ผลการประเมินตนเองด้านทักษะการเรียนรู้และนวัตกรรมของนักศึกษาไทยที่เข้าร่วมกิจกรรมการคิดเชิงออกแบบเพื่อนวัตกรรมทางสังคม

Self-assessments on Learning and Innovation Skills of Thai Students Participating in Design Thinking for Social Innovation Activities

สุภรพรรณ คนเฉียบ[1] และ มิ่งขวัญ กันจินะ[2]*

Supornphan Konchiab[1] and Mingkwan Gunjina[2]*

[1]สาขาวิชาศิลปศาสตร์ คณะบริหารธุรกิจและศิลปศาสตร์ มหาวิทยาลัยเทคโนโลยีราชมงคลล้านนา เชียงใหม่ จ. เชียงใหม่ 50300

Department of Liberal Arts, Faculty of Business Administration and Liberal Arts, Rajamangala University of Technology Lanna Chiang Mai 50300, Thailand

[2]กลุ่มวิชาคณิตศาสตร์ คณะวิทยาศาสตร์และเทคโนโลยีการเกษตร มหาวิทยาลัยเทคโนโลยีราชมงคลล้านนา จ. เชียงใหม่ 50300

[2]Department of Mathematics, Faculty of Sciences and Agricultural Technology, Rajamangala University of Technology Lanna, Chiangmai 50300, Thailand

*Corresponding author: E-mail: tu502@hotmail.com

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Abstract: This research aimed to compare levels of learning and innovation skills based on students' self-assessments before and after participating in the design thinking for social innovation activities with the local community in Chiang Mai province. It also aimed to compare skill levels across the three phases of design thinking: Empathy, Ideation, and Prototype. The population was a group of 27 Thai undergraduates from different majors and academic levels who voluntarily participated in the design thinking for social innovation activities in March 2018. The research instrument was a set of five-point rating scale self-assessment questionnaires on learning and innovation skills. Based on a dependent sample t-test analysis, all skills were significantly improved after the activities. Participants also assessed that they were most likely to develop collaborative skills over the three phrases. Communication was the second most developed skills in the Empathy and Ideation phases, while critical thinking and problem solving were the second most developed skills in the Prototype phase.

Keywords: Learning and innovative skills, design thinking, social innovation, self-assessment

บทคัดย่อ: การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) เปรียบเทียบระดับการประเมินตนเองด้านทักษะการเรียนรู้และนวัตกรรมของนักศึกษาไทยก่อนและหลังการเข้าร่วมกิจกรรมการคิดเชิงออกแบบเพื่อนวัตกรรมทางสังคมร่วมกับชุมชนท้องถิ่นในจังหวัดเชียงใหม่ 2) เปรียบเทียบระดับทักษะการเรียนรู้และนวัตกรรมในกระบวนการคิดเชิงออกแบบ 3 ระยะ ได้แก่ ระยะการเข้าใจปัญหา ระยะการสร้างสรรค์ความคิด และระยะการสร้างแบบจำลอง

ประชากร ได้แก่ นักศึกษาจากมหาวิทยาลัยเทคโนโลยีราชมงคลล้านนาที่อาสาสมัครเข้าร่วมกิจกรรมการคิดเชิงออกแบบเพื่อนวัตกรรมทางสังคมตั้งแต่ปีการศึกษา ในเดือนมีนาคม ปีการศึกษา 2561 จำนวน 27 คน เครื่องมือวิจัย คือ แบบประเมินตนเองด้านทักษะการเรียนรู้และนวัตกรรม แบบการประเมินค่า 5 ระดับ จำนวน 25 ข้อ เพื่อนำมาเปรียบเทียบผลประเมินตนเองก่อนและหลังกิจกรรม โดยการทดสอบที แบบไม่เป็นอิสระต่อกัน ผลการวิจัยพบว่า การประเมินตนเองด้านทักษะการเรียนรู้และนวัตกรรมของนักศึกษาไทยหลังเข้าร่วมกิจกรรมสูงกว่าก่อนเข้าร่วมกิจกรรม อย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 และจากการเปรียบเทียบระดับทักษะในกระบวนการคิดเชิงออกแบบ 3 ระยะ พบว่า ทักษะด้านความร่วมมือมีการพัฒนาสูงที่สุดในทุกระยะ รองลงไปคือทักษะด้านการสื่อสารในระยะการเข้าใจปัญหาและระยะการสร้างสรรค์ความคิด และทักษะด้านการคิดอย่างมีวิจารญาณและแก้ไขปัญหาในระยะการสร้างแบบจำลอง

