

Factors Related to Active Learning: Perspective of Learning Technology Development

Nutnicha Sornlump, Arisara Jiamsanguanwong*

Department of Industrial Engineering
Faculty of Engineering
Chulalongkorn University
Bangkok, Thailand
*Arisara.j@chula.ac.th

Waratta Authayarat
Department of Industrial Engineering
Faculty of Engineering
Burapha University
Chonburi, Thailand

Abstract

The COVID-19 pandemic has caused significant changes in every aspect of daily life. Many educational institutions around the world have decided to cancel in-person classes and move all classes to online mode. Despite the fact that in-person classroom learning is said to be more effective and preferable, online learning has played a significant role in limiting COVID-19 transmission. With recent technological advancements, synchronous e-learning allows teachers to communicate and interact with students virtually. However, in several studies, the effectiveness of on-site and online learning has been studied and compared. According to the survey, about 65.9% of the sample group prefer to study on-site rather than study online regards to its limitation of interaction. It would be great if the development of learning technology, especially online learning platform, provide the appropriate functionality that supports active learning activities. Thus, the purpose of present study was to investigate the key factors that contributed to active learning in the context of online learning. This study conducted systematic reviews of the PRISMA-P together with 96 users interview from both learners and teachers to extract the key factors that related to active learning in online learning platform. As a result, the factors that contribute to and support active learning are critical thinking, decision-making, problem-solving, effective questioning, idea demonstration, participatory, micro-interaction, self-reflection, and the positive teacher-student relationship. Implications for future learning technology development were discussed.

Keywords

Active learning, Synchronous e-learning technology, Factor, Learning technology development

1. Introduction

The COVID-19 outbreak has disrupted and altered the way business and activities are conducted in our daily lives. As a result, many educational institutions around the world decided to shut down and shift their teaching style from physical classroom learning to online classroom learning. This was the most suitable way to study during the 2019 novel coronavirus pandemic as it minimizes the physical contact between students and instructors (Hussein et al., 2020). With technology advancement, synchronous e-learning has successfully bridged the gap between on-site and online learning. It allows the student to virtually attend a class session through video conferencing (Giesbers et al., 2013). Nowadays, there are many synchronous technology as a tool in online learning, such as Google Meet, Cisco Webex, Microsoft Teams, Learn Anywhere, and Zoom.

One benefit of online learning includes helping learners to use their time more efficiently, as it helps students save time consuming in traveling to and from the university. Another benefit that students gain from online learning is the improvement of the safety and welfare of students as it reduces the risk of contacting the virus (Sahu, 2020). Moreover, online classrooms create the potential to reach out more students, as everyone would be able to access the class contents, as long as they have the internet access and technologies (Hussein, 2016). However, online learning also contains some drawbacks which arised from the lesson management of schools and the learning methods. There were some common problems with virtual classes that students around the world were experiencing, including the lack of interaction with the instructors and the lack of technological support (Ferri et al., 2020).

In several studies, the effectiveness of on-site and online learning has been studied and compared. The study indicated that on-site learning is more effective and preferable (Bozkurt et al., 2020). According to the survey, about 65.9% of the sample group prefer to study on-site rather than study online regards to its limitation of interaction (Chakraborty et al., 2021). The interaction style in learning can be divided into two approaches, namely passive learning and active learning. Passive learning is often used in a higher education which is in a lecture format. It is a one-way communication that learners are responsible for listening to experts who impart knowledge, and the opposite approach is an active learning, referring to the learning management process in which all learners are involved in taking action and use the thought process where students will shift their roles from receivers to co-creators (Sandrone et al., 2021).

Active learning was described in Bloom taxonomy as one of the pillars of a student-centered approach. Bloom's Taxonomy is a well-known educational goals framework (Arievitch, 2020). This taxonomy is based on the hierarchy of learning objectives, consisting of memorizing, understanding, applying, analyzing, evaluating, and creating, respectively. Although it is occasionally critiqued from a more classically didactic standpoint, the taxonomy is very well-liked and influential in modern educational research and practice (Booker, 2007). This could be seen that active learning had more positive outcomes than traditional learning for examples student were encouraged to participate in Q&A, satisfaction with learning at a higher level, increase the ability of critical thinking (Blasco-Arcas et al., 2013). Therefore, it would be great if the development of learning technology, especially online learning platform, concern the functionality that supports active learning activities.

