

Development of an Online Active Learning Model Using the Theory of Multiple Intelligence to Encourage Thai Undergraduate Student Analytical Thinking Skills

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This research aim was to create an online active learning (OAL) model using Multiple Intelligence Theory (MIT) to promote Thai undergraduate analytical thinking skills (ATS). Eight experts assisted with their expertise in the model's development and five for the model's final assessment. The research tools used consisted of an interview form and a model assessment form. The results showed that the PPICE learning model consisted of nine elements and five steps. The five steps were preparation and problem determination (Step 1), problem analysis (Step 2), study and collect relevant information to practice thinking (Step 3), conclusion and presentations (Step 4), lesson summary and evaluation (Step 5). The expert's assessment of the PPICE Model revealed that overall the model was at its 'best' level (mean = 4.63, SD = .048). Moreover, the experts judged the model's nine components as the 'best' (mean = 4.74, SD = 0.38), with measurement and evaluation second (mean = 4.70, SD = 0.45), and teaching and learning activity processes third (mean = 4.66, SD = 0.48).

Keywords: active teaching, analytical thinking, online learning, Thailand

INTRODUCTION

Learning, innovation, media, knowledge, and technology are essential factors in developing a knowledge society, which allows for the creation and promotion of learner lifelong learning (Hannafin et al. 1994). At the same time, advancements in technology has allowed for the integration and use in a teacher's developer toolkit of the Internet, its resources such as social media, and other digital tools (Land & Oliver, 2012; Nonthamand & Songkhla, 2018). Active teaching is a form suitable for learning objectives in terms of learning to create understanding and knowledge gained in daily life. Active learning also

encourages students to be alert to learning and instills cognitive enthusiasm beyond the rote teaching method alone. Therefore, active learning is an instruction style that enhances the student's learning achievement.

Active learning has also been shown to be a teaching style in which students are more satisfied with their learning (Sweller, 2006). Active learning also helps in learner decision making when used as a framework in the application of scaffolding techniques combined with technology and digital resources (Hannafin et al. 1994, 1999), as well as dealing with complicated and open-ended problems (Hannafin et al. 2009; Land & Oliver, 2012). In recent years, active learning has moved online where courses and resources are used freely over the Internet. However, there can be problems with OAL due to cognitive overload in the introduction of newer learning concepts and the lack of a student-centered approach (Fasihuddin, 2016).

However, multiple studies have been found to tackle the problems that OAL can bring. In Thailand, Nonthamand and Songkhla (2018) have suggested that OAL graduate student success comes from teamwork, collaboration, digital learning tools, and creative problem solving. Srikan et al. (2021) have added the need for OAL cooperative activities that drive self-knowledge creation, with the application of *constructivist thinking* (Almodaires et al., 2016) where information is acquired from content use instead of repetition (Kroll & Laboskey, 1996).

Thailand, as elsewhere, has significant challenges in teaching and developing higher education learner thinking skills (Nonthamand & Songkhla, 2018; Puchumni et al., 2019; Thaneerananon et al., 2016). Furthermore, multiple Thai government and education ministry objectives have outlined the nation's vision for the future (Buasuwan et al., 2021). These include thinking and communication capacity, problem-solving and life skills, and technology application skills.

The Theory of Multiple Intelligence (MIT) is closely related to these ideas, first introduced by Gardner in the early 1960s (Gardner & Hatch, 1989; Gardner, 2011; Gardner & Galanouli, 2016). Controversial in many educational circles, MIT suggests that individuals have multiple forms of intelligence. Therefore, as they learn differently, learning assessment should be individualized (Brualdi, 1998), with all education reform focused on an assessment reform process. Gardner also firmly believed that alternative assessment processes should be used, such as a performance-based assessment (Gardner & Galanouli, 2016). Armstrong (2009) has also suggested that student assessment checklists provide valuable information about each student's multiple intelligence profile.

