Turkish Journal of Computer and Mathematics Education *Vol.12 No.14 (2021), 5940-5950*

Research Article

An Online Learning Model to Promote Thai Student Analytical Thinking: A Systematic Literature Review

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Abstract:
The objective of this research was to conduct a systematic literature review (SLR) from which an online learning model to enhance Thai undergraduate analytical thinking (AT) skills was conceptualized. Initially using a mixed-methods approach, a five-step model was conceptualized. After that, a panel of seven experts gave input into the model's design, from which the model was expanded to include six related learning environments. The five steps included Step 1's preparation and problem identification, Step 2's problem analysis, Step 3's study and collection of relevant information (inside) to practice thinking, Step 4's conclusion and presentation, and finally, Step 5's summary and evaluation. The six learning environments included social media, the context, resources, active learning, scaffolding, and examiner. The results of the model encourage students to use analytical thinking. Also, students who studied with the online proactive learning model combined with TMI to promote analytical thinking ability were satisfied with the model.

Keywords: Analytical thinking, critical thinking,proactive learning,Thailand

Introduction

Today, one of the most significant challenges in Thai education is developing and promoting a learner's thinking skills (Thaneerananon et al., 2016). As citizens are presented with information in various forms that hold different degrees of truth (false information), having the ability to think analytically and critically may prevent us from falling victims to deception (Pimsai, 2002). These ideas are consistent with numerous other global studies and reports that have also elaborated on the critical importance of higher education's (HEs) responsibility in teaching students' creative problem-solving abilities prior to graduation (Nonthamand&Songkhla, 2018; Puchumni et al., 2019).

Expectations for students to solve complicated problems systematically by applying their knowledge and using proper and various solutions are now a prerequisite for employment and crucial to an individual's ability to learn throughout their lifetime. As such, analytical thinking (AT), creativity, critical thinking (CT), and problem-solving skills (PSS) have become essential elements in education at all levels (Asok et al., 2016; Charoenwongsak, 2003;Srikan et al., 2021).

In Thailand, the requirement for these skills is outlined in various government documents and five-year plans. However, in a joint UNESCO, Thai Ministry of Education's (MoE), and the Office of the Basic Education Commission (OBEC) developed the life '*Skills Framework Development for Basic Education*' (Buasuwan et al., 2021) to prepare Thai young learners better to meet the global challenges and demands of the 21st century. In this project's outline, in addition to the 2018 *Thai National Strategy* (2018-2037) and the *National Education Standards*, five further core competencies were identified. These included communication capacity, thinking capacity, problem-solving capacity, capacity for applying life skills, and capacity for technological application.

With these skills or 'capacities' highlighted under these new national and international priorities, this study then set out to undertake a systematic literature review of five related subjects and disciplines which the authors identified as possibly related to the development of an analytical thinking learning and teaching model.

Open learning environments (OLEs)

According to early research from Hannafin et al. (1994), OLEs were stated to be rooted in student-centered design ideas, which emphasizes contexts and activities that support a learner's understanding of what they determine to be necessary. OLEs also serves as a design framework in which technological tools, resources, and scaffolding are applied to assist students with personal decision making (Hannafin et al. 1999) and the engagement of complex and open-ended problems (Hannafin et al. 2009; Land & Oliver, 2012).

With the ongoing and rapid technological changes of the early 1990s, OLE emerged as a response to emerging instructional-design considerations that mirrored constructivist learning views (Hannafin et al. 1994). Simultaneously, technological advancements begin to allow the integration and use of Internet connectivity and digital tools and resources into the instructional developer toolkits (Land & Oliver, 2012;Nonthamand&Songkhla, 2018).

OLEs are also complex and open-ended, requiring students to initiate reflection, monitoring, and self-assessment of what is known and what needs to be known (Hannafin et al. 1999). Also, OLEs use heuristics-based learning in a non-defined and non-structured domain intended to foster critical thinking (CT) and think from multiple perspectives.

