Experiential teaching through organizing project-based learning at Ho Chi Minh City University of Technology and Education

Duong Thi Kim Oanh

Ho Chi Minh City University of Technology and Education
No.1,Vo Van Ngan,Thu Duc district,
Ho Chi Minh City, Vietnam
Email:oanhdtk@hcmute.edu.vn

ABSTRACT: *In this article, the author describes the outline of experiential teaching and learning activities such as project-based learning, learning games and so on. Besides, this article also focuses on organizing mini project-based learning activities and learning games in the experiential teaching of System Thinking subject at Ho Chi Minh City University of Technology and Education. Combination of both qualitative (observation, interview, practical product-based research) and quantitave (rubrics) research methods were applied to identify gradually changes of the core competences (collaboration and problem-solving) of technical students through participating in the experiential learning activities. Some minor suggestions are made on organizing the experiential learning activities in cohesion with learning outcomes, teaching and learning activities as well as using assessment to improve the core competences of technical students.*

KEYWORDS: **Experiential teaching; experietial learning activities; project-based learning; mini project - based Learning; rubrics.**

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1. Introduction

The development of both science and technology and is undoubtedly posing new requirements for knowledge, skills, and attitudes towards trained human resources. This requires a comprehensive innovation in tertiary education, where innovating experiential teaching methods are emphasized in order to develop professional/ technical competencies, common/core competencies (sophisticatedproblem-solving, cooperating, critical thinking, creative thinking), learning motivation and the increment of student responsibility in learning.

According to a study on 350 enterprises in Hanoi, Ho Chi Minh City and in the vicinity of those two cities about the competencies which employers expected their employees to possess, Christian and Magnusson (2013) affirmed that, limitations on foreign languages, professional capabilities and engineers/technicians' core competencies are truely challenging barriers to Vietnamese workers. Enterprises are seeking for human resources whom acquisition is not only technical capability but also cognitive, social and action one (Christian.J.B&Magnusson, 2014). These competencies, together with technical capabilities, facilitate employees' performance on professional activities with high results.

Ho Chi Minh City University of Technology and Education (HCMUTE) is one of the leading universities in training engineers and vocational educators in Vietnam. Being fully aware of the requirements that employers demand for the competence of engineers, from the school year 2012 - 2013 up to now, the education program of Engineering Technology at university level built in the direction of CDIO approach (Conceive, Design, Implement, and Operate) has been released in order to promote the holistic development of learners (professional/technical and general/core competencies). At the time when this training program is being implemented, two groups of teaching methods may be used: teaching methods and techniques to help students study actively (conversation, small group discussions...), or ones that facilitate experiential learning (project-based learning, situated learning...). This article outlines several general issues about experiential teaching and project-based learning as well as how to organize and evaluate project-based learning outcomes of System Thinking subject of university-level training programs at HCMUTE.

2. Research contents

2.1. Experiential teaching and types of experiential learning activities

Learning is one of the most fundamental activities that humankind possesses. Since time immemorial, we have discovered the relationship between "experience" - what have been acquired through doing, working, practicing - and "learning". Experiences have an influence on cognition and activities in general,

including human learning activities. It is said that, the concept of learning by doing, working, practicing ... exists for a prolonged period of our history. Confucius (551- 479 BC) affirmed the meaning and value of "learning by doing", saying: "I Hear and I Forget, I See and I Remember, I Do and I Understand". The importance of "learning by doing" was also pointed out around 350 BC by Aristotle (384 - 332 BC): "For the things we have to learn before we can do them, we learn by doing them" (Wikipedia).Learning is one of the most fundamental activities that humankind possesses. Since time immemorial, we have discovered the relationship between "experience" - what have been acquired through doing, working, practicing - and "learning". Experiences have an influence on cognition and activities in general, including human learning activities. It is said that, the concept of learning by doing, working, practicing ... exists for a prolonged period of our history. Confucius (551-479 BC) affirmed the meaning and value of "learning by doing", saying: "I Hear and I Forget, I See and I Remember, I Do and I Understand". The importance of "learning by doing" was also pointed out around 350 BC by Aristotle (384 - 332 BC): "For the things we have to learn before we can do them, we learn by doing them" (Wikipedia). Numerous in-depth studies on experiential learning were performed during the early decades of the twentieth century by Dewey. Basing on this research, in the 70s of the twentieth century, Lewin and Piaget, Kolb developed a modern theory of experiential learning. "Experimental learning is a process in which knowledge is formed through the transition from experience", said Kolb (1984).