Therefore, although faculties today recognize the importance of MIT, many wish to consider multiple approaches to learning and assessment (Gardner & Hatch, 1989), such as collaborative learning, which taps into various intelligence. This is consistent with Kezar (2001), who suggested that MIT and an individual's natural talents can be refined by higher education. Bordei and Ghiațău (2014) and Bordei (2017) also believed that MIT is a powerful tool that has a significant and direct impact on education, counseling, and business fields as it is focused on an individual's strengths. Thus, it frequently enhances a person's self-esteem, teamwork, motivation, teamwork, and leadership capabilities, as well as greater retention and understanding of the information collected. MIT also helps individuals (re)discover their creative resources, become more tolerant, open, active, supportive, curious, and in the end, better employees and citizens in a continuously changing world.

Finally, although the term 'online' is used frequently, its meaning gets somewhat lost in the complexity and evolution of its meaning. Not so long ago, 'going online' meant connecting through a computer and its dialup 'modem' (modulator/demodulator) to an analog phone system switch (landline/terrestrial connection). However, today that phrase technologically has a different meaning as 'going online' means connecting digital devices to a digital network in many ways, including fiber optic, coax cables, WiFi, and satellite such as with Starlink (Herath, 2021).

Similarly, the cumbersome and sizeable analog video cameras from the past have become today's lightweight and thin digital smartphone cameras. Campus networks have become cloud networks where learning management system (LMS) applications such as *Google Classroom* and *Schoology* are hosted (Poondej & Lerdpornkulrat, 2019; Wongpratoom & Sranankam, 2019). Therefore, whether it is called a digital connection, an online connection, or an Internet connection, at their core is information

communication technology (ICT) to make it all work, with newer teaching pedagogies such as blended learning (Banyan et al., 2016; Siripongdee et al., 2021) and flipped classrooms reliant on its infrastructure (Chigeza & Halbert, 2014; Pipitgool et al., 2021).

Moreover, with the rich array of media, including text, audio, video, graphics, and animation, comes the integration software and online tools needed to create active online learning environments. Students today and their instructors are expected to have familiarity with many of these tools, which then allows the creation and use of OAL environments. Project discussion and collaboration are expected through an online LMS or social media. The outcome of all this is a challenging, engaging, and student-centered experience.

LITERATURE REVIEW

Analytical Thinking Skills (ATS)

ATS are essential in today's advanced technology workplace, which is particularly true for the educators preparing tomorrow's digitally enabled knowledge workers with *higher-order thinking skills* (HOTS) (Asok et al., 2016; Phurikultong & Tuntiwongwanich, 2021). Although analytical thinking and critical thinking might seem at first to be the same, they are different as they have multiple but subtle differences. One such difference is that analytical thinking is a linear thinking process that allowing a seeker of information to take complicated information and break it down (Lewis, 2020; Sheahan, 2021). This then can lead to understanding solutions to complex questions. Moreover, although analytical thinking and critical thinking are fact-based, the desired outcome is a logical conclusion achieved from the facts' evidence and information (Sitthipon, 2012).

Moreover, analytical thinking is concerned with dividing items into their components, such as statements, ideas, theories, arguments, situations, and practices. Some studies have also suggested that when ATS is combined with problem-based learning, there can be a practical outcome in scientific argumentation skills (Perdana et al., 2019). ATS are also associated with directed thinking and achieving a desired outcome through truth-seeking, problem-solving, and understanding development (Stella, 2003), and is effective when ATS is combined with critical thinking skills (CTS) in the problem-solving process. Therefore, these combinations of skills promote and prepare learners for life's complexities in a 21st-century work environment (Thaneerananon et al., 2016). Therefore, it is critical to promote classroom thinking abilities combining *applicative, conceptual, ATS, CTS, synthesis, and creative thinking* abilities.

