The Problem-based Learning Model: PBL Model via Cloud Technology to Promote Programming Skills

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Abstract

The problem-based learning model via cloud technology (PBL model via cloud technology) is a research tool fabricated with the concepts of problem-based learning management, in which students are stimulated and enabled to foresee the problems that will arise. Also, in this learning style, teachers will define the problem situations and encourage students to develop their systematic analytical thinking skill by taking action through the cloud technology. Thus, it is believed that this learning model can be used as a guideline for the instruction management that can promote students to have thinking process and problem-solving process while developing their programming skills. The objectives of this research are (1) to synthesize the conceptual framework of the PBL model via cloud technology, (2) to develop the PBL model via cloud technology, and (3) to study the results of the PBL model via cloud technology. The results of this research show that (1) the overall elements suitability of the PBL model via cloud technology is at the highest level (Mean = 4.77, SD. = 0.44), and (2) the overall suitability of the PBL model via cloud technology is at the highest level (Mean = 4.74, SD. = 0.39). Referring to the research results above, it can be summarized that the PBL model via cloud technology can be employed as a guideline to further develop the PBL systems via cloud technology in order to promote the programming skills among vocational students in Thailand.

Keywords: PBL model via cloud technology, problem-based learning model, cloud technology, programming skills

1. Introduction

The Ministry of Education has carried out its missions according to the National Strategy (2023 - 2037), the 13th National Economic and Social Development Plan (2023 - 2027), and the National Education Plan 2017 - 2036, with an aim to achieve several sustainable development goals, e.g., to develop students to become complete human beings, to let them have opportunities and equality in education as well as necessary competencies for the modern world, etc. At the meantime, the quality of education must be elevated by means of learning management that can promote multiple intelligences, focusing on learning from real practices, or active learning, while providing encouragement and support for learners of all ages to learn anything as to their interests through different digital platforms (Ministry of Education, 2022).

Vocational education management is a kind of education management designated to produce and develop skillful manpower. Furthermore, it is expected to equip both students and graduates with the quality in consistence with the demand of community enterprises, labor market, and ability to do self-employment. The education management of this kind, aiming to produce and develop vocational manpower, must be corresponding to the National Economic and Social Development Plan, the National Education Plan, the National Qualifications Framework, the national educational standards, and the career standards, which require students and graduates to possess useful skills, knowledge, competencies, and have engagement in national development (Office of the Vocational Education Commission, 2019).

Problem-based learning is a teaching method that is widely employed in education field (Phonnong, 2019; Suryanti & Supeni, 2019) because this style of learning encourages students to see problems that will arise. Teachers will define the problem situations so as to encourage students to have a systematic analytical thinking process and be able to take actions (Phunaploy, Chatwattana & Piriyasurawong, 2021). It is believed that this method can arouse students to have more interests and more curiosity. In other words, it is a teaching method

that uses "problem situations" to stimulate students to pursue knowledge in order to solve the defined problems. Thereby, students are the ones to decide what knowledge they want to learn. Moreover, with this teaching method, students are able to learn good communication skills and teamwork skills at the same time (Puttiwanit et al., 2020).

Cloud technology is an information and communication technology that is very popular today (Jlelaty & Monzer, 2012). Teachers often use cloud system in online training processes and online instruction management (Oleksiuk & Oleksiuk, 2019). Cloud technology usually focuses on the integration of networking and computing, data storage, data service resources (Soutthaboualy, Chatwattana & Piriyasurawong, 2022; Supaluk, 2018; Chatwattana, 2018; Cheerapakorn & Chatwattana, 2023, Yoosomboon & Wannapiroon, 2015).

Programming skills refer to the skills related to understanding and writing computer programs by means of systematic critical thinking and problem solving in order to use a set of commands to solve problems (Hongyai, 2022), so that the computers can function as intended (Surpare et al., 2016).

