5	-164.0
Hydrogen Sulfide	H ₂ S	-85.5	-60.7
Chlorine	Cl ₂	-101.0	-34.6
Ammonia	NH ₃	-77.7	-33.4
Liquids			
Bromine	Br ₂	-7.2	+58.8
Methanol	CH ₃ OH	-93.9	+65.0
Water	H ₂ O	0	+100
n-Octane	C ₈ H ₁₈	-56.8	+125.7
Solids			
Iodine	I ₂	+113.5	+184.4
Sucrose (cane sugar)	C ₁₂ H ₂₂ O ₁₁	+185	Decomposes

A second kind of force between molecules also influences melting and boiling points, the

Figure 4.4: Example of content in a table form

5. Zoom in and zoom out: The content which can't display within one page of the Tablet-PC. It can reduce the size of the screen display or if the display is not clear, it can extend the content appropriately which shows in Figure 4.5

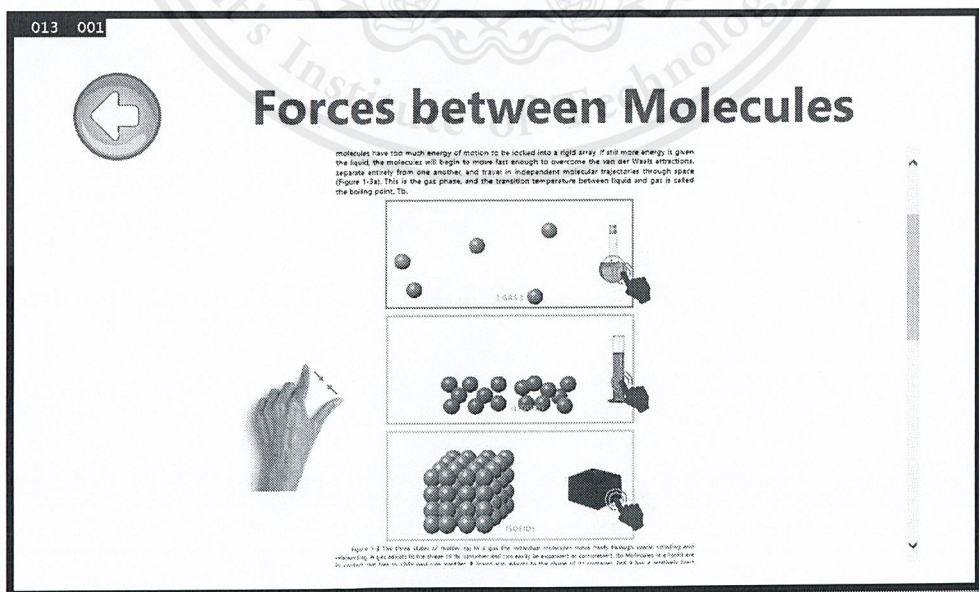


Figure 4.5: Example of a zoom in or out of content

6. The swipe is navigation to previous topic, next topics, previous subtopic and next subtopic which the mappings between content hierarchy and touch navigation are shown in figure 4.6