Supporting studies include Areesophonpichet (2013), who determined ATS were helpful to Thai graduate students in completing their research assignments as well as innovation creation, new knowledge development, and concept mapping skills. In another Thai study of over 1,500 teachers and students, Art-In (2017) determined that pre-service teachers could effectively be taught ATS. Moreover, ATS enhanced knowledge-sharing capabilities and recognized learning management patterns and procedures. Additionally, many comparisons have been made between ATS and its fit into Bloom's *Taxonomy of Educational Objectives*, a student learning classification framework shown in Figure 1 (Art-In, 2017; Bloom & Krathwohl, 2020).

FIGURE 1
BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES



Online Active Learning (OAL)

Online active learning has its roots in a concept known as ‘constructivism’ in which Bruner discussed how learners construct their knowledge (Brown, 2014) through a process of information organization and categorization through a process of discovering and developing their coding systems (Rannikmäe et al., 2020). This implies that knowledge is not coming from the teacher but through a self-discovery process, with the teacher acting as an information facilitator instead of transferring information through traditional rote learning.

Moreover, in Brown’s (2014) study of student teachers' online teaching using active learning methods and higher-level thinking skills (HOTS), the author determined that there had been a significant increase in HOTS when the online discussion board was used.

Moreover, numerous other studies have confirmed that when OAL is realized through *blended learning*, *flipped classrooms*, and Internet-enabled smartphones, student learning can become energized (Banyan et al., 2016; Siripongdee et al., 2021). Today, ICT based platforms such as Moodle and Google Classroom learning management systems (LMS) have become powerful OAL tools. Added to the Internet and internal and cloud-based LMS, teachers can now use powerful digital and social media tools to transform classrooms into rich, student-centered, interactive knowledge environments. However, some researchers have warned that in classrooms across Southeast Asia, including Thailand, OALs are rarely implemented (Puchumni et al. (2019). Fortunately in Thailand in 1999, OAL was introduced (Office of the Education Council, 1999), with initial efforts made to convert traditional passive classrooms into active ones, especially in rural areas (Climer et al., 2009).

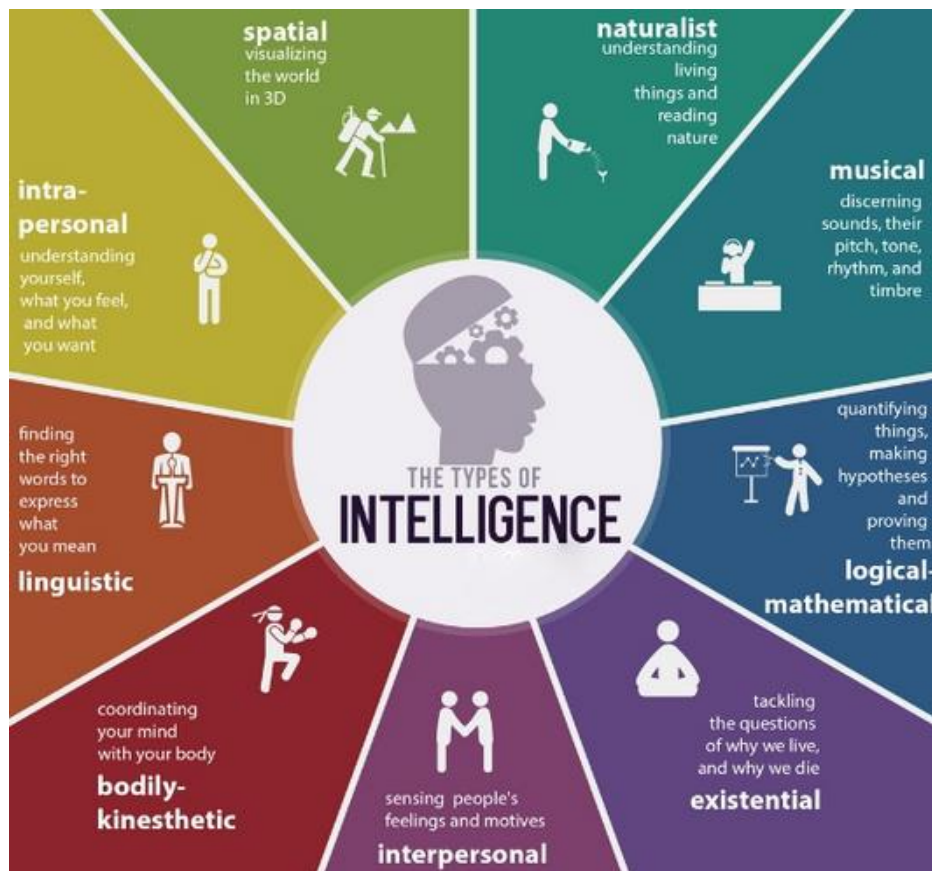
However, for better or worse, OAL has risen to become a critical priority globally due to the chaos and tribulations coming with the COVID-19 pandemic beginning in early 2020 (Srikan et al., 2021). Simply stated, the traditional classroom and setting were thrown out, and a government-mandated '*New Normal*' of online Zoom sessions and remote learning came into existence (Ruenphongphun et al., 2021; Siripongdee et al., 2021; Srakaew et al., 2021; Srikan et al., 2021; Wannapiroon & Pimdee, 2022). As countless studies have determined, OAL is not an easy process with steep learning curves for teachers, students, and their institutions. Moreover, ICT infrastructure, processes, and digital devices and their interplay have left many