According to the aforementioned principles, the researchers have had an idea to develop the PBL model via cloud technology for use as a guideline to promote programming skills. It is also expected that this model enables students to create bodies of knowledge by their own anywhere and anytime after analyzing and solving the problems or situations assigned by teachers through cloud technology on any devices that can connect to the internet.

2. Research Objectives and Hypotheses

1) To synthesize the conceptual framework of the PBL model via cloud technology to promote programming skills

2) To develop the PBL model via cloud technology to promote programming skills

3) To study the results of the PBL model via cloud technology to promote programming skills

According to the results of evaluation on the suitability of the development of the PBL model via cloud technology to promote programming skills is at high level.

3. Research Methodology

This research is related to the development of the PBL model via cloud technology to promote programming skills, and the research methodology is as follows.

3.1 Participants

The participants in this research are 7 experts from different institutions, all of whom are experts in educational technology, which are specialized in design instruction system.

3.2 Research Instruments and Data Analysis

The tools employed in this research consist of (1) the PBL model via cloud technology, and (2) the evaluation form on the suitability of the PBL model via cloud technology to promote programming skills. The data analysis are mean and standard deviation.

3.3 Research Methodology

The research methodology designated to design this model is based on the system approach (Khemmani, 2010; Utranan, 1982), which can be divided into 3 stages as shown in Figure 1.

Figure 1. Research methodology

Stage 1: Synthesis of the documents and the researches relevant to the PBL model via cloud technology. In order to establish the conceptual framework of this research, the researchers had studied and analyzed the documents

and the researches, which are concerning instruction system, vocational curriculum, problem-based learning, cloud technology, and programming skills.

Stage 2: Development of the PBL model via cloud technology. In this stage, the researchers based the design and the development of this model on the principles of system approach and problem-based learning.

Stage 3: Study the results of the PBL model via cloud technology. The researchers employed the research tools to find out the results after having the experts use the said model. There are 7 experts in this research who were derived by means of purposive sampling. The criteria for evaluation and the levels of suitability (Kanasutra, 1995) are shown in Table 1.

Table 1. Mean score range and interpretation of results

Range of average score	Levels of suitability
4.50 - 5.00	Highest
3.50 - 4.49	High
2.50 - 3.49	Moderate
1.50 - 2.49	Low
0.00 - 1.49	Lowest

4. Results

The results of the development of the PBL model via cloud technology to promote programming skills can be summarized as follows:

4.1 Results of the Synthesis of the Conceptual Framework of the PBL Model via Cloud Technology

After the synthesis of the documents and the researches relevant to the PBL model via cloud technology, especially in terms of instruction system (Khemmani, 2010; Utranan, 1982), vocational curriculum (Office of the Vocational Education Commission, 2019), problem-based learning (Phunaploy, Chatwattana & Piriyasurawong, 2021), cloud technology (Soutthaboualy, Chatwattana & Piriyasurawong, 2022; Supaluk, 2018; Chatwattana, 2018; Cheerapakorn & Chatwattana, 2023, Yoosomboon & Wannapiroon, 2015), and programming skills (Hongyai, 2022), the researchers obtained the conceptual framework of this research as shown in Figure 2.
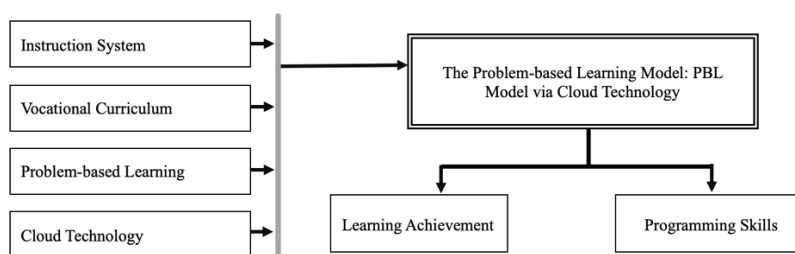