More recently, in Australia, Fasihuddin (2016) stated that an OLE is a newer form of online education that permits the use of resources and courses to be freelyavailable over the Internet. The author further states that examples of OLEs are EdX and Courserainitiatives, which have become widely accepted globally. However, in the doctoral thesis, the author found multiple issues in OLE use (Fasihuddin et al., 2016). These were cognitive overload resulting from the learning concepts presentation and the lack of individual student personalization and adaptability to their needs and preferences.Nonthamand and Songkhla (2018) in Thailand also noted that for graduate student success from using OLEs, willingness to work as teams, group discussions, creative problem solving, and digital learning media was paramount to success.

Other authors have also added that cooperative classroom activities drive self-knowledge creation (Srikan et al., 2021), which is rooted in *constructivist-inspired thinking*(Almodaires et al., 2016). Knowledge is acquired through content involvement instead of imitation or repetition (Kroll &Laboskey, 1996).

Online learning (OL)

Good online learning needs to support the needs of both the learners and the teachers. Additionally, with the added complexities and critical nature of online learning due to the global Covid-19 pandemic, online learning has been thrust upon many who have been slow to accept or adapt to this new environment. Unfortunately, there are still significant numbers of instructors who refuse to embrace newer online and digital technologies and are still focused on their comfort level of using traditional 'chalk and talk' methods (Vangmeejongmee&Naiyapatana, 2021).

However, in Thailand, online learning has been an essential element in education in the Kingdom long before the ongoing pandemic (Mala, 2020). In past years, Thailand's Minister of Education (MOE) used *Distance Learning Television* (DLTV) as a forerunner to the implementation of Internet broadband into Thailand's 74,987 villages and associated schools ("The new normal is digital," 2021). However, under what has become known as the '*New Normal*,' DLTV is being combined with newer digital platforms to bring personalized learning concepts into Thai households and school systems. Even UNESCO (2020) has recognized the critical importance of Thailand's DLTV and reported that it and online learning had become essential pedagogical methods to ensure physical distancing recommendations for the time of uncertainty during the COVID-19 pandemic. Finally, teaching via television (*on-air*) and home visits and student homework assignments (*on-hand*) additionally enhance self-study at home (Burns, 2011; Hwa et al., 2017). Furthermore, as Thailand swiftly transitions to the New Normal, the traditional classroom is being pushed to the back of the bus as the new leaders in Thailand's MOE expect educators and students to interact through digital platforms such as Zoom. It is now expected that this newer medium will allow two-way communications to actively engage students and provide additional support (Ruenphongphun et al., 2021).

Also, other researchers have added that online learning development must validate the learning goals and assessment processes and embrace concepts from earlier educational scholars such as Bloom's digital learning taxonomy (Silberman et al., 2015; Suartama et al., 2019). Also, according to Bocconi and Trentin (2014), the learning objectives must show a connection between assessing students' classroom and online content and their activities. In Thailand, Samruayruen et al. (2013) stated that the critical element in learner success in using an online learning environment was their ability to self-regulate their learning. Moreover, in Thailand, educational leaders have noted the critical nature of educators enhancing their ICT skills on their own and developing their online assessment processes (Ruenphongphun et al., 2021).

In Thailand, over the past decades, various governments have laid out plans and programs to develop student information literacy, media literacy, and information communications technology (ICT) literacy skills (Moto et al., 2018).In past years, Thailand released the *Information and Communication Technology Policy Framework*

(2011-2020) to serve as the framework for developing the nation's online Internet and ICT (ICTPF, 2011). More recently, Thailand's MOE has expanded on the foundations of the ICTPF and introduced the ThailandICT framework (ICT2020), which includes the '*Smart Thailand 2020'* strategy, which places ICT and the Internet in the spotlight to improve the Thai economy, the quality of life and the need for increased mobile penetration. Given the reliance of millions of Thai students during the Covid-19 pandemic campus lockouts, smartphone connectivity to the Internet has become a critical element in Thailand's educational progress moving forward.

