Synthesizing Learning Model of Problem Solving with Simulation

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Abstract - The objectives of this research are: to synthesize the learning model of problem solving with simulation (LMPSS) and to evaluate the learning process. Focus group has been taken as the research methodology consisted of 6 steps: 1) study from articles and related research, 2) define the research conceptual framework and design research tools, 3) draft the learning model from the study and analysis of related information, 4) identify 10 experts to evaluate the learning model, 5) organize a focus group to discuss, brainstorm and evaluate the learning model, and 6) modify and improve the learning model according to the experts’ suggestions and make the conclusion of the learning model synthesis. The findings are: firstly, the outcomes of LMPSS are consisted of 8 modules which are: interface module, learning module, simulation activity module, problem solving module, assessment module, collaboration module, scaffolding module, and content module. LMPSS model provides 4 steps of problem solving process: 1) define assumptions, 2) identify stages of problem solving, 3) experiment to prove assumptions, and 4) make the conclusion. The model will simulate situations and resources required in problem solving with SQL for students to experiment to find the final solution. Secondly, from the evaluation of 10 experts, LMPSS has been accepted.

Keywords - Learning Model, Problem Solving, Simulation

I. INTRODUCTION

Disruption of technology in terms of computer processing speed and, network communication speed, and big data processing influences huge changes in daily livings. Data and information are used in processing to forecast future possibility which is a kind of simulation. Simulation has been applied in several areas, for example, medical practices, engineering practices, learning practices, etc. Simulation is importance in terms of learning to create skills to learners in order to make appropriate decision in real situations. Therefore, in this research, we focus on simulation development.

From Thailand education reformation, Ministry of Education announced implementation of the Basic Education Curriculum 2008 (2017 revised edition), which served as the core curriculum for national education at the basic level. Learning areas comprise bodies of knowledge, skills or learning processes and desirable characteristics. The contents are divided into eight learning areas. Strand 4: Technology in Science learning area comprises of: 1) Design and Technology and 2) Computing Science, which focuses on computational thinking; analytical and constructive thinking; knowledge and systematic problem-solving [1]. This shows the awareness of human potential
development especially in analytical and problem-solving.

From disruption of technology and Thailand education reformation described, the signification problem in education was the learners lacked practicing skills. When graduated, they could not implement knowledge in real working life. Therefore, they had to take time to learn from situations in working. Moreover, most of them lacked systematic problem solving skill, so they could not solve occurred problems. Therefore, we focus on learning model of problem solving in this research.

From data collection of computer related curriculum from Rajabhat universities in Thailand western area, we found that computer students enrolled in several database related courses, for example, database systems, database management system. Database is the starting point of information system development. It can be said that database related courses are important in core computer courses especially in system development such as information system development, webpage programming and also big data analytics. In effective data managing, Structured Query Language: SQL is significant in data manipulation on databases. From SQL related courses, surveyed from lecturers, the relationship of SQL and courses in computers shows in figure 1.

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From figure 1, SQL plays a great role in several courses in computer programs. Therefore, we choose SQL in this research.

**II. RESEARCH OBJECTIVES**

The objectives of this research are:

1) To synthesize the learning model of problem solving with simulation.
2) To evaluate the learning process of problem solving with simulation.

**III. LITERATURE REVIEWS**

The main areas of this research are problem solving learning process and the implementation of education simulation model. The goal is to find the guidelines to integrate them. The related works are as follows:

Jaidee & Sanraj (2014), synthesized a learning model with simulation tool for structured algorithm using problem-based learning and scaffolding system on the e web (SAPBLS). SAPBLS is composed of four modules: 1) simulation tool for structured algorithm learning using problem-based learning with scaffolding systems to support learners, 2) students module for recording activities, learning outcomes and students profiles, 3) instruction module for teachers to manage course contents and 4) assessment module for evaluating learning outcomes. Twelve experts who are instructors in computer and education fields had accepted
that the synthesized model could be implemented as a prototype in algorithms and computer programming course, to computer science students with different levels of learning speeds.

Sintapanon (2007), defined that problem-based learning process is learning activities arrangement emphasized students to learn following processes: problem identification, solution planning, assumption making, information gathering, data analysis, assumption testing and conclusion making. Instructors and students identifies new and significant problems together, related to students’ intellectual status. Students will solve the problem and find the solution themselves. Problem solving abilities of student are different depending on intellectual, knowledge, experience, motivation and emotion. However, no one fit all, teachers should prepare study environments suitable for problem solving process, let students focus and practice to enhance their skills. This will lead students have potential to learn more and more. In problem solving learning model, the most important principles are learners learn by themselves, do activities, search for knowledges, find out, and create the own knowledges. Moreover, teachers have to create democratic classroom environments and take scientific processes to apply in learning activities.