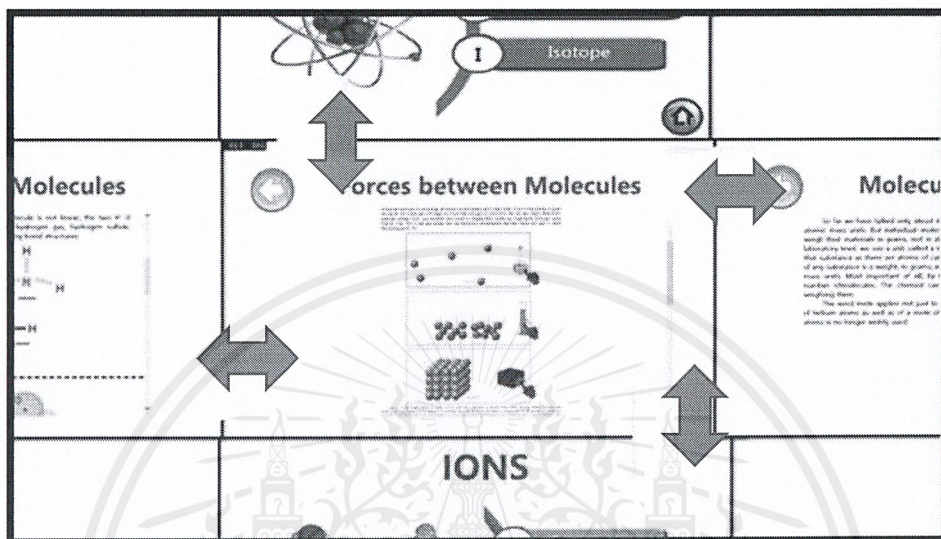


Figure 4.6: Example of swipe content

4.3 Usability Evaluation

In the part of the evaluation, we applied the usability testing to help in the evaluation. The classification criteria for measuring the ability of applications for Tablet-PC are five topics, including ease of use, navigation, simplicity, textual information and cognitive issue as described in chapter 2.

TABLE 4.1: Result of Usability Evaluation\

Topic of Evaluation	Satisfaction levels (percentage)
Ease of use	80
1. Users can access the desired information correctly.	80
2. Users feel that application ease of use.	80
Simplicity	85
3. Users feel that application with no complexity.	84
4. Users can learn how to use application with their own.	86

TABLE 4.1: Result of Usability Evaluation (Continue)

Topic of Evaluation	Satisfaction levels (percentage)
Navigation	79
5. Users can access the desired information easily.	82
6. The hierarchical relationships of the content is appropriate.	76
Textual information	86
7. Format of the contents is appropriate.	86
8. Types of content displayed is suitable (text, images, tables, etc.)	86
Cognitive issue	86
9. Interact with content to help users learning.	84
10. Media motivate users to demand to learn more.	86
11. Users understand the content increased after use applications.	88
Total Average	83.45

The assessment can be used to test the user group of 10 people by a satisfaction rating. Application of the computer based on the ability to use, we found that 83.45 percent of users are satisfied to use an application as shown in Table 4.1

Chapter 5

CONCLUSION

This chapter presents the conclusions from the design and development of CAI application. Including described problems while working on this research and work can be developed in the future.

From the study the type of content in each pattern in order to analyze relationship of Chemistry contents which is appropriated for the design of CAI application. We divided three step of the UID patterns. Firstly, we selected the instructional activities that support cognitive processes of learners. The contents are selected such as Atom, Molecules, and Ions topics. Sub topics including the Structure of Atoms, Isotopes, the Structure of Molecule, Forces between Molecules, Molecules and Moles, Common Ions, Ions in Solutions and Gaseous Ions. Secondly, we selected the UI component of each the patterns. The component such as text, image, navigation, calculation, input, equation, table and animation. Finally, we developed the UI patterns including navigation page, calculation page, and show of various content page. Furthermore, we designed interaction pattern of chemistry course which focused on the visualizations and enhance learning. The example of interaction pattern of design such as the structure of molecules, the state of molecules, the experiments and calculations. Then, we have implemented the application following the design which was described.

The part of the implementation, we developed the application on Windows 8 platform that focus on Tablet-PC and selected the C# language of develop. We used the Microsoft Visual Studio for develop the application and including the Blend of Visual Studio for design patterns. Because of the content of Chemistry is rather difficult, we applied interaction design give related content and enhance learning. We selected MySQL database of collect content which was used phpMyAdmin. The content of the tables and equations, we chose to store data in the HTML files that is easy of show content and management. The application also includes a quiz to help learners of test their knowledge after studying the content.