Newer Thai government initiatives where digital technologies, infrastructure improvements, and Internet connectivity are highlighted include the *Digital Economy Master Plan* (DEMP), followed in late 2020 by the Thai MOE announcing their *Thailand Education Eco-System* (Mala, 2020). There is also the cloud-based and AI-powered *Human Capital Excellence Center* (HCEC), the *Digital Education Excellence Platform* (DEEP), and the *Excellence Individual Development Plan* (EIDP) to improve the education system. Finally, in Thailand, the *New Normal* is digital! ("The new normal is digital," 2021).

Active learning environment (ALE)

Within a classroom, ALEs have been defined as anything that students do other than sitting and passively listening to a teacher's lecture (Asok et al., 2016). Therefore, ALEs included student listening practices to help them absorb what they had heard in the past. Short writing exercises react to lecture material and complex group exercises from which course material is applied to "real life" situations or new problems.

However, today, with the Internet, smartphones, and new learning methodologies such as *flipped classrooms* and *blended learning* (Banyen et al., 2016,Siripongdee et al., 2021), the ALE has expanded significantly beyond the traditional concept of ALE using tape recorders and classroom projectors. Today, *information and communication technology* (ICT) based educational platforms and devices provide a powerful array of digital tools. These tools transform the present isolated, teacher-centered, and text-bound classrooms into rich, student-focused, interactive knowledge environments (Hartley & Davies, 1978).

Also, in schools in the U.S. and other developed nations for multiple decades, ALE participation has been supported. However, according to Puchumni et al. (2019), in non-science classrooms across Thailand and Asia, ALEs have been a rare phenomenon.

However, in 1999 ALEs were introduced in Thailand's primary educational curriculumand discussion of ALE implementation at the national level started in early 2000 (Office of the Education Council, 1999). However, according to Puchumni et al. (2019), Thai education officials have failed to officially recognize and implement active learning in any three types of Thai educational institutes, including formal, non-formal, and informal. Despite this, Climer et al. (2009) have reported that attempts have been made in some rural areas of Thailand to convert traditionally passive learning classrooms into active ones.

Fortunately or unfortunately, depending on your point of view, the global Covid-19 pandemic has forced education online due to the school lockdowns and closures across Thailand over the past two years. The question then becomes what flavor of 'online education' evolves from this. Is it passive where students watch YouTube lectures like Khan Academy sessions? Or is learners and instructors active in engaging with interactive Zoom sessions? Or is yet another variation where a flipped classroom model is used as students and teachers are gradually allowed back onto their campuses?(Banyen et al., 2016,Siripongdee et al., 2021).

Also, various scholars have reported that achieving student *higher-order thinking skills* (HOTS), which includes complex judgmental skills such as critical thinking (CT) and problem-solving, relies on ALE and ICT to work effectively (Asok et al., 2016). In Japan, Kusumoto (2018) also saw the advantages when ALE was combined with content and language integrated learning (CLIL). Students were then able to enhance their cognitive skills and gain knowledge.

A good learning environment creates a good atmosphere for learning which facilitates effective teaching and learning (Fraser, 1998; McVey, 1989; Paul &Devarapalli, 2018; Prasitrat, 1990)