คำสำคัญ: ทักษะการเรียนรู้และนวัตกรรม การคิดเชิงออกแบบ นวัตกรรมทางสังคม การประเมินตนเอง

Introduction

In the 21st century, economic, technological, and social movements have changed rapidly and without clear direction, leading to more complex challenges. Many of these challenges are also viewed as “ill-defined” and “wicked” problems because they are complicated to understand and predictable, so it is demanding to solve them properly (Koh *et al*., 2015). Design thinking is seen as a potential approach to identify these “wicked problems” and generate ideas for possible solutions (Docherty, 2017). Therefore, design thinking is commonly used in many business enterprises to improve products and services as well as marketing and advertising strategies. It can also be seen as an approach for social innovation, including facilitating and developing better solutions to the complex social issues in communities and society (Brown and Wyatt, 2010; Docherty, 2017).

Design thinking comprises many features to facilitate better solutions to real-world problems. Firstly, design thinking is human-centered that involves the empathy process to gain insights into user’s deep needs and problems, leading to a clear identification of the problem (Razzouk and Shute, 2012). Focusing more on “design with users” than “design for users”, problems will be solved to meet the needs of users. Secondly, design thinking involves sharing ideas and efforts from a multidisciplinary team to solve problems (Brown and Wyatt, 2010). Different areas of expertise and perspectives would enable teams to handle diverse parts of complicated issues. Thirdly, design thinking is an iterative and non-linear process. It is also dynamic, flexible, and adaptable to fit a particular context. According to the d.school in Standford, USA,

design thinking process comprises five phases. First, the Empathize phase involves learning about users to understand their needs. Second, the Define phase refers to defining problem statement. Thirdly, the Ideate phase deals with brainstorming and generating solutions. Fourthly, Prototype phase involves building representations of one or more ideas. Lastly, Test phase includes testing ideas and gaining user feedback. As an ongoing process, problems can be redefined, and more ideas can be created for a better solution.

Based on features mentioned above, implementing design thinking requires many skill sets, including higher-order thinking skills such as critical thinking, problem-solving, creativity, and innovation, as well as and social skills such as communication and collaboration (Koh *et al*., 2015). These skills fall into learning and innovation skills or the 4Cs: communication, collaboration, creativity, as well as critical thinking and problem solving. According to Brown (2008), communication and collaboration are important skills of human-centered activities in design thinking. Also, working in a multidisciplinary team requires effective communication and collaboration. In addition, as Razzouk and Shute (2012) point out, design thinking involves creative thinking, systems thinking, problem-solving, and teamwork skills in generating solutions for complex problems. Therefore, it can be said that one can develop these skills when experience design thinking. However, little research regarding the use of design thinking to cultivate these skills has been published.

Rajamangala University of Technology Lanna has co-hosted international academic camps with educational institutions in Singapore and Japan since 2016, twice a year. In these camps, Thai and international students from different disciplines participated in design think process and work together to develop social innovation with local communities in Chiang Mai. Their learning through 12 days is facilitated by lecturers who were certified design thinking facilitators. Researchers, as ones of those facilitators, were interested in examining the effects of design thinking process on the development of learning and innovation skills. The objectives of this research were 1) to compare levels of learning and innovation skills based on students' self-assessments before and after participating in the design thinking for social innovation activities, and 2) to compare skill levels across the three phases of design thinking: Empathy, Ideation, and Prototype.

