

# **The Development of Integrated Active Learning Management and Design Thinking to Enhance the Critical Thinking, Creativity and Innovation for Student Teachers**

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**Abstract:** Based on the study of developing the integration of Active Learning Management and Design Thinking in order to enhance critical thinking creativity and innovator for teaching students. Therefore, the researcher was interested in studying the effectiveness of integration with the learning model with the purpose of studying the behavioral indicators of four critical thinking indicators, four creative skills, indicators, and indicators of innovative skills. The samples in the research were undergraduate students at the Faculty of Industrial Education and Technology at King Mongkut's Institute of Technology Ladkrabang and registered for curriculum development, in the first semester of the 2022 academic year from a random group (N= 177) (Cluster Random Sampling). The sample group was selected through cluster random sampling, with a total of 35 students. The research tools were as follows: (1) learning plan for the course and curriculum development in terms of local and related curriculum development; (2) an interview form on learning behavior, an observation form activity sheet and a performance evaluation form; (3) a critical thinking measure form, a creativity measure form and an innovator measure form. The statistics used for data analysis, mean, standard deviation and a paired sample t-test.

**Keywords:** Design Thinking, Critical Thinking, Creativity, Innovator

## **Introduction**

Model Thailand 4.0 specifies a country driven by technology, linked to the development of the country, according to the 20-Year National Strategic Plan (2018-2037). The National Strategic Issues for Human Resource Development and Empowerment have important goals to develop people in all dimensions and at all ages to be good, talented and quality people, to encourage lifelong learning and to continuously develop themselves throughout life and become innovators consistent with the research results: “Development of Essential Skills of Thai Teacher in the Digital Age”. The results found that the current state of essential skills among Thai teachers can be categorized into six skill areas: (1) integration and knowledge creation for digital learning skill; (2) information seeking and information use skills; (3) the use of digital technology for educational learning skills; (4) creation and innovation development skills; (5) communication and coordination skills; and (6) ethical use of digital technology media skills (The Teachers’ Council of Thailand, 2022).

Creativity and innovation skills are the most essential skills that Thai teachers need to develop for the digital age (The Teachers’ Council of Thailand, 2022). Therefore, preparation for student teachers is considered necessary for both teachers and students. It prepared students to be problem solvers and create innovations or working styles in the present with changes according to technology and various media. Especially in this era, when there is a rapid of growth in technology. Therefore, in conclusion, from the synthesis of the characteristics of teaching professional students (Wongtatham, 2015; Wasan and Teerawat, 2016; Phinit, 2018; Panich, 2012; School of General Education, 2021; Suthikan et al., 2021), there should be critical thinking. Learning by solving real-world problems are as follows: (1) Critical Thinking: thinking and reasoning based on comprehension and systematically linked to behavioral characteristics, including the following:

(1) to specify an idea, and to ask questions about various stories to gather information and find new topic ideas. To explain or identify the perspective, the issue of the story, and to indicate the relationship between the ideas and issues in order to lead appropriate topic ideas. To understand various situations and to express and support opinions on various issues.

(2) to evaluate data, analyze evidence, collect information, and summarize interesting topics to explain, link content, and communicate accurate information. To evaluate, analyze the accuracy and reliability of the data for quality, to identify the credibility of the data and to separate the issues from the analyzed data and to analyze the data and investigating various phenomena.

(3) for perspectives and interpretation, examination and consideration of alternatives, to incorporate personal perspectives with various empirical perspectives. To check assumptions or hypotheses by considering relevant information and to exchange opinions with others about various events or data received.

(4) To draw conclusions, summarize results of the use of the information, to discuss the conclusions and the resulting outcomes by carefully considering the causes and effects, principles, and indicating evidence.

2. Creative thinking skills refer to the desire to know and understand intelligently. It is the development and application of effective communication skills and the behavioral characteristics of creative thinking skills included the following:

(1) Originality refers to the ability to generate unique and diverse ideas quickly, even in response to challenging tasks. This skill involves being able to think outside the box and come up with new perspectives that are relevant to the assigned task.