Figure 2. Conceptual framework of the PBL model via cloud technology

4.2 Results of the Development of the PBL Model via Cloud Technology

The PBL model via cloud technology is intended to be used as a guideline to further develop other PBL systems via cloud technology so as to promote programming skills, which are regarded as learners' essential characteristics in terms of systematic critical thinking and problem solving with the aid of technologies. The PBL model via cloud technology, as shown in Figure 3.
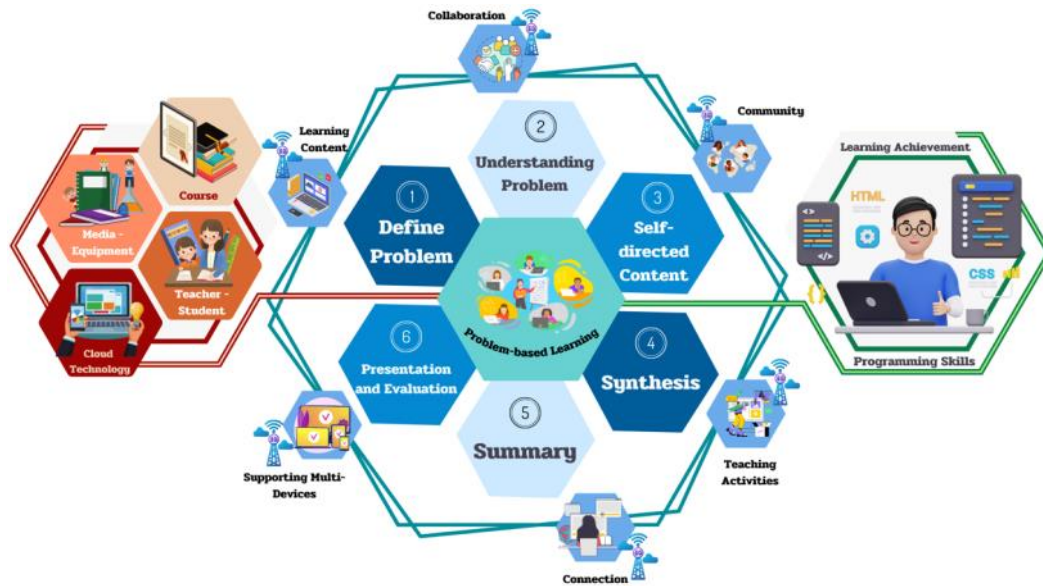
Figure 3. The problem-based learning model: PBL model via cloud technology

Figure 3 represents the PBL model via cloud technology, which includes the following 4 main elements:

1. Input factor: This element is composed of the sub-elements involved in the instruction management, i.e., analysis of user's characteristics, courses, students, teachers, media and equipment, and cloud technology.

2. Problem-based learning process via could technology: In this study, the researchers synthesized the problem-based learning process that consists of 6 steps, i.e., define problem, understanding problem, self-directed content, synthesis, summary, presentation and evaluation (Phunaploy, Chatwattana & Piriyasurawong, 2021). Additionally, the researchers included the 6 elements of cloud technology in this PBL model as well, with an aim to promote programming skills; thereby, the said cloud technology elements are learning content, collaboration, communication, teaching activities, connection, and supporting multi-devices.

3. Output: This refers to the outcome derived from the learning process, i.e. (1) learning achievement, which is related to the measurement of students' knowledge before and after learning, and (2) programming skills, which are the abilities to think systematically and write computer programs, in the computer programming courses, in order to solve problems in different situations through the effective use of technology.

4. Feedback: The feedback herein includes (1) learning achievement, and (2) programming skills.

4.3 Results of the Study on the Suitability of the PBL Model via Cloud Technology

The study the results of the PBL model via cloud technology with 7 experts in this research who were derived by means of purposive sampling. The results of the PBL model via cloud technology are shown in Table 2 and Table 3.

