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# Enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing

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## Abstract

The purposes of this research study were: 1) to design inquiry-based learning activities to enhance students' critical thinking skills through teaching and learning using social network and cloud computing and 2) to evaluate these learning activities. The research methodology is divided into two steps. The first step involved designing the learning activities and the second step involved evaluation. The study sample was purposively selected and consisted of ten experts in higher education instructional design, inquiry-based learning activity design, social network, cloud computing and enhancing critical thinking skills. This sample either held a doctoral degree or at least three years of experience in relevant fields. This research describes the learning activities and assesses appropriateness using an evaluation form. Data were analyzed using the mean ( $\bar{x}$ ) and standard deviation. The research findings were as follows: the learning activities consisted of three main steps: 1) pre-teaching and learning preparation, 2) enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing and 3) measurement and evaluation. The sample judged the learning activities as highly appropriate and applicable to real practice.

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**Keywords:** Cloud Computing; Critical Thinking Skills; Inquiry-Based Learning Activities; Social Network

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## 1. Introduction

A framework for 21<sup>st</sup> century learning developed by the Partnership for 21<sup>st</sup> Century Skill outlines a vision of a successful student functioning in the new global economy. This framework presents an overview of 21<sup>st</sup> century teaching and learning techniques and explores relevant outcomes across three key areas: 1) content knowledge, 2) specific skills and 3) expertise and literacies. For success in today's world, students require core academic subject knowledge and understanding, in addition to other skills such as critical thinking and problem solving, creativity and innovation, communication and collaboration.

Critical thinking has been defined as an important educational goal and is understood to mean reasonable reflective thinking that is focused on deciding what to believe or do. In this research study, critical thinking skills were specified in six elements according to Norris and Ennis (1989). These elements include 1) determining the credibility of sources and observations, 2) inferring and judging deductive conclusions, 3) definitions and identification of assumptions, 4) planning induction experiments and predicting probable consequences, 5) inferring and judging inductive conclusions and 6) semantics (Wannapiroon, 2008).

Previous research has shown that students' critical thinking abilities are significantly higher when these skills are taught through inquiry-based learning than traditional teaching methods (Wongkam et al.). In the current study, critical thinking skills were taught using the BSCS 5E instructional model. This model consists of five phases as follows: 1) engagement: the teacher assesses the student's prior knowledge and engages the student's interest in new concepts through short activities that promote curiosity and elicit prior knowledge, 2) exploration: the teacher provides a number of cooperative exploration activities designed to help the student to use their prior knowledge to generate new ideas, explore questions and possibilities and to design and conduct an investigation, 3) explanation: this phase focuses on the student's exploration, provides opportunities to demonstrate conceptual understanding and processing skills or behaviors and gives the teacher an opportunity to guide the student toward deepening their understanding, 4) elaboration: the teacher challenges and extends the student's conceptual understanding through new experiences. The student is then able to develop a deeper and broader understanding and apply this to other activities. Finally, 5) evaluation: this phase encourages the student to assess their understanding and abilities and provides opportunities for the teacher to assess progress towards educational objectives (Bybee et al.).

Information and communication technologies and social network can be used as effective tools to improve instructional approaches and enhance critical thinking skills using the online environment (Haghparsat et al., 2013). Social network are defined as any site or service that allows people to connect with each other, to inform others about events and activities and to share news, photos, videos and other items of interest. Social networking is a relatively new way to communicate and share information (Poore, 2013). The current study used Facebook as the social networking tool of choice given that 85% of the 21 million social network accounts in Thailand are Facebook accounts (Zocialinc).

Cloud computing can help educational institutions to resolve a number of their common challenges, including cost reduction, enabling quick and effective communication, security and privacy and ensuring flexibility and accessibility (Alshuwaier et al., 2013). Cloud computing contributes to the growing number of useful services that are now available on the internet and provides a range of services useful to students and teachers, such as direct access to different academic resources, research applications and higher education tools. Cloud computing enables the user to access a network of ubiquitous, convenient and on-demand configurable computing resources such as networks, servers, storage applications and services (Mell & Grance).

The learning steps and activities of social learning environment as inquiry-based on cloud technology were appropriate for developing the student's critical thinking skills (Meepian & Wannapiroon, 2013).

The aim of the present study was to explore if students' critical thinking skills could be improved through teaching and learning by inquiry-based learning activities using social network and cloud computing. This approach is seen as a potentially effective way to facilitate learning in the 21<sup>st</sup> century learning.