Thus, the purpose of present study was to investigate the key factors that related to active learning in the context of online learning. The result from this study has the implications on online learning technology development to develop the technology that support active learning activities to help narrowing the gap between on-site and online learning. This study conducted systematic reviews of the PRISMA-P together with real users interview from both learners and teachers to extract the key factors that related to active learning in online learning platform.

2. Methods

2.1 Systematic Review

The systematic review was considered the traditional way of summarizing previous related research on the focused topic. In this research, the purpose of systematic review was to investigate the factors that contributed to active learning in the context of online learning. The PRISMA-P was used to gather and evaluate all relevant literatures that fit with pre-defined eligibility criteria such as keyword, inclusion, and exclusion criteria and to report the minimum set of papers in systematic reviews.

2.1.1 Data Collection

The initial searching keywords are "factor", "active learning", "evaluation", and "online learning". These initial keywords were used to search in three electronic databases: ScienceDirect, IEEE Xplore, and Scopus. The search only looks for keywords in article topics and abstracts from 2008 to 2021, and only in English language. The PRISMA-P flowchart of the study is shown in Figure 1.

2.1.2 Inclusion and Exclusion criteria

The inclusion criteria of eligible papers are in the field of human-computer interaction. It must be a Synchronous Active Learning and the search is in English. After screening, the results can be divided into 3 groups as follows: the impact of active learning, methodology for measuring learning performance, and instructional and other learning contexts (guidelines and principles). Figure 2. shows summary of the number of eligible papers in each group,

however, this research focuses only on the impact of active learning. Exclusion criteria were the articles that did not publish in English. Conference abstracts, thesis/dissertations, book reviews, commentaries, whitepapers, and expert reviews were excluded from the majority of empirical studies. Also, the non-desktop related, disabled participants factors, and asynchronous studies were excluded from the study.