Theory of Multiple Intelligences (TMI) learning

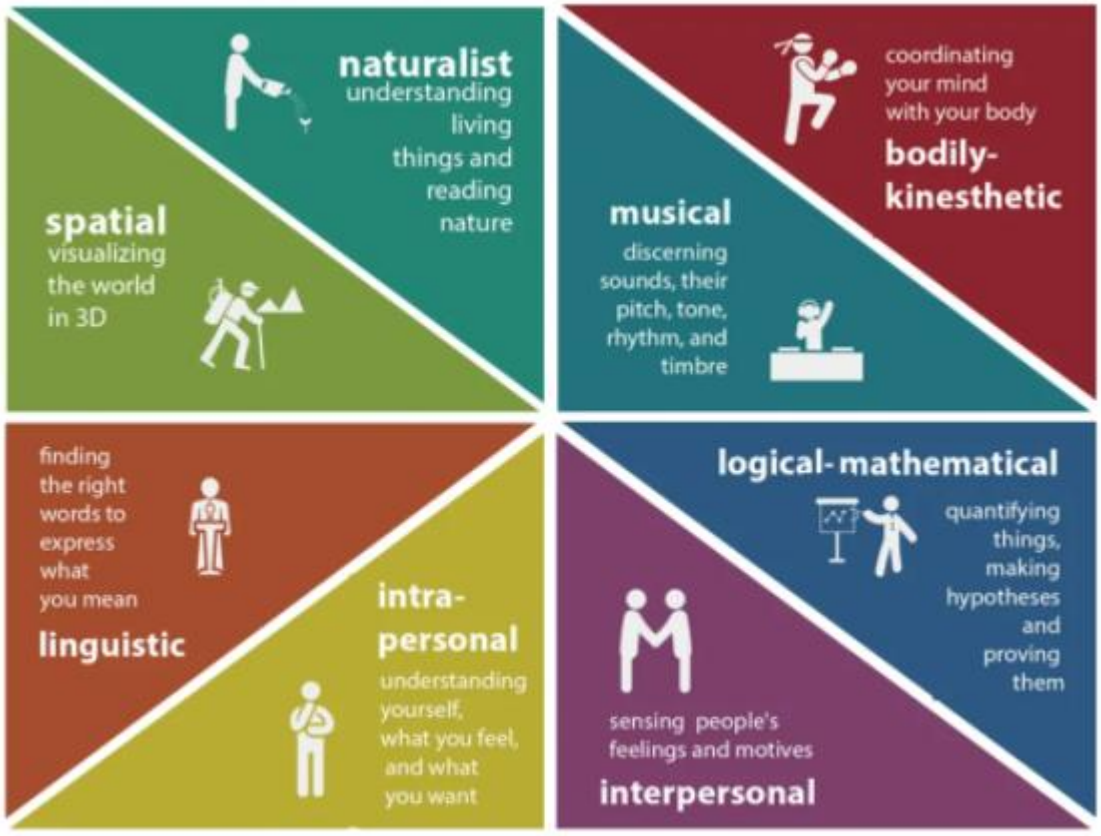
Each child's learning is different, which acts like a rainbow of colors, with each learner having different tastes, personalities, teachers, parents, or guardians. One scholar who recognized the variety and diversity of these factors early on was Howard Gardner, who initially developed eight different types of intelligence (Figure 1) but added more over the following years (Krechevsky& Seidel, 1998; Marenus, 2020). Theseincluded *spiritual intelligence*, *existential intelligence* (Bakić-mirić, 2010), and *moral intelligence*—but Gardner did not believe these new 'intelligences' met his original inclusion criteria (Gardner, 2011). Gardner also defined intelligence as the ability to solve problems or create a culturally valuable product (Krechevsky& Seidel, 1998).

For education, TMI, although controversial (Cherry, 2021), can be summed up as a theory for *individualism* and *pluralization*,as *individualism* posits that all people are unique(Marenus, 2020). Therefore, according to Gardner's TMI, there is no logical reason to teach and assess students identically since all students do not learn in the same way and cannot be assessed uniformly (Uysal, 2004).Also, TMI suggests that teaching and learning

should focus on each learner's particular intelligence (Figure 1). Therefore, educators must take into account their learners' diversified learning ways to appropriately assess each child's progress (Brualdi, 1998).