For evaluation, we used the Usability Testing of assessment. The factors of measuring the ability of application which focus on Tablet-PC consisted of ease of use, navigation, simplicity,

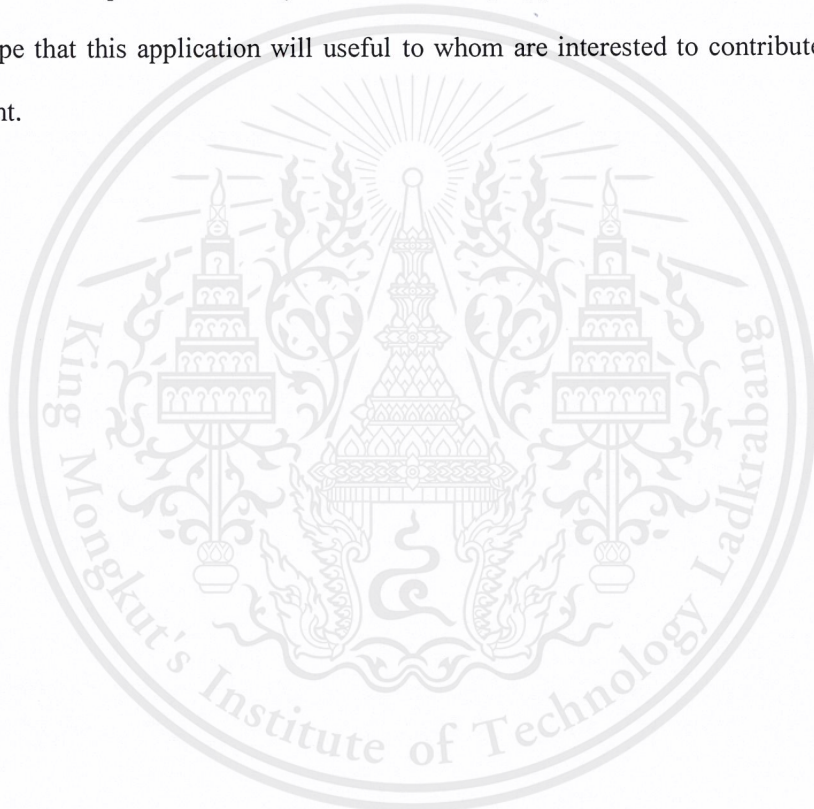
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textual information and cognitive issue. The result is 83.45 percent of the learners are motivated and being attention to study better than traditional learning and also bring effective more learning.

The problem found is the step of development application which is quite complex and difficult of the interaction design pattern. The part of the evaluation, experts complained of questionnaire quite more sense than understanding of the content. And the application can run only Windows Platform.

For the future work, we will improve the CAI application by including increase quiz and practicing more comprehensive study. We will develop application able to run several platform. And we hope that this application will useful to whom are interested to contribute it for further development.



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APPENDIX A

Usability Evaluation Table

แบบประเมินความพึงพอใจของผู้ใช้งาน แอปพลิเคชัน บทเรียนคอมพิวเตอร์ช่วยสอนวิชาเคมี

โปรดทำเครื่องหมาย ✓ ลงในช่องแสดงระดับความพึงพอใจ ดังนี้

5 = มากที่สุด 4 = มาก 3 = ปานกลาง 2 = น้อย 1 = น้อยที่สุด

หัวข้อการประเมิน	ระดับความพึงพอใจ				
	5	4	3	2	1
Ease of use					
1. ผู้ใช้สามารถเข้าถึงข้อมูลที่ต้องการได้อย่างถูกต้อง					
2. ผู้ใช้รู้สึกว่าการใช้แอปพลิเคชันใช้งานง่าย					
Simplicity					
3. ผู้ใช้รู้สึกว่าการใช้แอปพลิเคชันไม่มีความซับซ้อน					
4. ผู้ใช้สามารถเรียนรู้การใช้แอปพลิเคชันได้ด้วยตนเอง					
Navigation					
5. ผู้ใช้สามารถเข้าถึงข้อมูลตามที่ต้องการได้ง่าย					
6. การจัดลำดับความสัมพันธ์ของเนื้อหามีความเหมาะสม					
Textual information					
7. รูปแบบการจัดวางเนื้อหาที่มีความเหมาะสม					
8. ประเภทของเนื้อหาที่แสดงมีความเหมาะสม(ข้อความ, รูปภาพ, ตาราง, ฯลฯ)					
Cognitive Issue					
9. การมีปฏิสัมพันธ์กับเนื้อหาช่วยให้ผู้ใช้เกิดการเรียนรู้					
10. สื่อกระตุ้นให้ผู้ใช้เกิดความต้องการที่เรียนรู้มากขึ้น					
11. ผู้ใช้มีความเข้าใจในเนื้อหาเพิ่มมากขึ้นหลังจากใช้งานแอปพลิเคชัน					

ข้อเสนอแนะ

.....