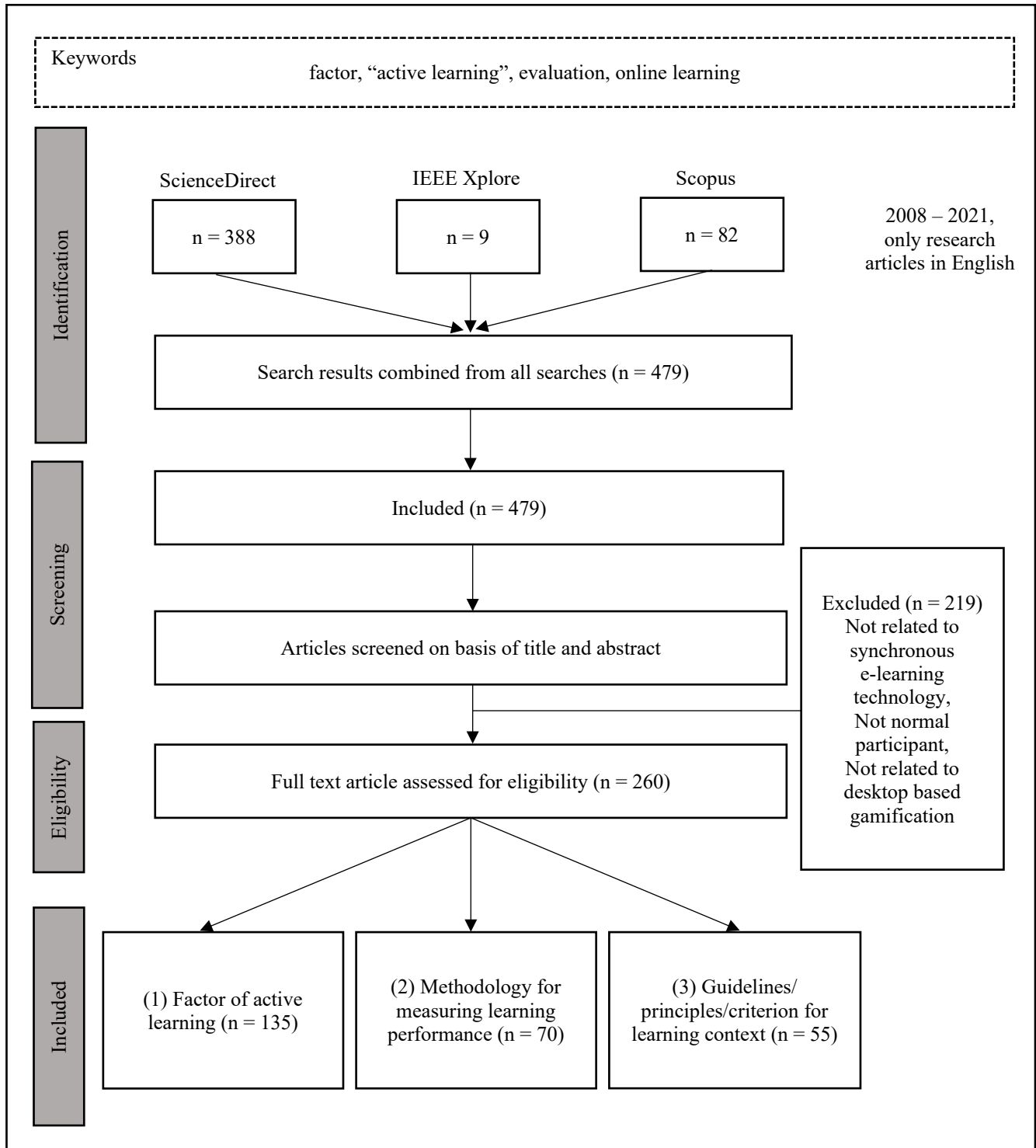


Figure 1. PRISMA-P flow chart of study

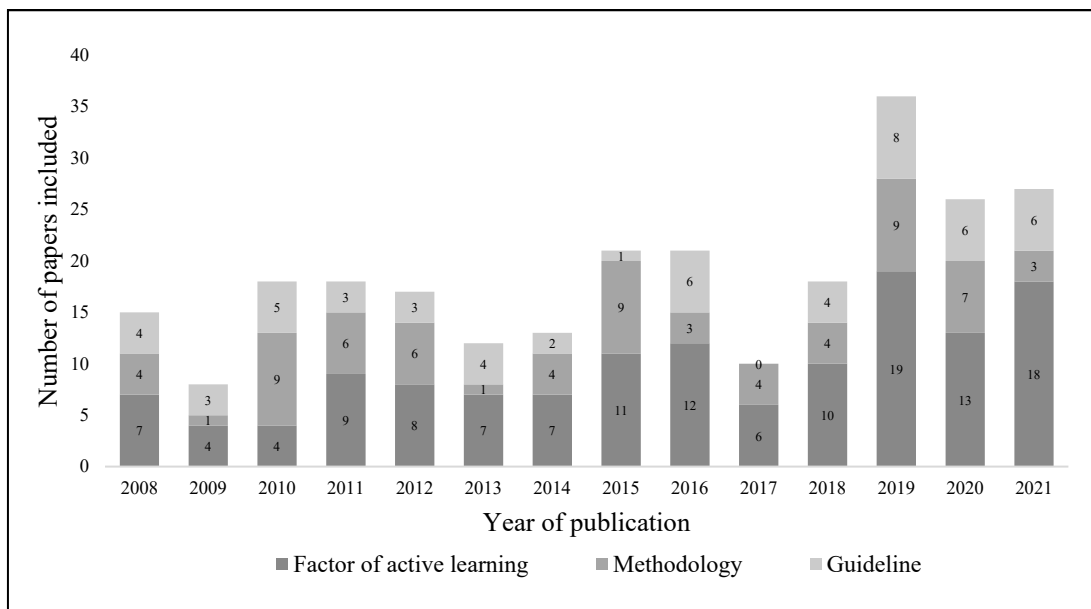


Figure 2. Summary of the number of eligible papers

2.2 User Interview

2.2.1 Participants

A total of 96 participants (72 students and 24 instructors) from the Faculty of Engineering and Faculty of Science at Chulalongkorn University and Burapha University in Thailand participated in the interview session of this study. Their age ranged from 21 – 25 years old (students) and 32 – 45 years old (instructors). All participants are familiar with using platforms either one of the 3 types of learning technologies: Zoom, Microsoft Teams, and Google Meet.

2.2.2 Apparatus

Due to the Covid-19 situation, all interview sessions were conducted online via Zoom. The devices used were computers, microphone, camera, and iPads.

2.2.3 Interview questions

The pros and cons of using e-learning classroom platforms such as Zoom, Microsoft Teams, and Google Meet were discussed. The interviews were conducted based on three questions: Q1- What did you like and dislike about online learning and teaching during the epidemic of Covid 19? Please explain, Q2- When you use the online platform for learning or working with groups, what problems are you experiencing? Please explain, and Q3- Is there any problem with the system used for online learning/teaching compared to learning/teaching in the classroom before the Covid 19 epidemic? Please explain. All interview sessions were recorded and transcribed as a written record for further data mining to extract key factors.

3. Result

3.1 Systematic Review

The systematic review provides a summary of the primary research related to the factor of active learning. The duplicated journals were removed from the three databases, as a result, a total of 479 papers were obtained. The papers were then sorted based on their titles and abstracts together with the inclusion and exclusion criteria. Lastly, data extraction was done manually on spreadsheet software and focused only on factors of active