Krechevsky and Seidel (1998) have also suggested that TMI should contain four assessmentprinciples if it is fair. These include the need for assessment contextualization, multiple methods to demonstrate students' understanding, ability to monitor student growth; it should be accompanied by reflections and self-assessment to allow students to understand their progress. Therefore, all educational reform must be accompanied by an assessment reform process, and it should be focused on each student's progress and growth. Moreover, TMI suggests that assessing a student's giftedness begins with identifying the nature and quality of the student's intelligences. However, using psychometric and standardized tests, only a limited part of the students' qualities can be assessed. In contrast, Gardner firmly supports using alternative assessment techniques, such as performance-based assessment, to determine students' strengths in multiple intelligence view (Gardner &Galanouli, 2016). Student self-reports and checklists may also provide valuable information about the students' multiple intelligence profiles (Armstrong, 2009).

Figure 1. Theory of Multiple Intelligences (TMI).



Source: Marenus (2020)

Analytical thinking (AT)

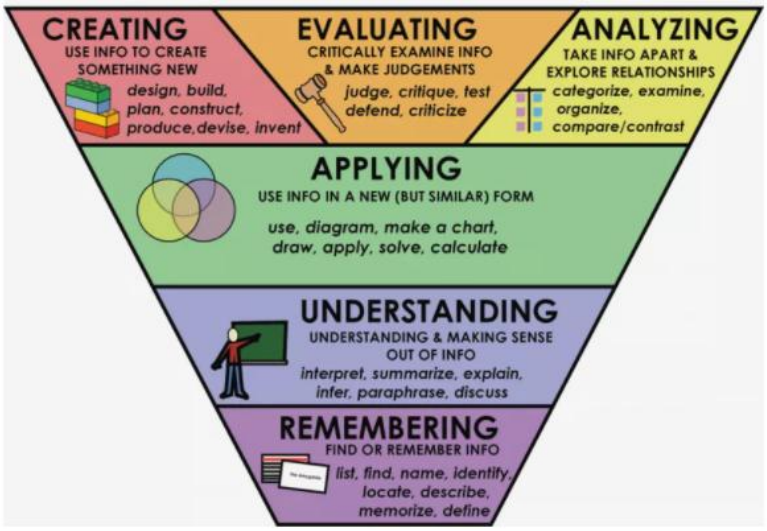
Although AT and CT might appear at first to be the same, they are not. Of the many but subtle differences, the one that stands out probably the most is that AT involves linear thinking that enables an investigator to break down complex information (Lewis, 2020; Sheahan, 2021), which leads to figuring out the solution a complex question. Also, although both AT and CT use facts, facts are used to build on information and evidence support that culminates in a logical conclusion (Sitthipon, 2012).

Also, AT is about breaking things (situations, practices, problems, statements, ideas, theories, arguments) down into their parts, with AT/CT often associated with directed thinking such as solving problems, seeking the truth, and developing understanding, with the focus on the desired outcome (Stella, 2003).It is also necessary that AT is blended with CT, primarily part of the problem-solving process, to provide skills required to prepare the learner for a more complex life and 21st-century work environment (Thaneerananon et al., 2016). Therefore, it is essential that thinking ability promotion classrooms should combine *applicative, conceptual, AT, CT, synthesis, and creative thinking* abilities (Charoenwongsak, 2003). In another AT study, Areesophonpichet (2013) mentioned that AT skills were helpful for graduate students in completing research, developing new knowledge, innovation, and concept mapping skill development in Thailand.

Furthermore, in the *Taxonomy of Educational Objectives*which is often referred to as 'Bloom's Taxonomy,' a framework was developed to classify statements of what we expect or intend students to learn as a result of

instruction (Anderson &Krathwohl, 2001; Bloom et al., 1956; Krathwohl, 2002). Within the framework at level four is the discussion concerning an individual's capability for analyzing information (Figure 2).

Figure 2. Bloom's Taxonomy.