Office of the Education Council, Ministry of Education (2007), defines the concept of problem solving learning process. Students do learning activities, construct concreate works, students interacts with teachers and classmates to think about the situations and problems, develop problem solving skill and concern future possible problems. This form of learning stimulates students’ intention together and makes students know the benefits of learning, make logically behaviour and creativity.

Moookum (2002), defied the meaning of problem solving learning process is the process that teachers focus on step-by-step and logically problem solving started with problem identification, solution planning, assumption making, information gathering, data analysis and conclusion making.

We reviewed the concept of problem solving learning process from the related works in terms of meanings and processes. We found that the problem solving processes are different depending on research details. We analyze and focus on the relationship between problem solving process and the appropriate implementation to solve identified problem. The problem solving learning processes from the reviewed research are as shown in Table I.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>PROBLEM SOLVING LEARNING PROCESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step</td>
<td>Sintapanon [5]</td>
</tr>
<tr>
<td></td>
<td>Moonkhun [6]</td>
</tr>
<tr>
<td></td>
<td>Derzy [9]</td>
</tr>
<tr>
<td></td>
<td>Alshare Choon Tat [9]</td>
</tr>
<tr>
<td></td>
<td>Hiromu wongkham [10]</td>
</tr>
<tr>
<td></td>
<td>Perry [11]</td>
</tr>
<tr>
<td></td>
<td>Clyde [12]</td>
</tr>
<tr>
<td></td>
<td>Guilford [7]</td>
</tr>
<tr>
<td></td>
<td>Weir [12]</td>
</tr>
<tr>
<td></td>
<td>Bell [14]</td>
</tr>
<tr>
<td>Synthesis results</td>
<td>Make assumption</td>
</tr>
</tbody>
</table>

1. Identify the Problem
2. Make assumption
3. Plan for Solution
4. Gather Information
5. Data analysis and hypothesis testing
6. Conclusion

<table>
<thead>
<tr>
<th>Synthesis results</th>
<th>Verfication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make assumption</td>
<td></td>
</tr>
<tr>
<td>Problem analysis</td>
<td>Verify the hypothesis and perform solutions to get answers or sets of possible answers</td>
</tr>
<tr>
<td>Determine the problem-solving process</td>
<td>Expansion to prove the assumption</td>
</tr>
</tbody>
</table>

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From Table I, we synthesized the problem solving processes from acknowledged researches. We found that the problem solving processes applied in the learning model of problem solving with simulation are composed of 4 components as followings:

1) Assumption making is the stage of problem understanding to analyze problems and identify assumptions in problem solving.

2) Solution planning is the stage of cause analyzing by considering on the relationship of problems and causes together with assumptions to define guidelines and steps of problem solving.

3) Experimenting is the stage to prove assumptions. In this stage, data collecting is carried out to choose the method or best guidelines by practicing steps by steps defined in solution planning stage.

4) Conclusion making is the stage of collecting outputs from problem solving following the guidelines to systematically summarize the problem solving.

From the investigation of related works in this topic, we analyzed them with problem solving processes, then we proposed the conceptual framework of developing a learning model of problem solving with simulation to help learners learning SQL as shown in Figure 2.

![Figure 2. The Conceptual Framework of a Learning Model of Problem Solving with Simulation](image)

From figure 2, we define the conceptual framework of a learning model of problem solving with simulation which integrate the concept of simulation to problem solving learning to help learners understand each process with collaboration and scaffolding system to help learners when required. Therefore, LMPSS or Learning Model of Problem Solving with Simulation is a simulation model to help learners practicing and understanding. Scaffolding system is included to help learners until they can find the solution. We also study and evaluate the effectiveness and satisfaction of learning. Users are divided into 2 groups: 1) instructors can define details of learning management, for example, simulation model, problems, problem solving process, and learning assessment and 2) learners can register to enrol into the course, do pre-tests, activities, and post-tests.

**IV. METHODOLOGY OF THE RESEARCH**

The synthesizing of the learning model is composed of 6 steps:

1) Investigating on related articles, documents and researches in topics: problem solving learning, simulation, agent, and scaffolding system.

2) Defining research conceptual framework. We define 3 issues of the overview framework: problem solving learning, simulation and
scaffolding system. Then, we specified the method and tools used in this research.

3) Drafting the learning model from the study and analyze principles, literatures and researches related to problem solving management with 4 steps: make assumptions, plan for solution, experiment to prove assumptions and make conclusion.

4) Specifying 10 experts to evaluate the learning model: 5 experts from computer education, 2 experts from information technology and communication for education, 1 expert from research and curriculum development, 1 expert from information technology and 1 expert from technology management. They were graduated doctoral degree and had at least 5 year experience on teaching or acknowledged in academic and research.

5) Arranging a meeting of a discussion group of 10 experts to brainstorm and evaluate the learning model to find out the ambiguous issues to make more perfection of the learning model in terms of the acceptance of the concepts of its structures and components. Before discussion, we presented the proposed model, components, processes, and the relationships of the components as shown in Figure 3.