(2) Fluency refers to the ability to work on difficult or challenging tasks, being open to new ideas, and able to handle situations that were never encountered. This skill involves using various methods to generate a wide range of ideas, concepts, or topics that are possible.

(3) Flexibility refers to the ability to make decisions and choose methods, ideas, or topics based on different perspectives, analyzing methods, and ideas by considering different viewpoints and gathering relevant information before making decisions.

(4) Elaboration involves the process of selecting the most suitable methods, ideas, or topics, evaluating and summarizing, and choosing the most appropriate methods, ideas, or topics.

3. Innovative skills are the ability to link ideas while the brain attempts to synthesize and understand new information. This leads to the creation of ideas and the search for solutions through the process of questioning, observing, interacting, and experimenting. The innovative skills have behavioral characteristics that included the following:

(1) Linking ideas: Combining ideas to link ideas, objects, services, and technologies from various fields of knowledge, as well as using various experiences and synthesize them. A link can be drawn from one point to another in a variety of experiences and leads to the creation of new ideas; (2) Ask questions: Asking questions is a working method of innovators that stimulates other discovery behaviors, namely observation, interaction, and experimentation. Innovators ask challenging questions of the map of ideas in the brain, often consisting of the following: (1) “What is...” to discover hidden things; (2) “What is the cause...” to understand the underlying driving force; and (3) “Why...” and

“Why not...” questions that are beneficial to creative thinking and discovering things that have never been done before.

(3) Observation: Most innovators are good observers. While observing, they begin to link similar things from various unrelated information, leading to the discovery of unexpected ideas. Interesting questions serve as a stimulus, using observation methods to see which products customers use while working, the activities of customers, suppliers, or companies, leading to finding unexpected or abnormal things. This is the key to generating new ideas and creating innovations.

(4) Creating interactions is a way to interact with people in general or those who have not interacted much before, in order to find new understanding in unexpected directions. The search for new ideas from experts outside the field can expand into new ideas or innovations.

(5) Experimentation is a way of testing new ideas by creating prototypes and conducting pilot experiments. Experimentation is the best way to provide information about future possibilities. It has been found that among all discovery skills, experimentation is the best differentiator between innovators and non-innovators.

Design Thinking is a thinking process that deeply understands various problems by focusing on users and target groups as the center and develops creative ideas and diverse perspectives to solve problems. Design thinking is used as a ‘tool’, ‘method’, or ‘thinking process’ to solve various problems. Human-centered thinking and design are used to solve real human problems. The Stanford Design Thinking Process consisted of five steps: Empathize, Define, Ideate, Prototype, and Test (Brown, 2009; Dorst, 2011; Tom and Kelly, 2013; Seidel, and Fixson, 2013; UK Design Council, 2017; The Stanford D. School, 2017).

Step 1: Empathize - Understanding the problem deeply by observing and interviewing to gather both general and in-depth information. This information comes from both background knowledge and experience to use as a guide to define and establish the scope of the problem.

Step 2: Define - Synthesizing information from Step 1 to gain understanding and analyzing the problem to clearly define the problem, as well as choosing and summarizing possible solutions.

Step 3: Ideate - Using brainstorming techniques to generate creative ideas without boundaries or limitations. The focus is on finding ideas and solutions that could potentially solve the problem, with an emphasis on possibility and versatility. The emphasis is placed on generating as many ideas as possible. This stage can be considered as a creative stage, option or solution. The ideas or ways used to solve the most suitable problems are selected.

Step 4: Prototyping: In modeling or prototyping, users or prospects can test and critique in order to understand the problem more and know how much faster prototyping is. It will help to find mistakes faster. The model or prototype that has been produced can be objects, photographs, role-playing, animation or simulations.