Materials and Methods

This study focused on the quantitative approach. It aimed to measure and compare changes in skill levels over time. The numerical data were obtained by using a set of five-point rating scale self-assessment questionnaires and analysed using descriptive and statistical analysis. According to Cresswell (2018), the quantitative approach generally contributes to validity, reliability, and generalizable of the study. In this study, levels of performance representing characteristics of each skill set were ranked by students to measure the development of each skill set.

Population and sample

The population was a group of 27 Thai RMUTL students from different majors and academic levels who volunteered to participate in design thinking for social innovation activities in March 2018. Fourteen students were from the Faculty of Business Administration and Liberal Arts, including Accounting, Business Administration, Tourism, Business Information System, Business English, English for International Communication, and International Business Management. Ten students were from the Faculty of Engineer, including Mechanical Engineering, Computer Engineering, Tools and Die Engineering, and Civil Engineering. Three students were from the Faculty of Fine Arts and Architecture, including Architecture and Visual Communication Design. These students, together with international students, are divided into three groups, working on three projects with local communities in Chiang Mai: 1) Tea leave and homestay community, 2) Wickerwork community and 3) Food Processing of Agricultural Products.

Research Tool

The research tool was a set of five-point rating scale self-assessment questionnaires on learning and innovation skills. It comprises a set of 4 Cs skills with 25 sub-skills. Firstly, 10 items of communication skills consist of listening, speaking, pronunciation, vocabulary, and presentation skills, as well as communication strategies (e.g., circumlocution, approximation, lexicalise fillers, comprehension check, and asking for help). Secondly, five items of collaboration skills comprise team building, leadership, being active members, active listening skills as well as responsibilities. Thirdly, five items of critical thinking and problem-solving skills include reasoning and argument, decision making, systematic thinking, and problem-solving skills, as well as dealing with unforeseen problems. Lastly,

five items of creativity include brainstorming, generating, sharing, and evaluating ideas, as well as being open to new ideas. These items were developed from document analysis of previous literature regarding definitions and classifications of learning and innovation skills and daily journals of student learning journey in the design thinking for social innovation project in 2016. The Index of Item-Objective Congruence (IOC) was used to validate the content by three experts who were experienced design thinking facilitators. The questionnaires were also piloted with 11 students from the design thinking for social innovation project in 2017. Based on Cronbach's alpha measure, the reliability of the questionnaires was high (α=0.94).

Data Collection

Data were collected in March 2018 when the design thinking for social innovation activities took place. Prior to the activities, informed consent was undertaken to ensure that students fully understood the aims and process of the research, as well as their roles and rights. Based on Singapore Polytechnic's design thinking framework, the process comprises four phases: Sense and Sensibility (i.e., prepare the minds), Empathy (i.e., understand user context, generate insights, and define statement of needs), Ideation (i.e., generate ideas, develop ideas to concepts, and select design concepts), and Prototype (build prototypes, get user feedback, test and improve).

On a daily basis, the questionnaires were distributed to each student and collected by a Thai team leader of each group. Data collection was on-going for 10 days of design thinking for social innovation activities, as outlined in Table 1. The design thinking for social innovation activities started from Orientation (Day 1) that involved pre-self-assessment. In the Empathy phase (Day 2-5), students engaged in the community, observed, and interviewed users, collected and clustered data, gained insights into deep needs, and designed persona. In the Ideation phase (Day 6-7), students brainstormed ideas for possible solutions, set criteria (e.g., cost, safety, and efficiency), and selected the best solutions. In the Prototype phase (Day 8-9), students sketched and drafted prototypes, obtained feedback from users, and revised their prototypes. In the gallery walk (Day 10), students presented their learning process and learning outcomes, followed by the post-self-assessment.