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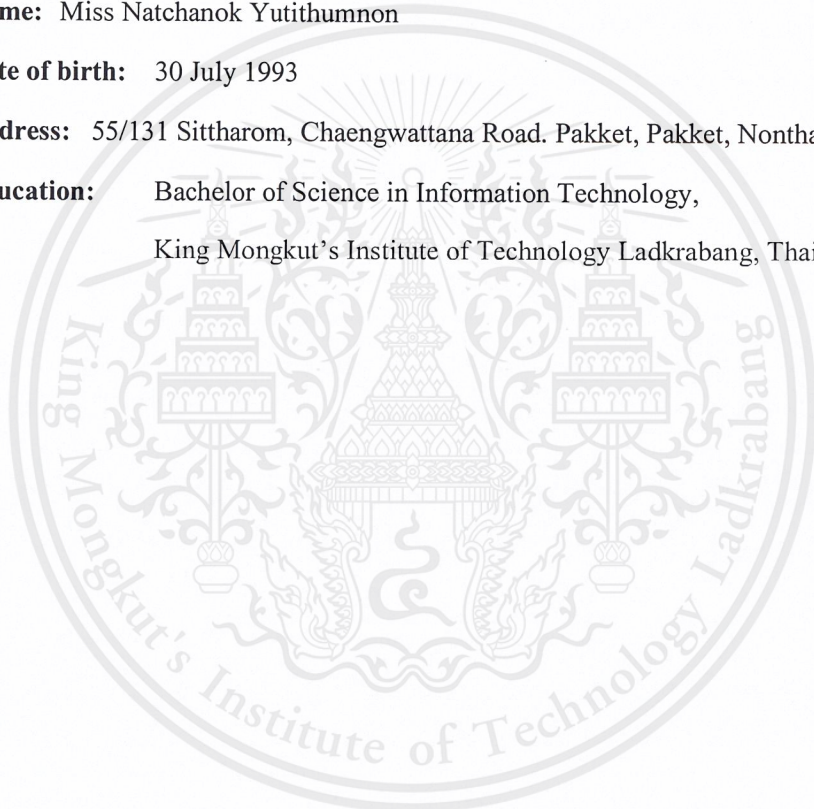
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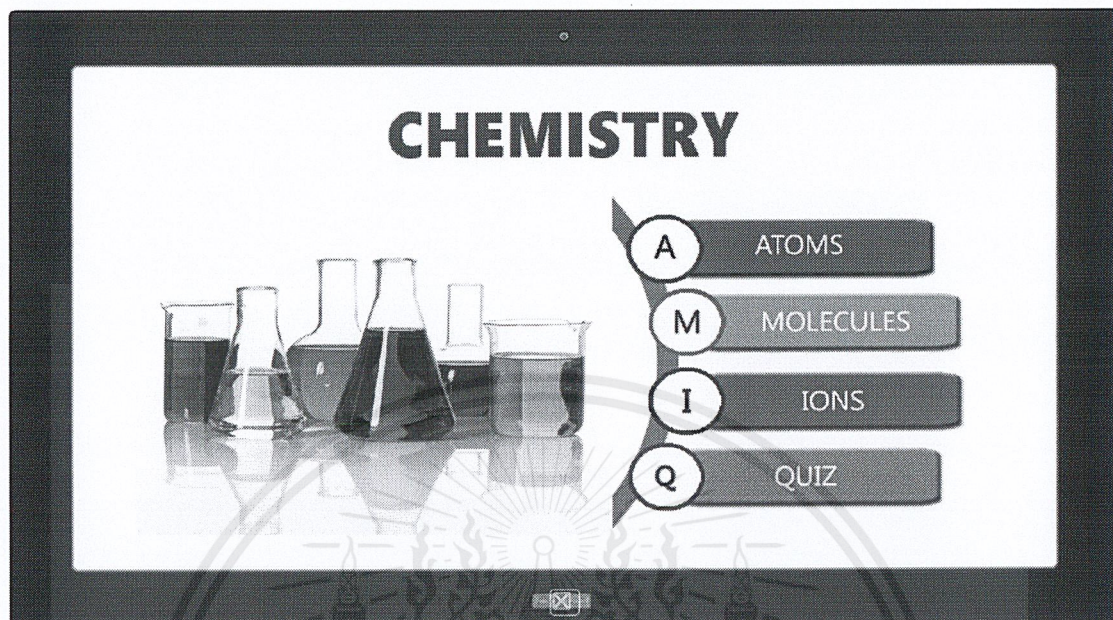