## 2. Purpose of the study

The purposes of this research study were;

- 2.1. To design inquiry-based learning activities to enhance students' critical thinking skills through teaching and learning using social network and cloud computing.
- 2.2. To evaluate the inquiry-based learning activities using social network and cloud computing.

## 3. Scope of the study

### 3.1. Population

The population in this research study consisted of experts in higher education instructional design, inquiry-based learning activity design, social network, cloud computing and enhancing critical thinking skills.

### 3.2. Sample Groups

The sample comprised ten experts in higher education instructional design, inquiry-based learning activity design, social network, cloud computing and enhancing critical thinking skills. This sample either held a doctoral degree or at least three years of experience in related fields. A purposive selection method was used.

### 3.3. Variables of the research

The independent variable was inquiry-based learning activities to enhance students' critical thinking skills through teaching and learning using social network and cloud computing and the dependent variable was results of the appropriateness evaluation of learning activities.

## 4. Conceptual Framework

The conceptual framework for enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing is shown in Figure 1.

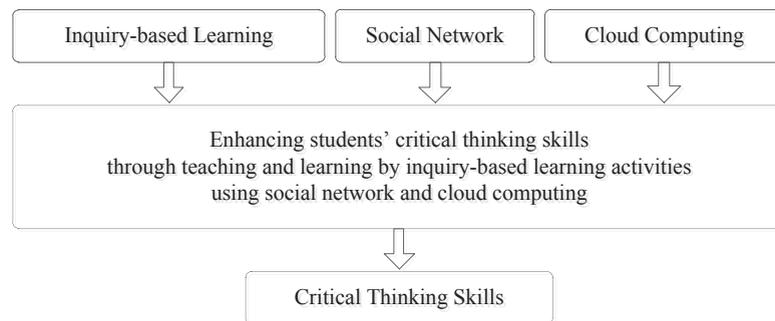


Fig. 1. conceptual framework.

**5. Research Methodology**

5.1. *The aim was to design inquiry-based learning activities to enhance students’ critical thinking skills through teaching and learning using social network and cloud computing.*

5.1.1. Relevant articles and research papers were analyzed and synthesized.

5.1.2. Five experts were interviewed to gather and analyze data about learning activities. These experts were asked to provide data on students’ ICT literacy for learning, learning styles and cognitive styles.

5.1.3. Research instruments were designed as follows: 1) inquiry-based learning activities to enhance students’ critical thinking skills through teaching and learning using social network and cloud computing and 2) an appropriateness evaluation form.

5.1.4. Learning activities were verified and appropriateness evaluation forms were filled in by the five identified experts.

5.2. *The aim was to evaluate the effectiveness of inquiry based learning activities for enhancing students’ critical thinking skills through teaching and learning using social network and cloud computing.*

5.2.1. The learning activities were evaluated by the five experts.

5.2.2. The learning activities were modified based on the advice of the experts.

5.2.3. The learning activities were evaluated using diagrams and a written essay.

5.2.4. The results of the appropriateness evaluation were analysed using mean ( $\bar{x}$ ) and standard deviation (S.D.). Five criteria for evaluation were considered using Likert scales anchored with the terms highest, high, moderate, low and lowest.

**6. Result**

6.1. *Inquiry-based learning activities to enhance students’ critical thinking skills through teaching and learning using social network and cloud computing are illustrated in Figure 2.*

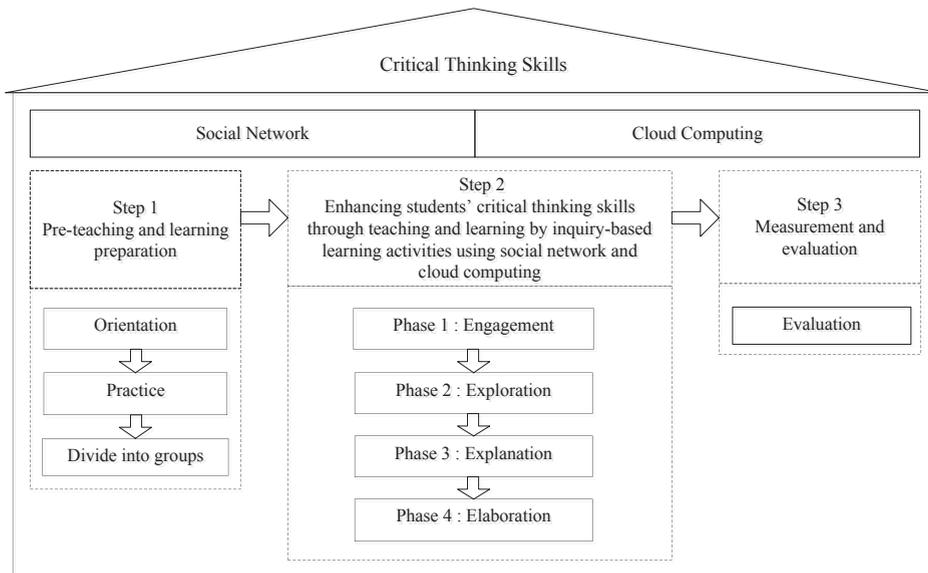


Fig. 2. Enhancing students’ critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing.