Table 1. Design thinking activities and learning outcomes of social Innovation

Phases	Design thinking activities	Learning outcomes of social innovation
Day 1: Orientation	• Design thinking recap	Gaining familiarity of the design thinking process
Day 2-5: Empathy	• Team boning, an overview of the local community context • Observation and interview in local communities • Collecting and clustering data points • Mining insights and identifying needs • Designing persona, a profile of users in community	Understanding users' deep needs: 1) Tea leave and homestay community needed the new generation to get involved in Miang (pickled tea leaves) business to conserve the culture. 2) Wickerwork community needed to find ways to maintain the quality of Kor (fan palm) roof to sell to customers. 3) Food processing workers needed to work in better condition while maintaining productivity.
Day 6-7: Ideation	• Brainstorming ideas for solutions • Setting criteria and selecting best solutions	Creating and introducing prototypes 1) Tea leave and homestay community: Campaign to promote Miang to visitors and contemporary Miang recipe 2) Storage of keeping Kor roof for wickerwork community 3) Pumpkin lifting machine for food processing workers
Day 8-9: Prototype	• Drafting prototype • Co-creation with local community and revision	
Day 10: Gallery walk	• Exhibiting and presenting projects • Obtaining feedback from audiences	

Data Analysis

1. Means and standard deviations were used to show the levels of the performances representing characteristics of each skill set, both in pre-self-assessment and post-self-assessment. The levels of developed skills were defined as below.

Ranges	**Levels of developed skills**
4.51 – 5.00	most likely developed
3.51 – 4.50	more likely developed
2.51 – 3.50	likely developed

1.51 – 2.50 less likely developed
1.00 – 1.50 least likely developed

2. A dependent t-test analysis was used to test whether or not the self-assessment scores after participating in the design thinking for social innovation activities was higher than those before taking part in the activities.

Results

The comparison of the pre- and post-self-assessments

Students appeared to improve their learning and innovation skills after participating in the design thinking for social innovation activities. From means and standard deviations showed in Table 2, levels of developed skills in the pre-self-assessment were at a high level (3.87), including collaboration (4.16), creativity (4.05), critical thinking and problem solving (3.75) and communication (3.51) respectively. In the post-self-assessment, levels of each skill were at the highest level (4.63), including creativity (4.65), communication (4.63), critical thinking and problem solving (4.61), and collaboration (4.60) respectively.

Table 2. The results from the dependent t-test of four skills

Skills	Self-assessments	Means	S.D.	t	P-value
Communication	Pre	3.51	0.68	8.07	< 0.05
	Post	4.64	0.29		
Collaboration	Pre	4.16	0.47	4.52	< 0.05
	Post	4.60	0.24		
Critical thinking and problem solving	Pre	3.75	0.54	6.86	< 0.05
	Post	4.61	0.38		
Creativity	Pre	4.05	0.40	6.58	< 0.05
	Post	4.65	0.31		

From the dependent t-test of pre- and post- self-assessments, the result from the analysis yielded the t statistics was 8.92 with the compare-mean 0.76 and the standard deviation 1.08. The P-value was less than 0.05. The results showed that students appeared to improve their learning and innovation skills after participating in the design thinking for social innovation activities. As shown in Table 3, based on the dependent t-test analysis, levels of learning and innovation skills in the post-self-assessment increased significantly. Also, when applying the dependent t-test analysis

to each skill, the results showed a significant improvement in each skill.