User Manual
for Computer Assisted Instruction on Tablet-PC

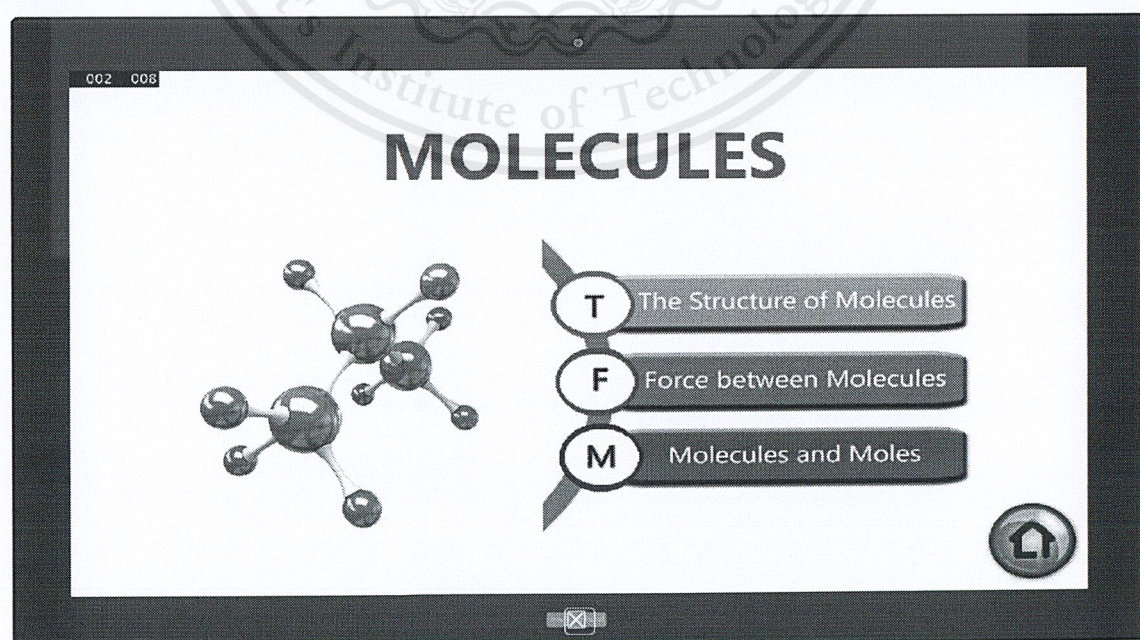
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1. Open the CAI application and select topic with touch the button on screen. The topic such as Atom, Molecules, Ions and Quiz.