Source: RawiaInaim / Kwantlen Polytechnic University

SLR summary

From the SLR, the authors determined strong relationships between five main themes, including open learning environments (OLEs), online learning (OL), active learning environments (ALE), The Theory of Multiple Intelligences (TMI) learning, and analytical thinking (AT). Also, there are many learning resources and approaches to AT that differ according to interests that require behavior and thought development through a student-centered learning process. Learners can create knowledge, experiences, activities, or exchange knowledge with friends, teachers, experts, and cooperation between teachers and learners. Therefore, the following section details the methods, results, and discussion of the expert input and evolution of the study'sAT learning models for Thai undergraduate students.

Objectives of the research

To develop and assess the appropriateness of an online proactive learning environment combined with TMI to promote analytical thinking ability.

Research methods

Systematic literature review (SLR)

For this study, the researchers conducted a systematic literature review(SLR) spanning nearly half a century concerning five central teaching and learning themes. According to Xiao and Watson (2017), SLRs are the foundation of academic inquires and should be conducted before empirical research and used as a background review. Furthermore, the SLR for this study was both domestic and international in its scope, as can be seen from the final paper's overview provided in Table 1.

Table 1. Results from the model's development from the SLR

Constructs	Item	Documents, reports, news articles, books, and theory
Open learning environments	OLEs	(Almodaires et al., 2016; Fasihuddin, 2016; Fasihuddin et al., 2016; Hannafin et al., 1994, 1999, 2009; Kroll &Laboskey, 1996; Land & Oliver, 2012; Nonthamand&Songkhla, 2018;Srikan et al., 2021)
Online learning	OL	(Bocconi&Trentin, 2014; Burns, 2011; Hwa et al., 2017; ICTPF, 2011; Mala, 2020; Moto et al., 2018; Ruenphongphun et al., 2021;Samruayruen et al., 2013; Silberman et al., 2015; Suartama et al., 2019; "The new normal is digital," 2021; UNESCO, 2020; Vangmeejongmee&Naiyapatana, 2021)

Active learning environment	ALE	(Asok et al., 2016; Banyen et al., 2016,Climer et al., 2009; Fraser, 1998; Hartley & Davies, 1978; Kusumoto, 2018; McVey, 1989; Office of the Education Council, 1999; Paul &Devarapalli, 2018; Prasitrat, 1990; Puchumni et al., 2019; Siripongdee et al., 2021)
Theory of Multiple Intelligences learning	TMI	(Armstrong, 2009; Bakić-mirić, 2010; Brualdi, 1998; Cherry, 2021; Gardner, 2011;Gardner &Galanouli, 2016; Krechevsky& Seidel, 1998; Marenus, 2020;Uysal, 2004)
Analytical thinking	AT	(Anderson &Krathwohl, 2001; Areesophonpichet, 2013; Bloom et al., 1956; Charoenwongsak, 2003; Krathwohl, 2002; Sheahan, 2021; Sitthipon, 2012; Stella, 2003; Thaneerananon et al., 2016)

Qualitative and quantitative research practices

Initially, the qualitative research was reviewed, synthesized, and analyzed to produce an online proactive learning environment combined with TMI to promote analytical thinking ability. Five primary steps were identified and modified based on suggestions from a panel of experts. This was followed by a second qualitative analysis in which six learning environments were determined to be potentially helpful in an AT learning model environment.