learning. As a result, a total of 135 papers were selected and included in this research. According to the systematic review, the factors of active learning were theoretically drawn to a conclusion and are shown in Table 1 that explains 5 key factors of active learning together with its definitions: critical thinking, decision-making, problem-solving, effective questioning, and idea demonstration.

Table 1. Factors of active learning from systematic review

Group 1: Factor of active learning	Definition
Critical thinking	Critical thinking is the ability to acquire information, analyze and evaluate to reach a conclusion or answer by using logic or reasoning skill (Dinuță, 2015). Critical thinking allows student to exercise their thought process in a logical manner.
Decision-making	Decision-making is the process of making choices by identifying a decision, gathering information, and assessing alternative solutions (Castelli et al., 2010). Decision-making allows students to discover the direction of learning, find their own learning style, leading to self-determination (Metacognition).
Problem-solving	Problem-solving skill is an intellectual, logical, and systematic method that helps individuals when dealing with problems, searching for multiple solutions, and selecting the best solution regarding to the conditions (Wang and Chiew, 2010). This is one of the phases and strategies reflect students' knowledge mastery.
Effective questioning	Effective questioning is the ability to ask questions that can capture the issue relevant to what you want to ask effectively (Sylvester, 2016). This make students think along and learn in the same rhythm. This ability assists students to communicate and understand class content as well as assists instructor to acknowledge students' understanding level and make a decision of moving to the next topic.
Idea demonstration	The idea demonstration is the ability to explain their idea and thought to others (Stone and Stojnic, 2014). It is considered to stimulate class in order to create active learning atmosphere.