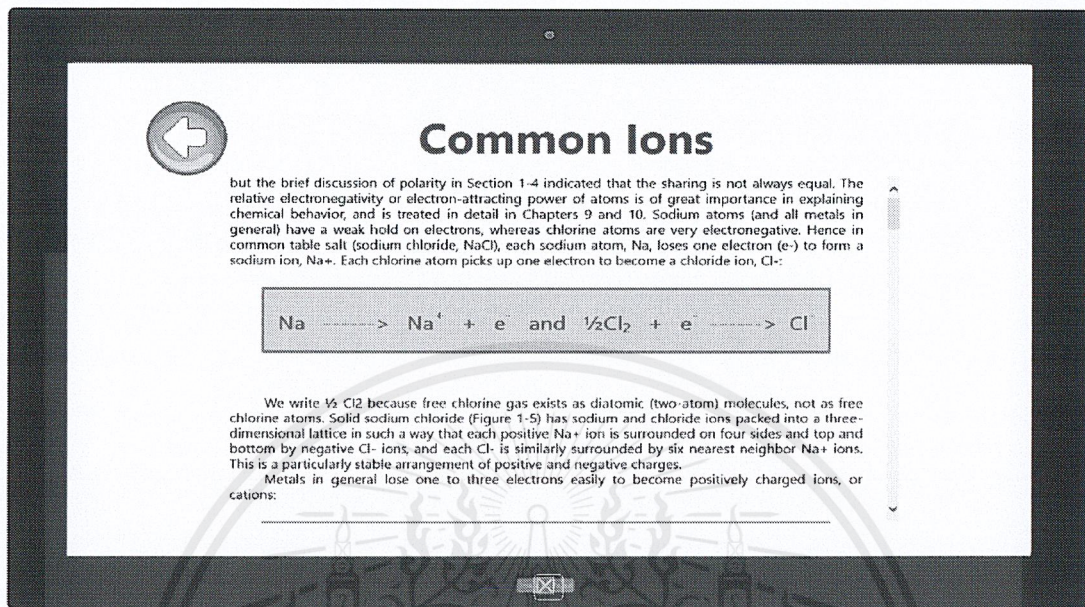
2. Select sub topic of interest by touching the button on screen. The sub topic such as The structure of Atoms, Isotopes, The Structure of Molecules, Forces between Molecules, Molecules and Moles, Common Ions, Ions in Solution and Gaseous Ions



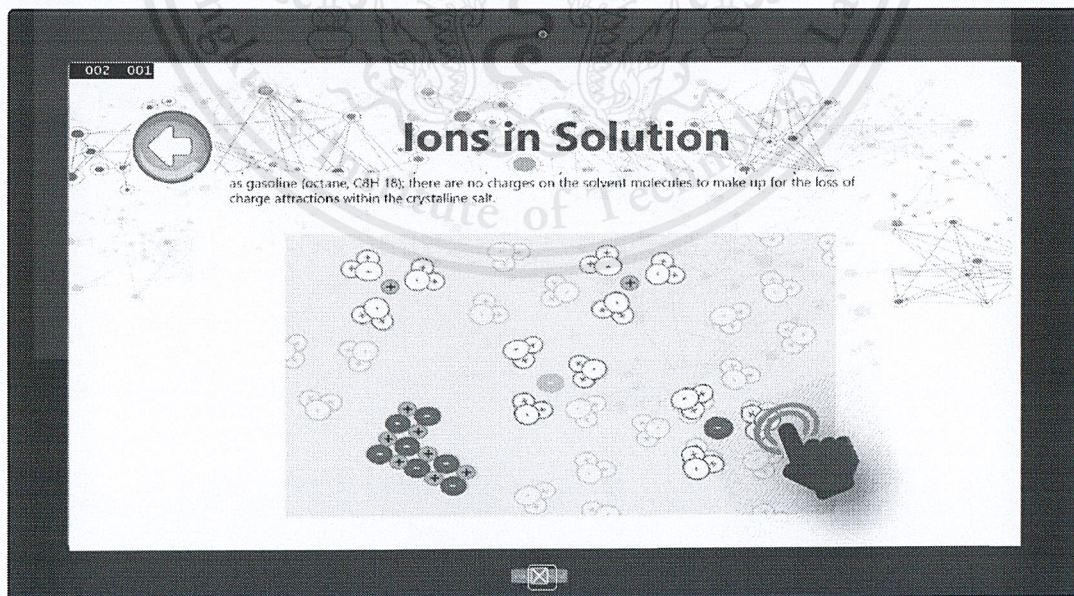
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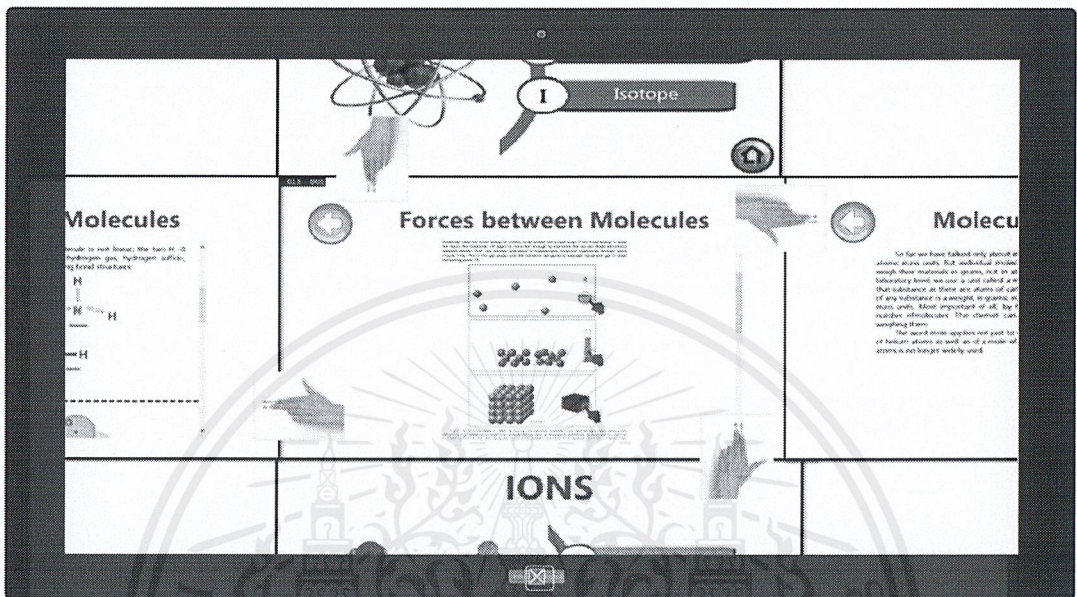
3. The application shows the content of sub topic that is selected.