Research results

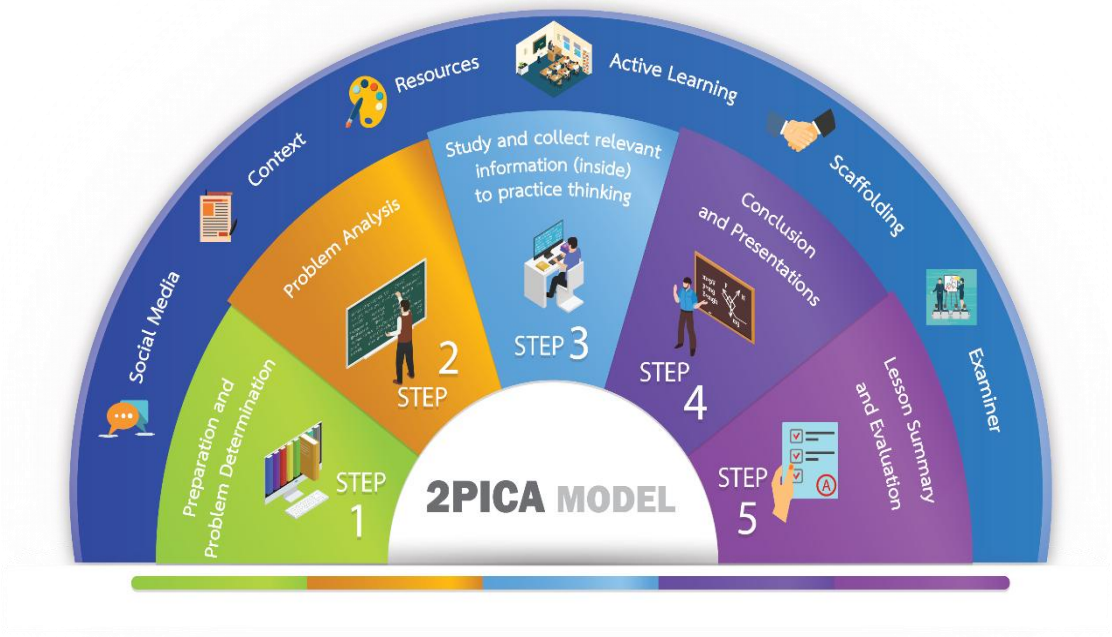
The results of the SLR of relevant knowledge enabled the researchers to use knowledge to synthesize an online proactive learning model in conjunction with the theory of multiple intelligences (TMI). This then allows better ability to promote the ability to think analytically to create learning models, as shown in Figure 3 and Figure 4. In the initial 2PICA model, five steps were identified. These included Step 1's preparation and problem identification, Step 2's problem analysis, Step 3's study and collection of relevant information (inside) to practice thinking, Step 4's conclusion and presentation, and finally, Step 5's summary and evaluation.

Figure3.2PICA Analytical Thinking Online Learning Model.

Experts' model assessment

After developing the study's initial proposed 2PICA Model, seven experts with PhDs were invited to assist with the assessment of the model. Each academic had expertise in teaching-learning styles, innovation, creativity, computer education, technology, educational programs, or research. From the panel of experts' input, the researchers were asked to adjust the six learning environment models for better clarity (Figure 2). These environments included socialmedia, the context, resources, active learning, scaffolding, and examiner. As such, the final six learning environments and five-step model used to support a Thai undergraduate AT skills was well supported and consistent with other Thai and international studies (Almodaire et al., 2018; Buus, 2012; Ohler, 2013; Srikan et al., 2021)

Figure 4. An online proactive learning environment combined with TMI to promote analytical thinking ability.



Discussion

In the study's final model presented in Figure 3, five main steps are depicted to conceptualize an online proactive learning model combined with multiple cognitive theoriesthat promote Thai undergraduate analytical thinking. These steps consist of:

Stage 1: Preparation and problem determination

Step 1 entails each instructor presenting the problems, issues, or case studies related to the lesson's goals to stimulate interest. Teachers and students work together to define problems or issues that need to be solved. Groups are organized into 3 - 6 students based on assorted knowledge from pre-study exams. After that, learners collaborate in determining the problem or issue that needs to be solved and share the responsibility to find a solution within the group. Emphasis is placed on fundamental roles such as group leader, data aggregator, and presenter through communication tools including *Google Meet*® and *Line*®social media platforms. Collaboration tools include *Google Drive*®, *Google Docs*®, and *Google Calendar*®. Therefore, participation in a co-learner community and, on a broader scale, participation in a community of practitioners is characterized as socialization. This, therefore, can be extended into the broader social and cultural rules and conventions that are common to all global communities (Kirschner&Erkens, 2006).