3.2 User Interview

Written interview records were extracted by text mining technique. Text mining is the process of extracting interesting and significant patterns from textual data sources with the purpose of searching for information. Several applications of text mining techniques, such as summarization, classification, and clustering, can be applied to extract an enormous amount of information (Talib et al., 2016). Two researchers were instructed to read the interview transcript and select keywords that fit best with the objective of present study. The results were analyzed to determine whether the keywords chosen by both researchers were agreeable. In most cases, a discussion between two researchers was held to solve the disagreement and was then counted as agreeable. Lastly, Cronbach's alpha is used to verify the validity of this text mining results by these 2 researchers; if Cronbach's alpha is greater than 0.70, the interview is considered reliable (Adamson and Prion, 2013). The result revealed that Cronbach's alpha was 0.83, the results was therefore reliable. Figure 3. shows the example of keywords extracted from the interview transcript and grouped to four factors by two researchers. To begin with, "group works" and "breakout room" were two keywords obtained from interview transcript. These two keywords provided a key element of "micro-interaction", which implied encouragement of communicating and exchanging the idea between people in a small group activity. Additionally, participation in class that occurred in a variety of means, such as "chatting box" or "turning on the camera", also hinted another essential element of "participatory". Another keyword is "do exercises". Doing exercises or homework helps students assess own lesson understanding and reflect what students have learnt during class. Thus, doing exercises or homework led to a key element of "self-reflection". Self-reflection possibly can reinforce an individual growth from learning activity. Last key element that refers to a characteristic of positive relationship between teacher and student was "positive teacher-student relationship". The positive relationship between teacher and student would be the essential element that creates psychological support for students in order to draw out the students' ultimate potentials. The definitions

of four factors: participatory, micro-interaction, self-reflection, and positive teacher-student relationship extracted from user interview were shown in Table 2.

