VIRTUAL CHEMLAB

TIEW BOON HAN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Alamat tetap: 11-A, KG BARU MAHSAN, 7200 BAHAU, N.S

Tarikh: 8/7/2011

(TANDATANGANPENYELIA)

Prof. Madya Dr. Faaizah Shahbodin
Nama Penyelia

Tarikh: 8/7/2011

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This report is submitted in partial fulfilment of the requirement for Bachelor of Computer Science (Interactive Media)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITY TEKNIKAL MALAYSIA MELAKA
2011

DECLARATION

I hereby declare that this project report entitled

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is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date: 8/7/2011

(TIEW BOON HAN)

SUPERVISOR : _____ Date: 8/7/2011

(ASSOC. PROF. DR. FAAIZAH BINTI SHAHBODIN)

DEDICATION

To my beloved parents, sisters, brother, supervisor, lecturers and friends.

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ABSTRACT

This project aims to provide a platform to conduct virtual chemistry experiment in a virtual laboratory (Virtual ChemLAB) integrate with simulation and games for chemistry students. Through Virtual ChemLAB, students can carry out observations through simulation when conducting the experiment. Meanwhile, game such as solving word puzzle is implemented to test their level of understanding towards the end of the experiment. Students can get fun in the learning process as well as to enhance their capability of analyzing and solving problems. Furthermore, an animated pedagogical agent will guide students to complete the experiment with step by step procedures. This application is hoped to be a new approach for students to conduct the virtual experiment as a preparation before entering the real-life laboratory. At the same time, students can have a brand new revision material to help their chemistry learning.

ABSTRAK

Projek ini bertujuan untuk menyediakan satu platform untuk menjalankan eksperimen maya di makmal eksperimen maya (*Virtual ChemLAB*) yang mengintegrasikan dengan simulasi dan permainan game untuk pelajar-pelajar kimia. Melalui *Virtual ChemLAB*, pelajar boleh melakukan pemerhatian semasa melakukan eksperimen. Pada masa yang sama, permainan seperti menyelesaikan teka-teki dilaksanakan untuk menguji tahap pemahaman di hujung eksperimen. Pelajar dapat keseronokan dalam proses pembelajaran serta meningkatkan kemampuan mereka untuk menganalisa dan menyelesaikan masalah. Selanjutnya, agen pedagogi animasi akan membimbing pelajar untuk melakukan eksperimen dengan langkah-langkah prosedur eksperimen. Aplikasi ini diharapkan menjadi satu pendekatan baru bagi pelajar untuk melakukan eksperimen maya sebagai persediaan sebelum memasuki makmal sebenar. Pada masa yang sama, pelajar akan mempunyai satu bahan ulangkaji yang baru untuk membantu pembelajaran kimia mereka.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Project Background

This project focus on the domain of two dimension (2D) simulation of virtual chemistry laboratory integrated with 2D games, entitled "Virtual ChemLAB". Learning process in the current system is more to one way learning. Students in nowadays are exploring of learning experience that are digital, social and experiential where they prefer learning by doing activity rather than learning by listening. Moreover, Chemistry requires visualization to understand the concept of its theory. Apart from that, current virtual chemistry laboratories mostly lacked of interactivity.

Virtual chemistry experiment can be used to help students familiar with laboratory techniques and step by step procedures related to their laboratory section as a preparation to carry out the same experiment in a real-life chemical laboratory. As the result, this allows students to get a brief idea or picture on the experiment to do when in the real-life laboratory.

The simulation of experiment in virtual laboratory can educate student in a more realism way. On top of that, games serve as an enhancement tool to evaluate the understanding of user based on the experiment that has been carried out. Thus, Virtual ChemLAB can serve as a new platform where students can assess their laboratory assessment by using this game virtual chemistry laboratory other than real-life laboratory activity.