Stage 2: Problem analysis

Step 2 entails each student being given responsibility for analyzing, isolating, and discussing the root causes of the assigned problems to determine the issues or learning objectives and conducting further research to gain more subject knowledge. The teacher's role is to introduce the learning environment and collaborative tools resources such as *Google Drive*®, *Google Docs*®, and *Google Calendar*®.

Stage 3: Study and collect relevant information (inside) to practice thinking

Individual and group thinking practice is developed using concepts learned from TMI. These include the ability to analyze and study knowledge from resources provided by the teacher or from sources outside the group according to each student'sTMI aptitude and intelligence area through learning content management tools such as Google Classroom®, communication tools such as *Google Meet*®, *Google*®, and *Line*®, collaboration tools such as *Google Drive*®, *Google Docs*®, and *Google Calendar*®, and creative tools such as *Google Drawings*®and *Canva*®, among others.

Stage 4: Conclusion and Presentations

Stage 4 entails each learner taking the information they have gathered and analyzing it to conclude the problem as set out. This phase of the data analysis also involves identifying the appropriate method according to the condition of each learner's information and ability. The collected information is then arranged in clearly

defined segments using theoretical and logical reasoning. The information is then compiled and summarized. Students then conclude the elements arranged and gain new knowledge from the topic of the problem based on each group's aptitude as outlined by TMI. Finally, the information is summarized and presented according to the learning environment that the teacher prepared for the next step inexchanging the findings and knowledge. Students listen to reviews, classmate and teacher suggestions, and make improvements and present the results of the activities.Numerous cloud-based products are also available to help students present their work, including creativity tools such as *Illustrator*®, *Procreate*®, *Google Drawings*® or Canva®, communication tools such as *Google Meet*®, *Google*®, and *Line*®, and presentation tools such as *Google Slides*®, *YouTube*®, and *PowToon*®. Students can make presentations through captions, pictures, or digital media. Instructors can create stimulating questions to show the relationship of the information to check the consistency of the work produced with the objectives. Thus, this learning environment becomes an intellectual tool that works together to solve problems and a support base in organizing new activities or situations for learners to apply and expand their new knowledge.

Step 5: Lesson summary and evaluation

In the final lesson *summary and evaluation*phase, the assessment takes place based on the coverage of the answers to the problem topics. The lesson content and learning environment for all six environments will be in the form of text, images, and videos through the website, including rules and research methods. Interaction with content and interaction with other people takes place, allowing everyone to express their opinions and exchange what they have learned. Session quizzes and final course assessments on intellectual tools used in collaborative problem solving and coaching are undertaken. These include an online learning environment and communication tools such as *Google Meet*®, *Google*®, and *Line*®. Collaboration tools include *Google Drive*®, *Google Docs*®, and *Google Calendar*®. Presentation tools include *Google Slides*®, *YouTube*®, and *PowToon*®, via cloud technology.Finally, the teacher assesses each student's learning development by assessing the results produced. The students also assess themselves and the group members' performance, which leads to the final post-test using learner assessment tools based on *Google Form*®, *Google Sheets*®, or *Rubistar*®. Although most would consider the above applications as *productivity tools*, in reality, these tools become a student's intellectual partner, which enhances their cognitive powers during thinking, problem-solving, and learning (Jonassen&Reeves, 1996; Lajoie, 2000).

Conclusion

The research and development results enabled researchers to develop an online proactive learning model in conjunction with the theory of multiple intelligences to promote the ability to think analytically. Moreover, the researchers designed teaching and learning activities to promote analytical thinking to develop learners to practice analytical thinking. Further focus was given to students on learning and studying in a project using an online teaching management environment.

Acknowledgment

The authors wish to thank Ajarn Charlie for his dedicated support, English language editing, and proofing.

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