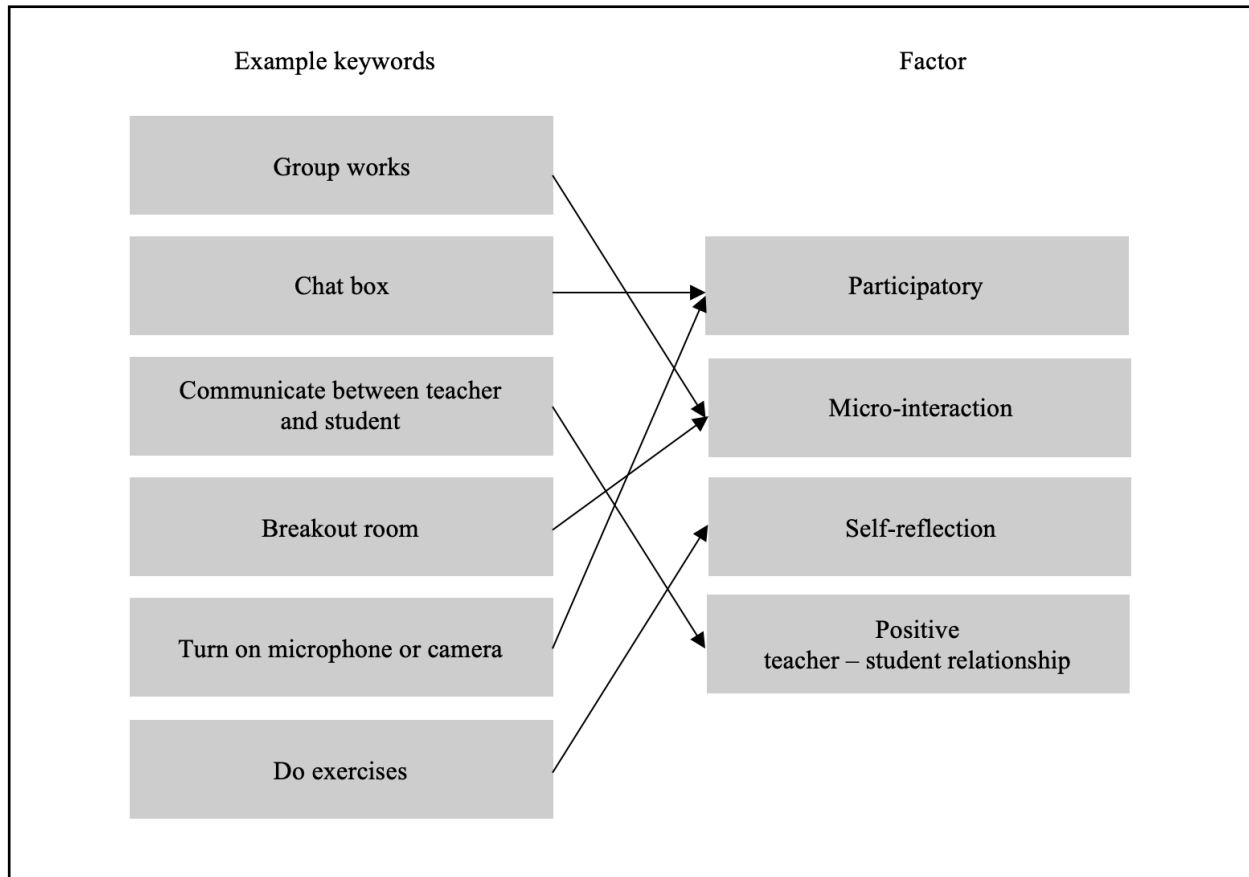


Figure 3. Example of keywords extracted from the interview

Table 2. Factors of active learning from user interview

Group 2: Factor of active learning	Definition
Participatory	A participatory is an action that a particular person or group of people taking part in an active learning class (Surjanti et al., 2020).
Micro-interaction	Micro-interaction is a small group activity that encourage people to communicate, exchange thoughts, create group outcome and motivate people to vigorously join in an active learning activity (Breslav et al., 2014).
Self-reflection	Self-reflection is a process of thinking and understanding about your own feeling, thought, and behavior. This process can reinforce an individual growth from learning activity through self-reflection (Nesbit, 2012).
Positive teacher-student relationship	Positive teacher-student relationship is a characteristic of relationship that creates a psychological support for students in order to draw out students' potential, be independent, and motivate them in class (Connell and Wellborn, 1991)

4. Discussions

The results from theoretical of active learning and practical issues from real users interviews had revealed 9 factors contributed to the active learning which are critical thinking, decision-making, problem-solving, effective questioning, idea demonstration, participatory, micro-interaction, self-reflection, and a positive teacher-student relationship. The designer of online learning technology should take these underlying factors as a fundamental into their consideration in order to provide a good usability and utility learning platform or future technology that could bridge the gap between on-site and online learning that promote active learning activities. These could be used as a guideline to understand what is needed as a learning technology interaction.

To begin with, one of the important factors influencing active learning is critical thinking, which was identified through theoretical research. Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. Critical thinking provides a key element in cognitive and metacognitive development and thus facilitate better personal cognitive development and the development of higher order thinking skills. To encourage critical thinking, functions such as visibility control, voice-based discussion, text-based discussion, real-time survey, or real-time poll are suggested. Likewise, decision-making is also another key factor. It is the process of making choices by identifying decisions, collecting information, and evaluating alternative solutions. Appropriate decisions must be eventually finalized from various alternatives. Therefore, decision-making is an essential process which is helpful in learning planning or discovering the direction of learning, leading to self-determination. Integration of functions such as data recorded library and real-time responsive would be suggested as well. Additionally, problem-solving skill is another impactful factor. It is an intellectual, logical, and systematic method that assists individuals in dealing with problems and searching for multiple solutions, allowing them to select the best solution given the circumstances. On the one hand, it helps instructors assess students' knowledge acquisition and provide timely appropriate. Some examples of functions are visibility control, voice-based discussion, text-based discussion are also recommended to improve student learning.

Furthermore, effective questioning and idea demonstration are two factors, that can be obtained from theoretical research. Effective questioning is ability to ask questions that can capture the issue relevant to what you want to ask effectively. Besides, it would enhance students' learning through two-way communication and allow instructor to acknowledge students' understanding and move to the next point or next topic of the lesson. Effective questioning can also be conducted through voice-based discussion, drawing, and text-based discussion during classes. Similarly, idea demonstration is another effective way of engaging students throughout the class discussion. Idea demonstration is a way in which students construct their understandings based on student ability to present their idea and thought to others. It would stimulate the classroom and its environment as active learning atmosphere. To improve student engagement through idea demonstration, applying functions such as visibility control, voice-based discussion, text-based discussion, drawing, and facial expressions are also recommended.