1.2 Problem statement

Chemistry is the science of matter related to composition, behaviour, structure and properties of matter. The chemical reactions will take place when the substances undergo any changes. The mechanism of this reaction will only apply in theory as student is hardly to visualize. Therefore, students normally only know the theory within the words as they do not really understand and analyze what is happening behind the story.

Unfortunately, the current learning process is more to one way learning. Next, the problems are arising when students access their real-life laboratory session as the participation may not involve all of the students. Due to limited access to chemical facilities and apparatus in laboratory, students might get in pairs to work. As a result, the experiment is mostly conquering by some portion of the students. On top of that, certain experiments might be dangerous when executing in a real laboratory. Some of the teachers might skip the experiments to avoid any accident happens.

Thus, a virtual chemistry laboratory which is enriched by multimedia learning environment will be the best solution to solve the problem. "Virtual ChemLAB" can simulate the real experiment with the interactive environment to help students gain the knowledge through learning by doing rather than learning by listening. The simulation part will show how actually the mechanism of the process works rather than they gain the output immediately and only know the theory.

By aid of simulation, students are explored to the knowledge in term of vision sense. Perhaps, students are not to memories things where most of the students do, but they can view the process within a reaction to enhance their understanding. The step by step procedures in the simulation will interact by students in virtual chemistry laboratory. Therefore, students can familiar the procedures of the real experiment in their coming laboratory session.

Besides, it provides the degree of flexibility where students can access the virtual laboratory anytime. On top of that, games in the virtual laboratory can evaluate the understanding of the students after the experiment is carried out. The

games environments can lead to high achievement of the student in understanding the experiment where skills such as critical thinking to solve problem and decision making are involved in order to successfully complete the game.

1.3 Objectives

There are several objectives have been determined:

- To measure the understanding of student after using the application.
- To check whether the effectiveness of using animation of the application is good.
- To measure user acceptance level on the graphic of the application.
- To measure user acceptance level on accepting this application to conduct the experiment before entering the real-life laboratory.
- To check the effect of using simulation in conducting experiment.
- To produce and create a virtual chemistry laboratory involving simulation and games.

1.4 Scope

The scope of project is only applied on three areas: target user, scope of work and limitation of the project.

1.4.1 Target User

This project is targeted for students in the secondary school who is taking chemistry subject. Students can use virtual laboratory as an add-on other than

laboratory session. Students can familiar procedures of the real experiment in their coming laboratory session.

1.4.2 Scope of Work

One experiment will be developed based on real-life laboratory experiment in Form Five student's syllabus. The topic will create and develop on: Redok Reaction Involving the Transfer of Electron at a Distance. The steps by steps procedures of the experiment will ensure the student to interact with the 2D simulation as student can familiar with the laboratory technique and procedures. Games such as solving a puzzle will be developed to evaluate the student understanding based on the experiment that have been carried out. English will be presented in the virtual laboratory. The deliverable of the product will be standalone application.

1.4.3 Limitation of the Project

Due to time constraint, only an experiment will be developed. Besides, the chemical apparatus is mainly in glass material; therefore the apparatus in virtual laboratory may not look as realistic as the real apparatus in real-life laboratory.

1.5 Project Significance

Towards the end of the project, it will bring benefits to the research that involve in the natural sciences such as chemistry, biology and physic. Many researches prove that one way learning is not effective for teaching. Simulation and games can help in learning processes by creating rich multimedia learning environment. Therefore, virtual laboratory can simulate the real-life experiment by providing the step by step procedures to help students familiar the laboratory technique through learning by doing. Targeted user can use this product as an add-on to prepare their laboratory session. They are not only depending on the laboratory

activity as all the students are able to get a chance to do the experiment by using virtual laboratory. It provides user a degree of flexibility to use the virtual laboratory at anytime.

1.6 Conclusion

This project highlights the utilization of virtual chemistry laboratory among the students. Virtual chemistry laboratory provides a new platform to the student to do a virtual experiment based on their real-life experiment. It aims to help student to familiar their laboratory skills and techniques through learning by doing.