Step 5: Testing by bringing the created model or prototype to test with users or target groups. The feedback, various suggestions as well as recommendations can be brought for use in the development and continue to improve. There may be a retrospective review of the project summary. There may also be indications of changes in behavior or relationships among members of the group.

The concept of applying the design thinking process can be used to develop a local curriculum with active learning to promote critical thinking, creative thinking skills and innovation skills for professional teachers. The development of the local curriculum had the principle of developing the curriculum to train learners to love and cherish the cultural heritage of their ancestors and act as a good member of society and to be able to create a livelihood, solve problems in life and in community (Office of Academic and Educational Standards 2010 A: 18-19). This is consistent with the living conditions of learners, culture, and local identity. They can learn about being Thai, being a good member of society and being able to make a living and solve problems in community life. The guidelines for local curriculum development require local curriculum developers to adjust teaching and learning activities or organize supplementary activities. The details of the content are adjusted by increasing or decreasing details from the update core curriculum or choose to use learning materials that are appropriate for the locality. This includes the need to create new teaching materials and described additional subjects that appear in the core curriculum with local curriculum development guidelines. The teacher professional students therefore had the opportunity to develop critical thinking skills, creative thinking skills and innovator skills as well as being able to communicate, create curriculum publishing content to benefit and create a better society. The research objectives were to compare the critical thinking skills, creative thinking skills, and innovation skills before and after using the integrated design thinking approach in learning management.

## **Research methodology**

### *Research Scope*

Population and sample group: the research population were undergraduate students from the Faculty of Industrial Education and Technology at King Mongkut's Institute of Technology Ladkrabang, in the first semester of the 2022 academic year, with a total of 117 students. The sample group was selected through cluster random sampling from one classroom, consisting of 35 students.

Studied Variables: The independent variable is the integrated design thinking approach in learning management, categorized into before and after learning. The dependent variables were critical thinking skills, creative thinking skills, and innovation skills. Content used in the research: the content used in this research is specified in the curriculum development.

### *Research tools*

A learning model integrates design thinking with local curriculum development activities in the curriculum development by studying principles, concepts, and design thinking processes critical thinking skills, creative thinking skills and innovator skills and creating a learning plan for local curriculum development by integrating the design thinking process into the learning management activities. Then, a questionnaire was conducted on the opinions of experts on learning plans for local curriculum development by integrating design thinking processes to check for consistency, suitability and the practical possibility of integrating design thinking processes for local curriculum development from experts. It was found that there was a corresponding value, suitability and the possibility of using. The confidence value or Cronbach's Alpha was 0.87. After that, the learning plan was modified for the following activities (Naowanit Songkram, 2011; Puchong Rojsaengrat, 2016; Chaiwat Suthirat, 2016; Naruthep and Charan, 2018).

Table 1 Learning Management Process and Activities

Learning management process	Activities
Step 1: Empathize	<p>Students collaboratively synthesized data using a learning technique by using questions (Power Question).</p> <ul style="list-style-type: none"> <li>• What makes us interested in this matter? (KP)</li> <li>• Which issues made us interested in developing it as a curriculum? (KP)</li> <li>• What benefits the learners in the curriculum (VP)?</li> <li>• Which content or activities develop learners? (KA)</li> <li>• Facilities and materials necessary for the course (KR)</li> <li>• How can people in the community and surrounding society participate in curriculum development (CR)?</li> <li>• History, Geography, Tradition, Culture, Economy, Landmarks (VP)</li> </ul> <p>Answer questions according to the issues and summarize them in Activity Sheet 1, a one-page curriculum development plan to be used as a guideline for going into the repository for local curriculum development.</p>
Step 2: Define ideate	<p>Students collaboratively synthesized data using a learning technique by using questions (Power Question).</p> <ul style="list-style-type: none"> <li>• How can the gathered information be responsive to the issues were interested in developing the curriculum and were beneficial in changing the behavior of learners in the course?</li> <li>• What experiences and content should be organized to help achieve the predetermined goals?</li> <li>• How can we arrange activities to promote learner development so that teaching can be effective, learners can develop appropriate skills, and processes can be the most suitable for the community context?</li> <li>• How do we evaluate the effectiveness of the educational experience to determine if we have achieved the predetermined goals?</li> </ul> <p>Use the information from the answers to design a draft local curriculum, Activity Sheet 2, and a local curriculum form to create a local curriculum that meets the needs and requirements for the curriculum.</p>