6) Modify the learning model according to the experts’ suggestion and make the conclusion of the synthesizing of learning model.

Figure 3, shows the learning model of problem solving with simulation system composed of 4 steps: 1) make assumptions, 2) plan for solution, 3) experiment to prove assumptions, and 4) make conclusion. The system is available on the Internet to make more convenient for users.
V. RESULT OF THE RESEARCH

From the research, we found that 10 experts agreed with the main components, structure, and minor components of the learning models as the following details.

1) From the synthesizing, the learning model of problem solving with simulation or LMPSS model is composed of 3 main components: simulation, problem solving learning and scaffolding system, which their relationships is shown in Figure 4.

![Figure 4. Components of the Learning Model of Problem Solving with Simulation](image)

From figure 4, it can be described as follows:

- **Interface module** is composed of 2 parts. The first part is responsible for connecting to learners to verify learners, their personal details, enroll to course, record learning activities, tests, and test results. The second part is for connecting to the instructors to verify instructors, course, contents, scaffolding, collaboration, learning results and simulation.

- **Learning module** is composed of functions defined in conceptual framework: problem solving module, simulation activity module, and assessment module by using contents from content module and using CoLT module and scaffolding module to support in learning.

- **Simulation activity module** simulates situations from problems for learners to practice or experiment to prove assumptions. It simulates problems and required resources for learners to experience more from situations. Learners can define problem solving steps by choosing activity details step by step to experiment to prove their own assumptions. They can view the results of the query and make conclusion by examining to find out the solution guidelines and submit their solutions to instructors to evaluate.

- **Problem solving module** is the module for manage learning according to problem solving process which composed of 4 steps: assumption making, solution planning, experimenting to prove assumptions and conclusion making. During learning, learners can learn contents from content module and get supports from CoLT module and scaffolding module. Moreover, they also can experiment to prove...
assumptions using the simulation in simulation activity module.

- Assessment module is the module for evaluating the learning results after learning from the simulation model. Learning results and solution guidelines are recorded in database for instructors to evaluate.

- CoLT module is the supporting module with the connection point of knowledge, idea and solving guideline exchange among learners, other learners, and instructors using online chat, information transmission via the Internet to generate more collaborative learning.

- Scaffolding module supports learning by helping learners during learning from problem solving module to help them to solve correctly step by step.

- Content module is composed of presentation of contents. Theory contents is presented by images and descriptions. Practicing contents is presented by demonstration videos. Summary content is presented by infographic images.

2) From the evaluation of LMPSS Model from 10 experts, they all accepted the LMPSS Model as shown in Table II.

<table>
<thead>
<tr>
<th>Evaluation Issues</th>
<th>Score ( \bar{x} )</th>
<th>S.D.</th>
<th>Level</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. conceptual overview of the learning model of problem solving with simulation</td>
<td>4.50</td>
<td>0.53</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>2. appropriation of components of the learning model of problem solving with simulation</td>
<td>4.80</td>
<td>0.42</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>3. appropriation of interface module</td>
<td>4.90</td>
<td>0.32</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>4. appropriation of learning module</td>
<td>4.50</td>
<td>0.53</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>5. appropriation of simulation activity module</td>
<td>4.70</td>
<td>0.48</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>6. appropriation of problem solving module</td>
<td>4.70</td>
<td>0.48</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>7. appropriation of assessment module</td>
<td>4.30</td>
<td>0.48</td>
<td>high</td>
<td>accepted</td>
</tr>
<tr>
<td>8. appropriation of CoLT module</td>
<td>4.60</td>
<td>0.52</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>9. appropriation of scaffolding module</td>
<td>4.80</td>
<td>0.42</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>10. appropriation of content module</td>
<td>4.60</td>
<td>0.52</td>
<td>highest</td>
<td>accepted</td>
</tr>
<tr>
<td>11. appropriation of the implementation of the learning model of problem solving with simulation</td>
<td>4.80</td>
<td>0.42</td>
<td>highest</td>
<td>accepted</td>
</tr>
</tbody>
</table>

Summary | 4.65 | 0.47 | highest | accepted |

From Table II, 10 experts were accepted the LMPSS model with the highest score (\( \bar{x} = 4.65, \) S.D. = 0.47).

VI. DISCUSSION AND CONCLUSION

This research is the synthesizing of the learning model of problem solving with simulation using discussion group technique. From the result of synthesizing, we found that 10 experts accepted conceptual framework, learning model components, and 8 related modules composed of collaboration module, scaffolding module, problem solving module, content module, simulation module, assessment module, learner and instructor module. They highly agreed that the synthesized learning model is appropriate to implement as a prototype in the development of computer-based lesson using problem solving learning with simulation.

REFERENCES

(Arranged in the order of citation in the same fashion as the case of Footnotes.)


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