In the next chapter, literature reviews such as comparison of existing system and the project methodology will be discussed in details to help the development of virtual chemistry laboratory.

CHAPTER II

LITERATURE REVIEW & PROJECT METHODOLOGY

2.1 Introduction

In this chapter, the fundamental information related to the project will be gathered in order to complete literature review. The domain of the project will be identified and explained together with the comparison of existing system. The pros and cons of the existing system will be evaluated as a reference to develop the application more effectively. The chosen project methodology will be discussed to describe the development process of the project. Next, project requirement as in software and hardware requirement will be discussed in this chapter.

2.2 Domain

The domain that is covered in this project is a virtual chemistry laboratory that provides a virtual learning environment that integrating with two-dimension (2D) simulation and games. It allows students to conduct the experiments and familiar with the laboratory techniques and skills through learning by doing. Therefore, it provides students a platform to optimize their skills in their real-life laboratory and each student able to conduct the experiments as alternative way as well as to do their revision based on the virtual experiment.

2.2.1 Virtual Laboratory

According to Noor and Wasfy (2001) virtual laboratory provides virtual environment that can interact by students and teachers. Virtual laboratory is comprised of all the technological, pedagogical and human resources to perform practical activities in an interactive virtual learning environment that can utilize by students and teachers (Prieto-Blázquez, et al., 2008). From the reviews, virtual laboratory is a platform contributes in many areas especially for pedagogical education where user can gain the knowledge through learning by doing in a virtual environment.

Virtual laboratory able to simulate realistic scenario in practical activity that students often cannot think out of the box to imagine complex theory in their learning process. Review that enrich multimedia environment in virtual laboratory helps students to develop their knowledge in natural science such as chemistry, biology and physics. These kinds of subject involve a lot of complex theory that a text book unable to explain it completely.

2.2.2 Virtual Chemistry Laboratory in Teaching

As mentioned in previous, virtual laboratory helps students to develop their knowledge in the subjects that consist of complex theory. Apart from that, students can familiar with the real experiment with aids of virtual experiments (B.Dalgarno, A.Bishop and D. Bedgood, 2003). Students can be prepared their laboratory session with using virtual laboratory. Besides, it provides a safety environment for student to carry out the experiments because certain experiments might be caused accident to be happened.

The two-dimensional (2D) simulation with step by step procedures can interact by students. According to M.Morozov (2004), simulation using in virtual laboratory help users to feel as they are in the real laboratory conduct the experiment. Thus, it will indirectly sharpen student's skill in real laboratory with appropriate

technique. Besides, in this project, games will be evaluated the understanding of students based on the experiment.

There is variety of approaches to develop the virtual laboratory. Three-dimension (3D) or virtual reality are not necessarily in virtual learning environment as well as not limit to web based in the internet (Dillenbourg, 2000). M.Morozov (2004) review that web-based and standalone learning environment can be presented in two-dimensional (2D) and 3D graphics and animation. Based on N.Bakar and H.D.Zaman (2008), the importance can be measured by how students interact in learning process and how the information can be represented in a virtual learning environment rather than structured information space.

2.2.3 Pedagogical Agent

Good virtual laboratories usually involve a lot of criteria to support it. The design interface of the virtual laboratory is important to immerse the user into the environment. Pedagogical agent is one of the elements to help with the design interface. Besides, to enhance the navigation flow and control elements of the interface, pedagogical agent plays the roles of it. In the research of M.Morozov(2004), the presentation that involves pedagogical elements provide a new concept in learning environment that can grab the user's attention, monitor as well as control the user get a better experience. The pedagogical in this project is a chemist. It will help the student by providing them guidance except to grab their attention. F.Arango, et al. (2007) also reviews the effectiveness pedagogies in educational laboratories as it can guide the student through the exercise via multimedia elements, give diagnostic capabilities and etc. H.I.Yung(2010) designed a animated agent within biology adventure in the research to increase the level of interactivity. Therefore, a pedagogical agent is an important component in this project because the step by step procedures are very crucial to make the application success.