Table 1 (continued)

Learning management process	Activities
Step 3: Prototype	The students synthesized the data, review content, and proposed a curriculum to the community for analysis, evaluation, and consideration of compatibility and appropriateness according to the components of the curriculum. The information is summarized using Activity Sheet 3, which evaluated the compatibility and appropriateness of the curriculum.
Step 4: Test and share	Present the curriculum to the community and then pilot the curriculum. Afterward, disseminate and deliver the curriculum to the community.

A measure of creative thinking skills and innovation skills, using Content Validity method to find the Index of Item Objective Congruence (IOC) among the indicative behaviors that represented creative thinking skills and innovation skills from the expert analysis, which showed that the IOC value was 0.966, indicating high content validity. Then, the measure was tested with a group of 25 individuals who were similar to the sample group. The Cronbach's Alpha value was found to be 0.902, indicating high reliability.

#### *Data collection*

The researcher collected data on the development of a local curriculum enhancement activity for promoting critical thinking, creative thinking, and innovation skills using a design thinking process in a blended learning environment. This study was quasi-experimental research that used a one-group pretest-posttest design. The research process involved the following: (1) preparation of a learning plan for the development of a local curriculum, including tools such as activity sheets, interview forms, observation forms, performance evaluation forms, the assessment of critical thinking, creative thinking, and innovation skills. The researcher also conducted group discussions to reflect on the results of the curriculum development activity, which took place during September-October 2022, among third-year students in the architecture and design program. The activity was designed in three phases and four steps:

##### 1. Understanding the problem and community needs

Step 1: Empathize - The researcher used observation and interviews to gain general and in-depth information from the local community that students were interested in developing the local curriculum.

##### 2. Development of ideas

Step 2: Define and ideate - This step involved synthesizing information gathered from Step 1 to gain a clear understanding of problems or community needs, and selected and summarized possible solutions using brainstorming and mind-mapping techniques. The focus is on finding ideas and ways to solve problems according to the needs of the community. An emphasis was placed on generating as many ideas as possible. At this stage, it can be considered as the creative stage, an option or a solution to select the ideas or ways to most suitably solve problems.

### 3. Innovation delivery period

Step 3: Prototype - This step involved developing a prototype or model of the proposed solution to be tested and evaluated by the local community in order to understand the problem more and to create the awareness of important things needed by the community.

Step 4: Test and share - This final step involved testing and evaluating the prototype with the local community to identify any issues and gather feedback to improve the prototype.

#### *Statistics used in data analysis*

The researcher analyzed the data according to the research objectives: (1) to compare critical thinking, creative thinking skills and the skills of innovators before and after using an active learning process that integrates design thinking processes using descriptive statistics analysis. Descriptive Statistics are the statistics used to describe the characteristics of the mean and standard deviation using a packaged program to analyze the statistical data. The paired-samples t-test was used. The population and sample were obtained by the cluster random sampling method for one room of 35 students. Then, the questionnaire was used to analyze the mean and standard deviation. The mean of the data was interpreted based on the criteria of Boonchom Srisa-at (2010) as follows: 4.51 – 5.00 means very good; 3.51 – 4.50 means the highest; 2.51 – 3.50 means moderate; 1.51 – 2.50 means low; 1.0 – 1.50 means the lowest.

## **Research results**

The research results on the development of a design-thinking integrated active learning management process conducted by researchers who analyzed the statistical data and presented the results as follows.