The learning activities consisted of three main steps:

*1) Pre-teaching and learning preparation*

1.1) Orientation

1.1.1) Teachers recommend courses, learning objectives, learning methods, learning activities, ways to send and verify assignments, communication channels and measurement and assessment procedures through Learning Management System (LMS).

1.2) Practice

1.2.1) Students register on LMS, Facebook and cloud computing and begin their practice. Students can use Facebook single sign on to share information with other social network.

1.3) Divide students into groups

1.3.1) Students are divided into groups. Each group consists of five people. Group names are created, the roles of group members defined and a group leader and secretary nominated.

*2) Enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing.*

This step can be divided into four phases:

2.1) Engagement

2.1.1) Teachers spark students' interests and curiosity using short activities or examples that link to prior knowledge by sharing documents, data, photos, audio clips or videos on a Facebook wall.

2.1.2) Teachers ask questions that spark students' interests and raise questions using Facebook comment functions. This activity aims to help students to determine the credibility of sources and observations.

2.1.3) Teachers examine students' prior knowledge using the Facebook comment function.

2.1.4) Teachers and students identify questions and issues that they are interested to inquire together using Facebook comment or Facebook discussion functions. This activity aims to help students to determine the credibility of sources and observations, and infer and judge deductive conclusions.

2.2) Exploration

2.2.1) Students clarify their understanding by using Facebook discussion functions to develop questions and issues that require answers. This activity assists in definitions and identification of assumptions.

2.2.2) Students plan their exploration and investigation via document sharing. This activity enhances the definitions and identification of assumptions.

2.2.3) Students set up hypotheses, define possible alternative hypotheses and discuss and share opinions with group members using Facebook discussion functions. During these activities, students can record and share data via document sharing. This activity enhances definitions and identification of assumptions.

2.2.4) Students search for data and conduct experiments, join in with fieldwork activities or test hypotheses. During these activities, they search for data using search engine which they can then be collected in various formats using document, file, data, photo, audio and video sharing. This activity can help students to determine the credibility of sources and observations.

2.2.5) Students verify hypotheses, develop new knowledge, discuss and share opinions with group members using Facebook discussion functions. They record new knowledge and cite data from various resources using document, file, data, photo, audio or video sharing. This activity can enhance planning induction experiments and predicting probable consequences.

### 2.3) Explanation

2.3.1) Students analyze, interpret and draw conclusions from the data obtained via document sharing. This activity aims to enhance inferring and judging inductive conclusions.

2.3.2) Students explain and present believable results in various formats using web tool. They cite data sources using document, file, data, photo, audio or video sharing. This activity enhances determining the credibility of sources and observations, and facilitates the planning induction experiments and predicting probable consequences.

2.3.3) Teachers and students share opinions between groups. They ask questions and offer suggestions to facilitate understanding using comment functions incorporated in web tools. This activity helps to determine the credibility of sources and observations.

2.3.4) Students in each group develop and present new knowledge using web tools and cite data from various resources via document, file, data, photo, audio or video sharing. This activity enhances definitions and identification of assumptions and semantics.

### 2.4) Elaboration

2.4.1) Teachers present new experiences, new situations or new questions to help students to apply and expand upon their knowledge more widely. This is done via document, data, photo, audio or video sharing on Facebook walls.

2.4.2) Students expand new knowledge more widely and discuss and share additional opinions with group members. Their understanding can be facilitated using Facebook comment or Facebook discussion functions. This activity can help to enhance determining the credibility of sources and observations, assist definitions and identification of assumptions, and semantics

2.4.3) Teachers ask students to clarify certain points and link prior and new knowledge using Facebook comment functions.

2.4.4) Students apply new knowledge in other contexts, present their results using web tool and cite data from various resources by document, data, photo, audio and video sharing. These activities enhance semantics.

## 3) *Measurement and evaluation*

### 3.1) Evaluation

3.1.1) Students self-assess their learning development, understanding and group working performance via document sharing.

3.1.2) Students assess the group working performance of other group members via document sharing.

3.1.3) Students evaluate teaching and course content via document sharing.