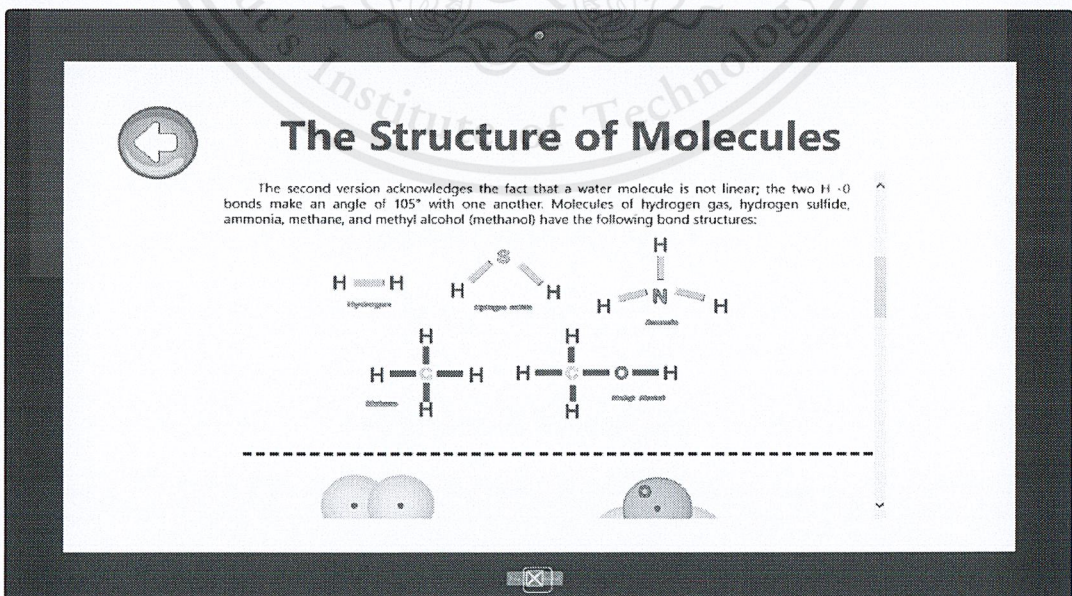
4. The part of contents are the touchscreen symbols. The user can touch screen the symbols for shown the content of interaction pattern.



5. Swipe Navigation : Application can swipe into previous or next topic and previous or next sub topic without touchscreen the button.