Table 2. Results of evaluation on the suitability of the PBL model via cloud technology (overall elements)

Items for evaluation	Assessment results		Interpretation of results
	Mean	S.D.	
1. What is the level of suitability of the principles and the concepts used to develop the PBL model via cloud technology?	4.71	0.48	Highest
2. What is the level of suitability in the elements of the PBL model via cloud technology.			
2.1 Input factor	4.71	0.48	Highest
2.2 Learning process	5.00	0.00	Highest
2.3 Output	4.71	0.48	Highest
2.4 Feedback	4.71	0.75	Highest
Overall average	4.77	0.44	Highest

Regarding Table 2, it is found that the overall elements suitability of the PBL model via cloud technology is at the highest level (Mean = 4.77, SD. = 0.44). This can be concluded that the PBL model via cloud technology

contains all necessary elements and it can be employed as a guideline to further develop other PBL systems to promote programming skills, which are learners' essential characteristics in terms of systematic critical thinking and problem solving with the effective use of technologies.

Table 3. Results of evaluation on the suitability of the PBL model via cloud technology

Items for evaluation	Assessment Results		Interpretation of results
	Mean	S.D.	
1. Input factor			
1.1 Course	4.71	0.48	Highest
1.2 Student	4.57	0.53	Highest
1.3 Media and equipment	4.85	0.37	Highest
1.4 Cloud technology	4.57	0.53	Highest
2. Learning process using the PBL via cloud technology			
2.1 Define problem	4.85	0.37	Highest
2.2 Understanding problem	4.71	0.48	Highest
2.3 Self-directed content	5.00	0.00	Highest
2.4 Synthesis	5.00	0.00	Highest
2.5 Summary	4.85	0.37	Highest
2.6 Presentation and evaluation	4.85	0.37	Highest
3. Output			
3.1 Learning achievement	4.71	0.48	Highest
3.2 Programming skills	4.71	0.48	Highest
4. Feedback			
4.1 Learning achievement	4.57	0.53	Highest
4.2 Programming skills	4.42	0.53	High
Overall	4.74	0.39	Highest

In reference to Table 3, it is evident that the overall suitability of the PBL model via cloud technology is at the highest level (Mean = 4.74, SD. = 0.39). Therefore, it can be summarized that the PBL model via cloud technology has such appropriate elements that it can be used as a guideline for the problem-based learning. This kind of learning is said to encourage students to develop their critical thinking skills and take action. Not only that, with systematic thinking and effective use of technology, students are able to see problems that will arise in the future.

5. Conclusion & Discussion

The PBL model via cloud technology is fabricated on the basis of principles, concepts, theories, and technologies of new teaching in the era 4.0 in order to respond to and deal with the current situations while corresponding to today's learning styles of learners. In addition, this learning model is designated to enable students to learn anywhere and anytime, and receive first-hand experiences from problem-solving methods via cloud technology. Besides, it is expected that this model shall help students develop the skills of analytical thinking, good communication, and teamwork.

The PBL model via cloud technology is composed of 4 main elements, i.e., 1. input factor, which includes of course, student, media and equipment, and cloud technology; 2. learning process using the PBL via cloud technology, which consists of 6 steps, i.e., define problem, understanding problem, self-directed content, synthesis, summary, and presentation and evaluation; 3. output, which consists of learning achievement, and programming skills; and 4. feedback, which includes learning achievement, and programming skills.

According to the assessment on the suitability of the development of the PBL model via cloud technology, it is found that (1) the overall elements of the PBL model via cloud technology is at the highest level, and (2) the overall suitability of the PBL model via cloud technology is at the highest level. The results above are in line with the research of Phunaploy, Chatwattana & Piriyasurawong (2021), who said that the application of problem-based learning processes integrated with cloud learning technology in the management of activities and interactions can lead to continuous learning. Furthermore, it is consistent with the research of Chimmalee & Anupan (2022) who mentioned that the use of technologies, tools, and applications on cloud provides flexibility and improvement of instruction management, which has a vital role in the development of students' problem-solving skill. Moreover, it is in compliance to the study of Wang & Hwang (2017), who insisted that the management of collaborative learning activities using problem-based strategies contributes to the enhancement

of learning achievement, especially the programming skills of students.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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