3.1.4) Students take examinations to measure and assess their learning outcomes via document sharing. This activity aims to enhance determining the credibility of sources and observations, assist with inferring and judging deductive conclusions, help to define and identify assumptions, plan induction experiments and predict probable consequences, infer and judge inductive conclusions, and semantics.

3.1.5) Teachers assess learning, development and students' participation in learning activities using Facebook and web tool.

## 6.2. *Evaluation the effectiveness of enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing*

Table 1 shows that the sample perceived that enhancing students' critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing was highly appropriate ( $\bar{x} = 4.7$ , S.D. = 0.50).

Table 1. Results of the appropriateness evaluation of enhancing students’ critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing

Evaluation Lists	Results		Level of appropriateness
	$\bar{x}$	S.D.	
1. Pre-teaching and learning preparation			
1.1 Orientation	4.80	0.45	Highest
1.2 Practice	4.80	0.45	Highest
1.3 Divide students into groups	4.60	0.55	Highest
2. Enhancing students’ critical thinking skills through teaching and learning by inquiry based learning activities using social network and cloud computing			
2.1 Engagement	4.60	0.52	Highest
2.2 Exploration	4.72	0.49	Highest
2.3 Explanation	4.70	0.50	Highest
2.4 Elaboration	4.65	0.52	Highest
3. Measurement and evaluation			
3.1 Evaluation	4.76	0.47	Highest
Summary	4.7	0.50	Highest

Table 2 shows that the sample perceived that enhancing students’ critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing was highly applicable to real practice ( $\bar{x} = 4.5$ , S.D. = 0.55).

Table 2. Results of the appropriateness evaluation of enhancing student’s critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing for apply in real practice

Evaluation Lists	Results		Level of appropriateness
	$\bar{x}$	S.D.	
1. Teaching and learning by inquiry based learning activities using social network and cloud computing is appropriate to enhance critical thinking skills	4.6	0.55	Highest
2. Enhancing students’ critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing is possible to apply in real practice	4.4	0.55	High
Summary	4.5	0.55	High

**7. Conclusion**

These research findings show that information and communication technologies play an important role in student developments in 21<sup>st</sup> century learning. In this study, students used social network to communicate and collaborate with each other during learning activities. They used cloud computing to collect, manage, share and present data. Cloud computing provides a variety of useful services available on the internet.

Enhancing students’ critical thinking skills through teaching and learning by inquiry-based learning activities using social network and cloud computing is appropriate for application to real practice and helps student to develop the knowledge and skills that they will require to achieve success in the information age.

**8. Discussion**

According to the results of the appropriateness evaluation, the researcher found that:

- 8.1. The exploration step was considered to be highly appropriate according to Haghparast et al., who notes that information-seeking behaviors can be helpful in cultivating the critical thinking of higher education students.
- 8.2. When designing learning activities, the researcher focused on group activities, sharing information and discussion in line with Wei, who suggests that critical thinking is facilitated through the incorporation of others’ ideas and when reflecting on and synthesizing credible information
- 8.3. Social network were used as a tool in inquiry-based learning activities following Ractham & Firpo, who note that social networking sites such as Facebook have the potential to expand teaching and learning possibilities

beyond the classroom. These sites provide users with familiar and easy to-use technologies that can be easily adapted for use in educational settings. Facebook can be used as a tool to enhance communication and collaboration amongst course members.

8.4. The use of cloud computing as a tool in inquiry-based learning activities is supported by Eteokleous & Ktoridou, who note that a 'community of inquiry' (CoI) could be developed and sustained through cloud computing, ensuring virtual communication, collaboration and authoring between students. The innovative use of cloud resources, asynchronous communication and collaboration and authoring opportunities offers students and lecturers an appropriate context in which to enhance experience, construct knowledge and extend learning. More specifically, the adoption of an inquiry-based learning approach in CoI ensures that students develop skills such as problem solving, critical thinking, self-directed learning, communication, collaboration and knowledge construction. These are essential for professional success.

8.5. The design of the inquiry-based learning activities was informed by Ma et al., who presents five steps to facilitating students' learning as follows: 1) situating learning in an authentic context and stimulating students' interest, 2) encouraging self-directed learning, 3) solving and resolving problems through collaborative learning, 4) expanding the learning experience through individual-based learning and 5) presenting and assessing learning outcomes. The current research shows that students in the inquiry-based class achieved better content knowledge and technical skills than the students in the didactic instruction class. Most of the students expressed positive and favorable feelings towards their learning attitudes, learning abilities and to the online learning environment.

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