The evaluation results were used to compare creative thinking, creative construction skills, and innovation skills before and after the development of the integrated design-thinking curriculum activity for undergraduate students in a local context. The research details and summary of the results were as follows:

In testing the research hypothesis, the researcher used a preliminary agreement for the paired-samples t-test analysis and tested normal distribution using the Shapiro-Wilk test. As there were 35 participants (less than 50), it was found that the Sig value was greater than the alpha value ( $\alpha$ ) (Sig > .05), indicating that the data was normally distributed. The paired-samples t-test was used to test for differences in creative thinking, creative construction skills, and innovation skills before and after the design-thinking integrated active learning management process. The results are presented in Table 1 below.

**Table 2 Comparison of the Results of Critical Thinking Before and After an Active Learning Process that Integrates Design Thinking**

Critical thinking	Mean		Std. Deviation		t-test	Sig
	Before	After	Before	After		
1. Identify ideas, ask questions about various matters to gather information for finding new topic ideas. Explain or identify the concepts, perspectives, issues, and relationships between ideas and perspectives to address relevant topics. Understand various situations that occur and express opinions on different issues to support their ideas.	2.7314	4.1086	.6910	.6199	-9.850	<.001
2. Analyze information, examine evidence, gather data, and summarize it into interesting topics for explanation, linking content, and communicating accurate information. Evaluate the accuracy and reliability of the information for quality, and determine how much it can be trusted. Separate various issues from the analyzed and synthesized data, and investigate the information to explain various phenomena.	2.7143	3.9905	.6525	.5392	-8.885	<.001
3. Perspective and interpretation, review and consider alternatives, combine one's own ideas or perspectives with various perspectives derived from empirical data. Check your own assumptions or assumptions of others based on relevant information. Exchange opinions with others about events that have happened or information received.	2.5368	4.0809	.6280	.5797	-11.658	<.001
4. Summarize results from implementation. Discuss the conclusion and the results that will follow with careful consideration of cause and effect. Provide evidence to support their opinions.	2.6381	4.8286	.8493	.9840	-4.459	<.001
Total	2.6590	4.1295	.6226	.5352	-11.688	<.001

From the table, it was found that the t-test result = -11.688, the value sig.<.001 from the level of statistical significance ( $\alpha$ ) = .05 showed that the critical thinking of undergraduate students after using the learning process with proactive integrated design thinking process is higher than before the activities.

**Table 3 Comparison of Creative Thinking Skills Before and After the Active Learning Process that Integrates Design Thinking**

Creative thinking skills	Mean		Std. Deviation		t-test	Sig
	Before	After	Before	After		
1. Originality is the ability to think of topics and exotic points of view. It can be varied and able to come up with many ideas related to assigned tasks in a short time	2.8571	4.0429	.7213	.8859	-2.657	.012
2. Fluency: Do difficult or challenging tasks. Open-minded to new things. Being able to cope with things that have never happened before. Using multiple methods to get a possible method, idea, or topic	2.4667	4.3810	.5784	.7927	-12.177	<.001
3. Flexibility: Being able to decide on methods, concepts, and topics from many ideas and possibilities. Analyze methods and concepts from different perspectives. Gather as much relevant information as possible before making a decision.	2.5333	4.1429	.6725	.61190	-10.431	<.001
4. Elaboration: There is a process for selecting the most suitable method, concept or topic, conclusion, assessment and choose the most suitable method, concept, or topic.	2.7143	4.2571	.6449	.8691	-8.243	<.001
Total	2.5286	4.2171	.5512	.6989	-11.464	<.001

From the t-test result table = -11.464, the sig.<.001 value when the level of statistical significance ( $\alpha$ ) = .05 indicated that the creative thinking skills of undergraduate students after using the active learning management process and integrating higher design thinking processes than before the event.