educational areas (mainly rural) lacking the robustness to implement OAL classes effectively. Finally, Tarihoran et al. (2021) in Indonesia added that OAL is inexpensive and feasible. Therefore, OAL programs need to be part of the country's undergraduate training programs, and must be supported by both the educational institutions and the government.

Theory of Multiple Intelligence

As the debates concerning OAL and student-centered education gain momentum, one can quickly be reminded of Howard Gardner's outline of how he believed Multiple Intelligence determined how and why learners learned. In Gardner's view of intelligence, he initially outlines nine types of intelligence (Figure 2), from which he later added *spiritual intelligence*, *existential intelligence*, and *moral intelligence* (Bakić-mirić, 2010; Krechevsky & Seidel, 1998; Marenus, 2020). Also, Although Gardner's intelligence theory is controversial, it can be summarized as a theory of *individualism* that posits that everyone is unique (Cherry, 2021; Marenus, 2020). Many scholars have problems with the theory because it implies that since all learners learn differently, teaching and assessment of students the same way is not the correct method (Uysal, 2004).

FIGURE 2
NINE TYPES OF INTELLIGENCE



Source: Adapted from Armstrong (2009).

Research Objective

The research's objective was to create an OAL Model in combination with Gardner's MIT to promote Thai undergraduate students' ATS.

METHODS

The research process was divided into three phases. Phase 1 included a literature review of the proposed aspects of the OAL model. Phase 2 consisted of developing a five-level assessment questionnaire for use by two groups of experts. Phase 3 consisted of the actual questionnaire's use and evaluation of the model by the experts.

Research Tools

Expert interviews were used to ascertain the opinions of the experts concerning the development of an active online learning model which used aspects of Gardner's multiple intelligence to promote Thai undergraduate analytical thinking abilities. To achieve these objectives, two groups of experts were invited to give their opinions. Group 1 consisted of three experts in active learning and teaching and five experts in information communication technology (ICT) education and online teaching who gave the researchers their input and opinions concerning the model's development. Group 2's efforts were concerned the certification of the learning model, which consisted of two experts in active teaching and three in ICT education and online teaching.

Expert Questionnaire Development Process

In preparation for the learning model's development, the researchers reviewed and synthesized a wide array of literature related to theories and concepts concerning MIT, OAL, and undergraduate student ATS. This analysis developed a five-level opinion scale questionnaire for use by multiple groups of experts to assess the proposed OAL model.