Consecutively, practical research from this study has generated another four factors of active learning. First, a participatory is an action that a particular person or group of people taking part in an active learning class. Also, an integration of a participatory system with functions, such as Avatar emoticon, voice-based discussion, text-based discussion, and real-time survey and working space (i.e drawing, sticky notes) is recommended to enhance students learning. Second, micro-interaction is defined as another factor of active learning. Micro-interaction is a small-group activity that motivates people to actively engaged in an active learning activity by encouraging people to communicate, exchange ideas, and produce collective outcomes. To encourage the micro-interaction in class, functions such as visibility control, voice-based discussion, text-based discussion, and working space (i.e drawing, sticky notes) are suggested to allow participants to interact in the group activities. Another factor of active learning is self-reflection. Self-reflection is a process of thinking and understanding about one's own feeling, thought and behavior. Through self-reflection, it can reinforce an individual growth from learning activity.

Lastly, the final factor is the positive teacher-student relationship. The positive teacher-student relationship refers to a characteristic of relationship that creates a psychological support for students in order to draw out students' potential, provide a positive support condition for students in independent learning and motivate them in class. Integration of functions such as facial expressions, various immersive view designs of meeting room and voice-based to promote a positive teacher-student relationship.

From discussion above, it is recommended that functions such as visibility control, voice-based discussion, text-based discussion, facial expressions, drawing platform, working space, library, real-time response, real-time survey, and real-time poll should be integrated with the aforementioned factors of active learning to enhance students' learning effectiveness. Furthermore, these factors can be implemented into synchronous e-learning technology to support active learning in the future. However, the suggested functions in present study were only some guidelines. These functions still be open for future technology that could support these key factors contributed to the active online learning technology.

5. Conclusion

The objective of this study was to identify key factors related to active learning in the context of online learning to bridge the gap between on-site and online learning by applying these key factors from active learning to the route of development of online learning technology. This study conducted systematic reviews of the PRISMA-P together with real users interview from both learners and teachers to extract key factors that related to active learning in online learning platform. Nine effective factors are critical thinking, decision-making, problem-solving, effective questioning, idea demonstration, participatory, micro-interaction, self-reflection, and positive teacher-student relationship. These factors are fundamentally support active learning via online platforms that are student-centered and communicative (i.e. interaction among students or between students and teachers). As a result, these factors could be used as a guideline for the development of synchronous e-learning technology that naturally support active learning.

However, there are some limitations in present study. First, all interview sessions were conducted online, this may limit the quality of communication between interviewee and interviewer. Second, the stimulus online learning platform were limited only on Microsoft Teams, Zoom, and Google Meet as these platforms were mainly used in Thai university to provide classes during COVID-19 pandemic. Future work should consider to bring these finding factors to develop some designing tools for active learning technology development. Moreover, it should be worth considering in conducting usability evaluation of each learning technology for active learning activities in order to define the gap of user interface and match those need with factors providing from current study.

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Biographies

Nutnicha Sornlump is a master student of faculty of engineering (Industrial Engineering) at Chulalongkorn University, Bangkok, Thailand. She is a member at center of human factor and system engineering (CHASE) laboratory at the Department of Industrial Engineering, Chulalongkorn University

Waratta Authayarat is an Assistant Professor at the Department of Industrial Engineering, Burapha University, Mueang, Chonburi, Thailand. She holds a Bachelor Degree of Industrial Engineering from Burapha University, a Master Degree of Manufacturing Engineering from University of Malaya, and a Doctor of Philosophy of Industrial Engineering and Management from Tokyo Institute of Technology. She has experienced research in Service Design Thinking and Human Factors Engineering.

Arisara Jiamsanguanwong is an Assistant Professor at the Department of Industrial Engineering, Chulalongkorn University, Bangkok, Thailand. She is a member at center of human factor and system engineering (CHASE) laboratory at the Department of Industrial Engineering, Chulalongkorn University. She holds a Bachelor of Engineering in Industrial Engineering from Chulalongkorn University, a Master and Doctoral Degree of Industrial Engineering and Management from Tokyo Institute of Technology. She has experienced research in cognitive human factor, user interface, usability design/testing with a demonstrated history of working in the higher education and research institute.