**Table 4 Comparison of Creative Thinking Skills Before and After the Active Learning Process that Integrates Design Thinking**

Innovator's skills	Mean		Std. Deviation		T-Test	Sig
	Before	After	Before	After		
1. Linking thoughts is the integration of thoughts in one's own brain and those of others in linking ideas, objects, services, technologies from knowledge from various disciplines. This includes the use of various experiences and synthesized into something new.	2.5429	4.2000	.6168	.7712	-9.559	<.001
2. Questioning is an innovator's way of working that will encourage other discovery behaviors, observation, interaction, and experimentation. Innovators have the skill of questioning that challenges the validity of the mind map in the minds of innovators.	2.5714	4.128	.6080	.8075	-8.905	<.001

Table 4 (continued)

Innovator's skills	Mean		Std. Deviation		T-Test	Sig
	Before	After	Before	After		
3. Observation associates the same things from different information which are not related to one another to have a relationship. It became a discovery point for unexpected ideas with interesting questions as a stimulus. This is the key that leads to new ideas and innovations.	2.6143	4.2571	.6193	.8077	-8.985	<.001
4. Creating interactions is interaction with people in general or those who have not had much interaction before in order to find new understanding in unexpected directions. The search for new ideas from experts outside the field can expand the results to new ideas or innovations.	2.4714	4.2000	.7370	.7495	-10.353	<.001
5. Experimenting is trying out new ideas by creating prototypes and conducting pilot tests. Experimenting with new experiences is the best way to provide information about possibilities in the future.	2.6286	4.5429	.8075	.7413	-11.203	<.001
Total	2.5558	4.2286	.5363	.7070	-10.863	<.001

From the test results table, the t-test = -10.863, sig. < .001, the statistical significance ( $\alpha$ ) = .05 indicates. It showed that the innovation design thinking learning process significantly enhanced creative thinking skills and the innovative abilities of undergraduate students, compared to before the activity.

## Discussion

According to the comparative results of critical thinking, creative thinking skills and innovator skills, these three indicators are the value sig.<.001 when the level of statistical significance ( $\alpha$ ) = .05 before and after using the active learning process that integrates the design thinking process, it was found to be significantly higher than before learning at statistical significance ( $\alpha$ ) = .05 indicates. This corresponded with the hypothesis. Due to the proactive learning process that integrated the design thinking process, learners were encouraged to search for information, search, experiment, practice and draw conclusions, as follows: Step 1 is to inspire full understanding. Learners will practice critical thinking because teachers use power questioning techniques to go into the repository of local curriculum development. The students are trained to ask questions that lead to creativity, development, and the analysis of various factors that are important in curriculum development. This, in conjunction with the cooperative teaching model, is a group learning activity where teacher students work altogether to study problems. The need for innovation development here is to develop a local curriculum (Barkley, Cross and Major, 2014). Channarong Wisetsat (2019) found that there was a need for project-based learning from experience. The innovative approach of teaching professional students consists of five

steps that are consistent with the design thinking process. Step 2 is to brainstorm ideas and identify creative ideas. The students will practice creative thinking skills. Step 3 is to create a prototype. The students will practice critical thinking skills, creative thinking skills, and innovator skills. Step 4 is to try and transfer the curriculum to society (Test and Share). The students are trained to have critical thinking and innovator skills. The evaluation of activity results by self-assessment and peer-assessment were reflected in the results of learner development in the selection of work processes. The use of information in field visits and gathering to design local curriculum offered social reintegration curriculum that students can work on.

## Conclusion

The proactive learning process that integrates the design thinking process can be applied to promote critical thinking, creative thinking skills and innovator skills in other subjects in order for learners to be individuals with learning development who can apply the knowledge they have studied to other contexts in their own life. The instructors need to manage learning by coaching for learners to study, develop, create a body of knowledge and apply knowledge on their own, as well as boosting confidence and increasing learning efficiency for learners. To increase the satisfaction assessment on the use of proactive learning management processes that integrate design thinking processes to explore the need for learning environment arrangements, such as media, equipment, learner development guidelines, and the coaching style of the instructor and to increase the development of a tool to evaluate the empowerment for learners to develop themselves and recognize their own development.

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