The OAL Model Assessment Questionnaire

The assessment form was divided into six aspects. These included 1) the model's overview, 2) the model's components, 3) the model's teaching and learning process, 4) the model's tools, 5) the assessment according to the picture form, 6) the use of the pattern with the process of creating tools.

Data Analysis

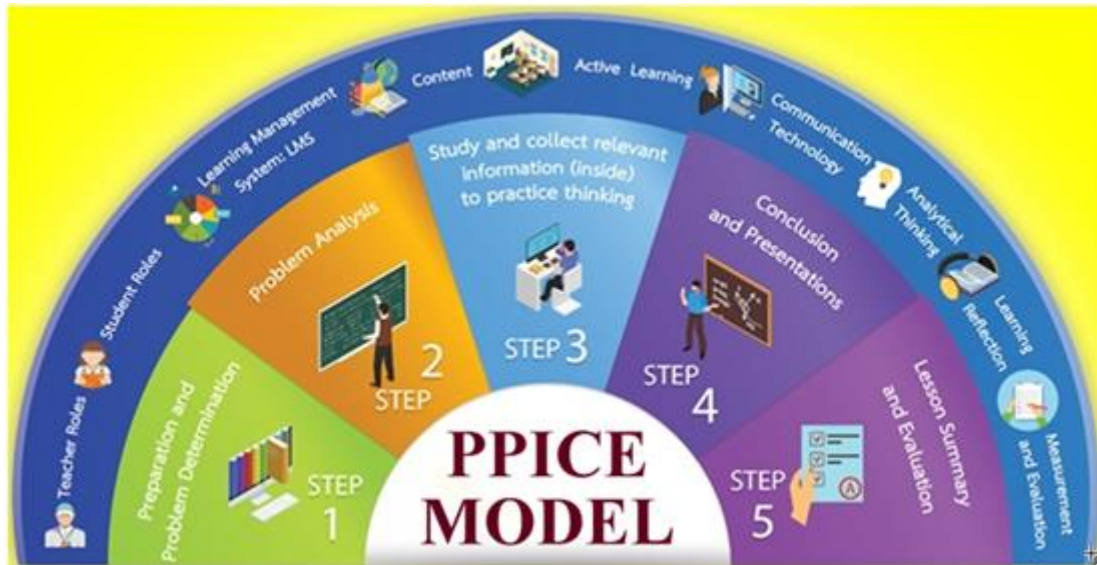
1. Data analysis was used on the data analysis, which checked content consistency.
2. Data analysis was then conducted for the model's certification assessment using the mean and standard deviation (SD). The model was improved based on the recommendations of the experts.

RESULTS AND DISCUSSION

The PPICE Model Basic Concepts

The OAL Model consisted of nine components and five steps, which are illustrated in Figure 3.

**FIGURE 3
THE PPICE MODEL**



The PPICE Online Active Learning (OAL) Management Model’s Nine Components

Elements of an OAL model combined with MIT to promote Thai undergraduate ATS consist of nine components (Figure 1).

1. *Teacher roles* are concerned with teaching and learning activities, where the teacher is a guide or facilitator in student learning activities. Also, teachers prepare content for teaching as well as a learning management plan (LMP). Teachers also are involved in answering student questions and observing student learning behavior by using the LMS.
2. *Student roles* are concerned with the organization of individual active teaching and learning activities that students accomplish independently. These include searching for knowledge, brainstorming, summarizing ideas, reflection, and collaboration. Learners exchange knowledge with their classmates so that learning behavior is promoted.
3. *A learning management system (LMS)* usually consists of a campus-wide program such as Moodle to manage student assignments and collaborative work. An LMS can also be used in the Internet cloud (Google Classroom). The LMS thus becomes the center of active teaching and learning management, allowing for recording and observing student learning behavior. The LMS allows students and teachers to access and use the content by providing management tools. The LMS also has centralized information backup, statistical record keeping, and teacher monitoring capabilities of student work.
4. *Lesson content* refers to the digitally stored e-documents. These can include Word files, spreadsheets, mind-maps, educational games, video files, images, and Web links to additional content (Kummanee et al., 2020; Poondej & Lerdpornkulrat, 2019; Samaniego Erazo, 2015).
5. *Active learning* is a student-centered approach to learning in which learners actively participate in their learning process, with instructors participating as guides and observers. One method to achieve student-centered learning is through project-based learning (PBL). When PBL is combined with OAL, they become robust methods for developing student ATS and CTS skills and providing a real-world context for learning (Warlick, 1999).
6. *Communication technology* refers to the array of digital tools and platforms involved in collaboration and communication between teachers and students. It can be either *synchronous* (Zoom) or *asynchronous* (Facebook, Line, LMS) (Fabríz et al., 2021). Asynchronous is considered a more independent-based and self-paced process that is also less teacher-