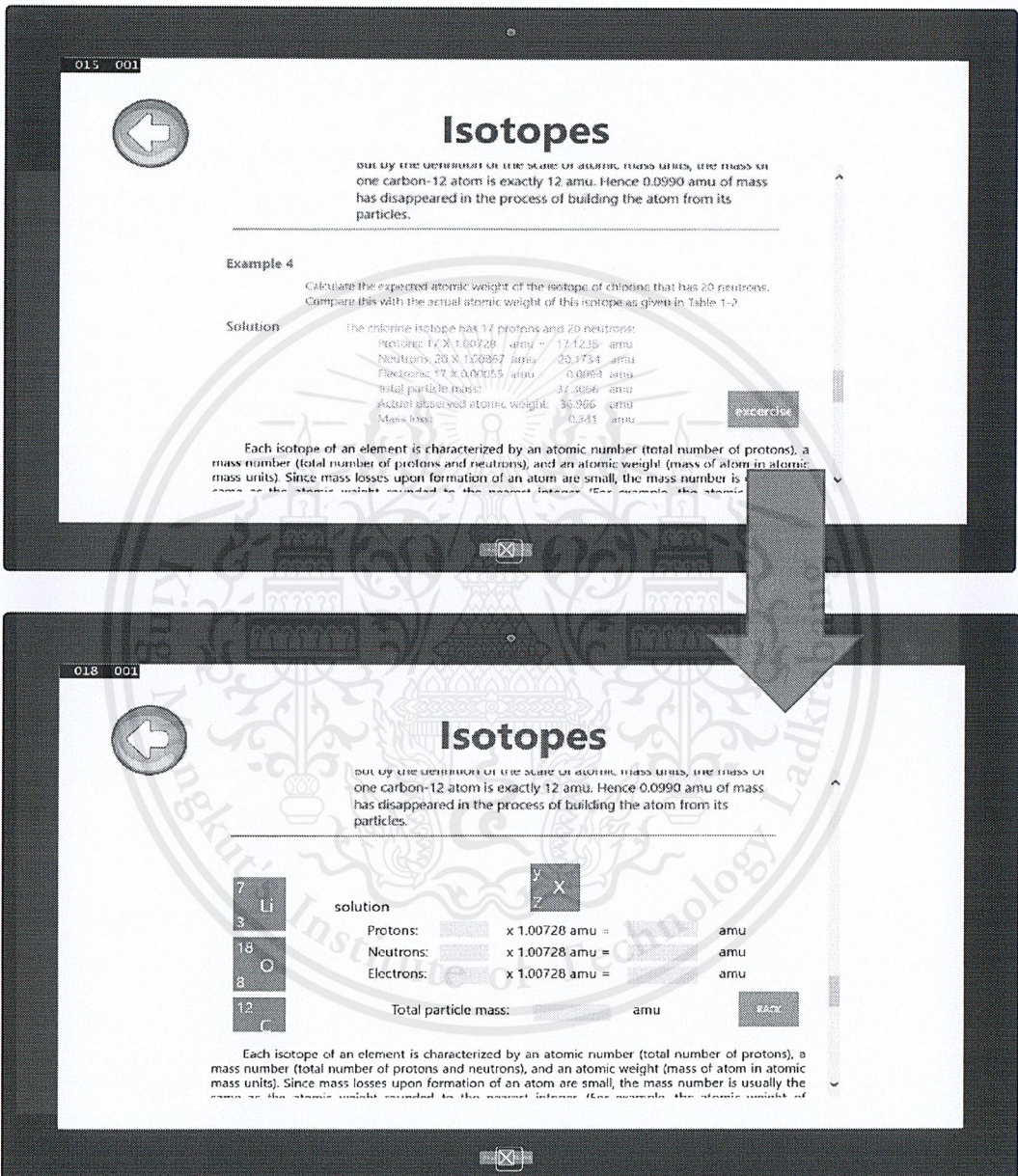
6. The part of contents aren't the touchscreen symbols. The user can touch screen to show the content of interaction pattern.



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7. In the pages of the exercise. The user can touch screen at the exercises button for show changing face, users can input data into the tablet-PC



8. In the pages of quiz. The users can fill a word into the blank to answer the question.