Table 3. The result from the dependent t-test

	Self-assessments	Mean	S.D.	t	P-value
Paired t-test	Pre	3.87	0.41	8.92	< 0.05
	Post	4.63	0.18		

Comparison of skill levels across the three phases of design thinking

The results from comparing student self-assessments in each phase of design thinking revealed that skill development in Phase 1 Empathy and Phase 2 Ideation shared a similar pattern. As shown in Figure 1, collaboration and communication were the most common skills, followed by creativity and critical thinking and problem-solving skills. These skills were ranked at an average level of 4.23, 4.15, 4.02, and 3.92 respectively in the Empathy phase while those were ranked higher at an average level of 4.41, 4.28, 4.18, and 4.12 in the Ideation phase. However, skills developed in Phase 3 Prototype were slightly different. Like other phases, collaboration skills were most likely developed, followed by critical thinking and problem-solving, creativity, and communication skills (with an average level of 4.42, 4.36, 4.34, and 4.30 respectively).

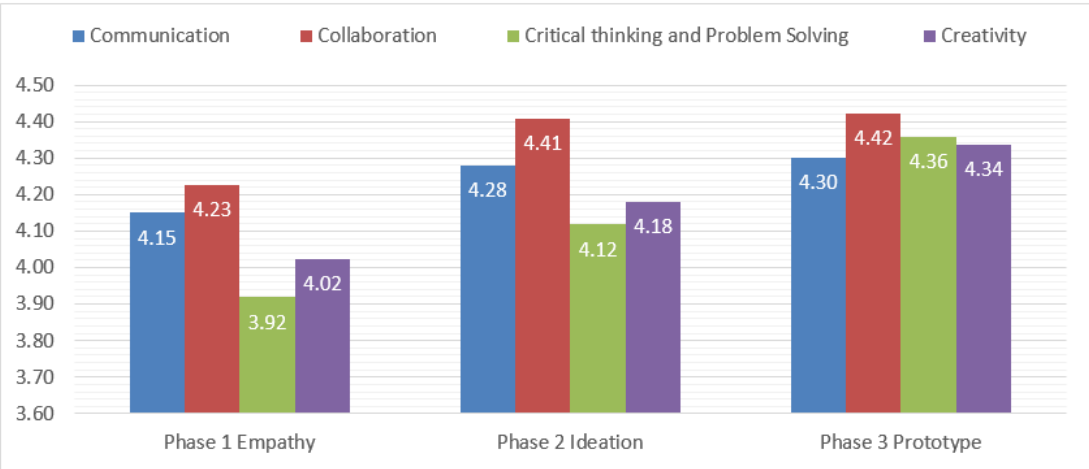

Figure 1. Skill Levels in Three Phases of Design Thinking

Also, the level of each skill tended to increase across phases, as shown in Figure 1. Firstly, communication skill levels in Phase 1, Phase 2, and Phase 3 were 4.15, 4.28, and

4.30, respectively. The highest sub-skills included listening and speaking, vocabulary learning, and asking for help. Secondly, critical thinking and problem-solving skill level increased from 3.92 to 4.12 and 4.36 from Phase 1 to Phase 3. Particularly, reasoning and argument, as well as decision making skills were most developed sub-skills. Thirdly, average levels of creativity in each phase were 4.02, 4.18 and 4.34. Being open to new ideas, monitoring one own idea, and brainstorming ideas were the top three. Lastly, it is noticeable that collaboration skills were ranked at a high level from Phase 1 and slightly increased in Phase 2 and Phase 3, (with an average level of 4.23, 4.41 and 4.42 respectively). Active listening skills were at the highest level, followed by responsibilities and being active members.

Discussion

The students perceived that they had improved all learning and innovation skills after taking part in the design thinking for social innovation activities. Such improvement might be the result of the fact that design thinking provides meaningful real-world activities that foster higher-order thinking as well as social skills (Koh *et al*., 2015). In terms of higher-order thinking skills, according to Razzouk and Shute (2012), critical thinking and problem-solving skills; such as exploration, generation, comparison, and selection, are essential for design thinking. While exploration helps broaden a problem and generation helps create and evaluate the solutions, comparison and selection help narrow a problem space and solution. Regarding social skills, communication and collaboration work alongside each other. In addition, Koh *et al*. (2015) state that creativity is required when students encounter complex problems as they need to apply content knowledge critically and creatively to generate ideas for solving problems. This finding supports arguments that design thinking is a useful tool to improve 21st century skills (e.g., Brown and Wyatt, 2010; Docherty, 2017; Koh *et al*., 2015).