dependent. On the other hand, synchronous is online learning which uses real-time interaction (Blau et al., 2017).

7. *Analytical thinking* refers to the process of modifying learning behavior from being passive to one that is active. It is, therefore, crucial that learners have ATS development so that they can develop meaningful learning processes (Areesophonpichet, 2013).
8. *Learning reflection* refers to teaching activities reflecting the knowledge acquired after participating in teaching and learning activities (Williamson, 2012). Learning reflection tools include videos of classroom and teaching sessions where learner problem-solving is enhanced, and the reflection process is realized
9. *Measurement and evaluation* in education is an essential element in a teacher's toolbox to develop effective student teaching (Waree, 2019).

PPICE Online Active Learning (OAL) Management Model Five Steps

The five steps in the researcher-developed PPICE OAL model consist of five steps. These were preparation and problem determination (Step 1), problem analysis (Step 2), study and collect relevant information (inside) to practice thinking (Step 3), Conclusion and presentations (Step 4), lesson summary, and evaluation (Step 5). This is consistent with Nilsook et al. (2021). They investigated using a Project-based Learning Model in vocational education teaching and determined that there were five steps, including a preparation step, a topic definition step, creation and testing step, a presentation step, and finally, the evaluation step.

Internet cloud tools used for all steps included:

- Collaboration tools: *Google Drive*[®], *Google Docs*[®], *Google Slides*[®] and *Google Calendar*[®]
- Learning management tools: *Google Classroom*.
- Communication tools: *Google Meet*, *Facebook*, and *Line*.
- Creative tools: *Google Drawings* and *Canva*.
- Presentation tools: *Google Drawings*, *Canva*, *Google Slides*, *YouTube*, or *Powtoon*.
- Post-testing tools: *Google Form*[®], *Google Sheets*[®], or *Rubistar*[®].

These model's five steps are:

- Step 1: *Preparation and problem determination* are involved with helping students understand and prepare for their project's problem. This includes comprehensive question generation according to the objectives and goals.
- Step 2: *Problem analysis* involves students taking responsibility for analyzing and identifying their project's problems and issues and discussing the causes of the problems to define the issues or learning objectives. The teacher's role is to introduce the learning environment and resources that can be used as guidelines for answering problems in collaborative discussion groups.
- Step 3: *Study and collect information (inside) to practice thinking*. Using basic concepts from Gardner's MIT, this step allows students to develop the best ways and methods they understand (Schomberg, 1986). Learners have to interact and brainstorm with each other to achieve each project's learning objectives through the use of small project groups.
- Step 4: *Conclusion and presentations* involve letting learners take the information gathered and analyze it to come to a logical conclusion about the defined problem. Learners must analyze the data and prepare to exchange their knowledge in Step 5. In Step 4, students listen to their classmates and teacher reviews and suggestions and make improvements.
- Step 5: *Lesson summary and evaluation* involve assessing a project's topics' coverage and answers. The lesson content and learning environment contain many tools and resources used in the previous steps. Discussion with others allows expressing opinions and exchanging what has been learned. Session quizzes and final course assessments are undertaken. Additionally, the instructor assesses each learner's learning development results, while the learners also conduct a self-assessment and their group's performance.

THE PPICE Learning Management Model Process Expert Assessment

Table 1 details the PPICE model assessment. Results revealed that overall the model was at its 'best' level with mean = 4.63, SD = .048. Moreover, the experts judged the model's nine *components* as the 'best' (mean = 4.74, SD = 0.38), with *measurement and evaluation* second (mean = 4.70, SD = 0.45), and *teaching and learning activity processes* third (mean = 4.66, SD = 0.48).

TABLE 1
THE PPICE LEARNING MANAGEMENT MODEL PROCESS EXPERT ASSESSMENT

Assessment Items	Experts (n=5)		
	M	SD	Suitability Level
Principles and concepts	4.56	0.53	Best
Objectives	4.54	0.51	Best
Components	4.74	0.38	Best
Application of ICT used in teaching and learning management	4.61	0.54	Best
Teaching and learning activity processes	4.66	0.48	Best
Measurement and evaluation	4.70	0.45	Best
Overview	4.63	0.48	Best

Based on the results of expert interviews on the components and processes of the proposed PPICE OAL model, several areas were suggested for improvement and development. These main points were:

- 1) Revise the diagram and pattern interpretation, making it exciting and easier to understand (Fasihuddin, 2016).
- 2) Reduce the number of tools the model uses for easier learner comprehension and use. Using a single tool such as *Google Docs* can save time for learners in performing the teaching activities.
- 3) Add additional relevant elements in the format.
- 4) Each step should name the activities in each step as abbreviated names representing the nature of the activities in that step.
- 5) The model should be able to demonstrate the characteristics of active learning. Suggested methods to do this included focusing on 1) long-term objectives, 2) student-centered learning, 3) learners taking responsibility for their projects, and 4) group work and encouraging analytical thinking.

Draft a model for each step of the OAL model teaching and learning activities, and focus on six primary areas, including 1) challenges, 2) staying focused 3), student-centered learning, 4) individuals responsible for their learning, 5) focusing on group work, and 6) promoting analytical thinking skills.

From the study's results and discussion, the PPICE OAL Model was determined to be consistent with similar studies (Changwong et al., 2018; Khongprakob & Kantathanawat, 2021; Phurikultong & Tuntiwongwanich, 2021; Pipitgool et al., 2021; Srikan et al., 2021; Sriwongchai et al., 2015; Wannapiroon & Pimdee, 2022).

CONCLUSION

The researchers used the literature review to help develop an active online learning model using the Theory of Multiple Intelligence to promote Thai undergraduate analytical thinking skills. Using two groups of experts, the OAL model was assessed and refined. The assessment form was divided into six aspects. These included 1) the model's overview, 2) the model's components, 3) the model's teaching and learning process, 4) the model's tools, 5) the assessment according to the picture form, 6) the use of the model's figure with the process of creating tools.

Furthermore, the results showed that the PPICE learning model consisted of nine components and five steps. The nine components were 1) *teacher roles*, 2) *student roles*, 3) *learning management system (LMS)*, 4) *lesson content*, 5) *active learning*, 6) *communication technology*, 7) *analytical thinking*, 8) *learning reflection*, and 9) *measurement and evaluation*. The five steps were (P) *preparation and problem determination* (Step 1), (P) *problem analysis* (Step 2), (I) *study and collecting relevant information to practice thinking* (Step 3), (C) *conclusion and presentations* (Step 4), (E) *lesson summary and evaluation* (Step 5).

The expert's assessment of the researcher-developed PPICE Model revealed that overall the model was at its 'best' level (mean = 4.63, SD = .048). Moreover, the expert judged the model's nine components as the 'best' (mean = 4.74, SD = 0.38). This was followed by the teaching and learning activity processes (mean = 4.66, SD = 0.48).

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