This study also showed that communication was the most likely improved skills after involving in design thinking for social innovation activities. The highest sub-skills were listening and speaking, vocabulary learning, and asking for help. Working in a team of international and interdisciplinary students for over 10 days encouraged Thai students to use English for oral communication skills intensively.

Particularly, in such intercultural context where Thai, Singaporean, and Japanese working together to achieve the same goal, listening and speaking in English is greatly significant to share ideas and establish mutual understanding. Thai students also dealt with extensive vocabulary use and learning as they were required to translate Thai to English to their international friends and English to Thai for users in local communities. Further, working with a multidisciplinary team, they inevitably dealt with unfamiliar technical terms. In many cases, they used strategies, such as asking for help from those who were more familiarized with specific English terms. It can be said that improving oral communication skills and strategies helps equip students with intercultural communicative competence to be able to cope up with a variety of English and establish mutual understanding effectively with people who are from different academic and cultural backgrounds (Kirkpatrick, 2012).

In addition, collaboration, although slightly increased, was the most common skill developed across three phases. In this study, Thai students were more likely to be good team members than team leaders as active listening and being active members, as well as responsibilities were most common. These skills are required for team working in 21st century. According to Partnership for 21st Century Learning (2019), successful collaboration requires individual team member's contributions, willingness to help, and share responsibility to achieve a mutual goal. Such collaborative efforts tend to facilitate multidisciplinary team dynamics that bring about better innovations than those working within a single discipline (Brown and Wyatt, 2010).

Interestingly, both communication and collaboration were the most common skills developed in Phase 1 Empathy and Phase 2 Ideation. The Empathy phase aims to gain a deeper understanding of users, their feeling, thoughts, and attitudes. To accomplish this aims, Thai students played many roles; including interviewers, note-takers, and translators, that encouraged them to communicate in Thai and English extensively. Team collaboration was also cultivated through sharing and reflecting on the data, as well as discussed to agree on problem definition mutually. Similarly, in the Ideation phase, they brainstormed, set the criteria, and discussed to agree on the

possible solutions. These activities showed that communication and collaboration complement each other. For example, correct translations Thai into English enabled International students to understand the data point and the deep need of the local community. Verbal and non-verbal communications among Thai and international students enabled students to understand and be open to other different points of view, leading to successful team collaboration to find the best solution to solve the problems. It can be said that activities in Empathy and Ideation phases, as Koh *et al*. (2015) point out, provide learning context to promote social skills and cross-cultural awareness required to interact and collaborate effectively.

Lastly, critical thinking and problem solving and creativity were more common in the Prototype phase because teams were required to analyze the nature of tasks to create a prototype and assign to the right individuals (e.g., sketching for architecture student and building structure for engineering students) so that they were able to finish their rough drafts in allocates time. Also, regarding Noweski *et al*. (2012), prototyping generally encourages thinking about details of ideas, testing and reflecting on ideas, dealing with feedback from others, as well as seeking a more creative way to improve the prototype. Experiencing such process repeatedly may encourage students to develop creative confidence. Thus, the Prototype phase appeared to provide students opportunities to think more critically and creatively.

Conclusion

From this study, design thinking for social innovation activities is regarded as an essential tool to cultivate learning and innovation skills, including communication, collaboration, critical thinking and problem solving, as well as creativity. However, these skills were assessed based only on students' perspectives. Further research could be conducted by triangulating students' perspectives on their development of social and innovation skills with facilitator's perspectives and evaluation of their learning outcomes (e.g., user's persona and prototypes). Other skills essential for 21st century learning, including life and career skills as well as information, media, and technology skills should also be investigated in future research.

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