Experiential learning is closely linked with experiential teaching. According to Valerie (2012), the former is based on the process of the latter. The concentration of experiential teaching is on learning activities and organizing the learning process, which emphasizes the method of organizing experiential learning activities in association with real life and career situations. Experiential teaching can not be understood as a specific teaching method; it is a conventional one illustrating methods of teaching associated with experiential learning (practice, discussion, discovery, design, manufacture ...) as to develop learners' competencies. Experiential learning activities are at the core of experiential teaching. A variety of experiential learning activities has been introduced, play-based learning (Silberman, 2006 and Ukens, 2007), work-based learning (Lei Li, Fan Cheung, Ning Wang, Lixing Lao, Yibin Feng, 2016), project-based learning (Lee Hong Sharon Yam and Rossini, 2010; Efstratia, 2014)and so on. Such experimental learning activities not only influence students' in-depth study to actively acquire knowledge but also develop professional/technical capabilities as well as core/ general ones.

2.2. Project-based learning

Project-based learning is an experiential learning activity which gives students an impetus on learning in a more in-depth and proactive way, as well as exploring real-world problems actively in a collaborative environment (Lee Hong Sharon Yam and Rossini, 2010). According to Breiter, Fey and Drechsler (2005), learning project is a sophisticated learning task which is built on problems appear in every day life and career, and is directly linked to several positive learning activities of students such as surveying, exploring, discovering, designing, manufacturing, problem-solving, proposing measures and so on.By implementing learning projects, the training and development of core and technical competencies of students through responsibly collaborating helps them create real products. Thus, in project-based learning, under the organization of teachers, by combining theory and practice, students independently perform complicated learning tasks in order to create either physical or mental products. Teamwork is a fundamental form of project-based learning. According to Harmer (2014), project-based learning possesses several following basic traits:

Project-based learning increases the activeness, initiative and responsibility of both teachers and students in the teaching process.

Project-based learning is learning by doing/solving problems exist in real life and career. The excitement and positive motivation for learning of students will increase, and through working/solving practical problems, the results of learning also improve clearly.

Project-based learning encourages students to cope with learning tasks that are considered inter-problem/ subject/major. Having successfully analyze and solve learning projects of inter-problem/subject/major not only helps students identify that theoretical knowledge can be practically apply in the training program but also develops belief in oneself as well as in one's own major.

Project-based learning is effectuated through the collaboration between stakeholder as well as the activities of small groups. Interaction among members during a learning project's implementation is believed to be the key to developing a variety of competencies, for instance, communication, planning/decision making, conflict resolution, criticism, and creativity.

Project-based learning is closely linked to the creation of either physical or non-material products. These are not only the results of applying theory into practice, but also act as the most evident and utter demonstration of

students' competencies development after the learning process.

Aside from defining the features of project-based learning, international research also concentrates on clarifying the types of project-based learning. According to a research on project-based learning types published by many scientists, namely Cummings, Huff, Oakes and Zoltowski (2013); Harmer (2014), Padma and Sridhar (2015), the types of project-based learning were outlined in this paper include:

Research Project- Based Learning: Being usually implemented in each lesson/chapter/subject, research projects help students deeply understand the core content of that lesson/chapter/subject. Through doing research projects, students of experiential learning are capable of applying knowledge/skills from lessons/chapters/subjects to deal with either theoretical or practical problems and to develop core competencies. Research projects usually take place during several school hours/school days/school week. The products of learning and research projects are really diverse, including reports, survey data, models, posters... Mini Project-Based Learning is a typical form of Research Project-Based Learning. Mini Project-Based Learning can be implemented in all range of subjects of general education (political and legal theory, mathematics and natural sciences, social sciences and humanities), professional education (Basis of majors and major groups, specialized knowledge - for theoretical and experimental modules) of university-level training programs. The products of Mini Project-Based Learning can be both physical and non-material.

Construction Project- Based Learning: A construction learning project concentrates on designing and manufacturing real products. These can be physical (automatic watering system, surface dehydration system, automatic water purification system for aquariums...) or non-material (plays, exhibitions...). In tertiary education institutions, construction learning projects are often organized in the form of a Core/course Project-Based Learning or Capstone Project-Based Learning. In order to complete construction learning projects, students need to apply core knowledge and skills of majors or inter-majors to create products. The time needed for implementing a construction project takes place for weeks or semesters.

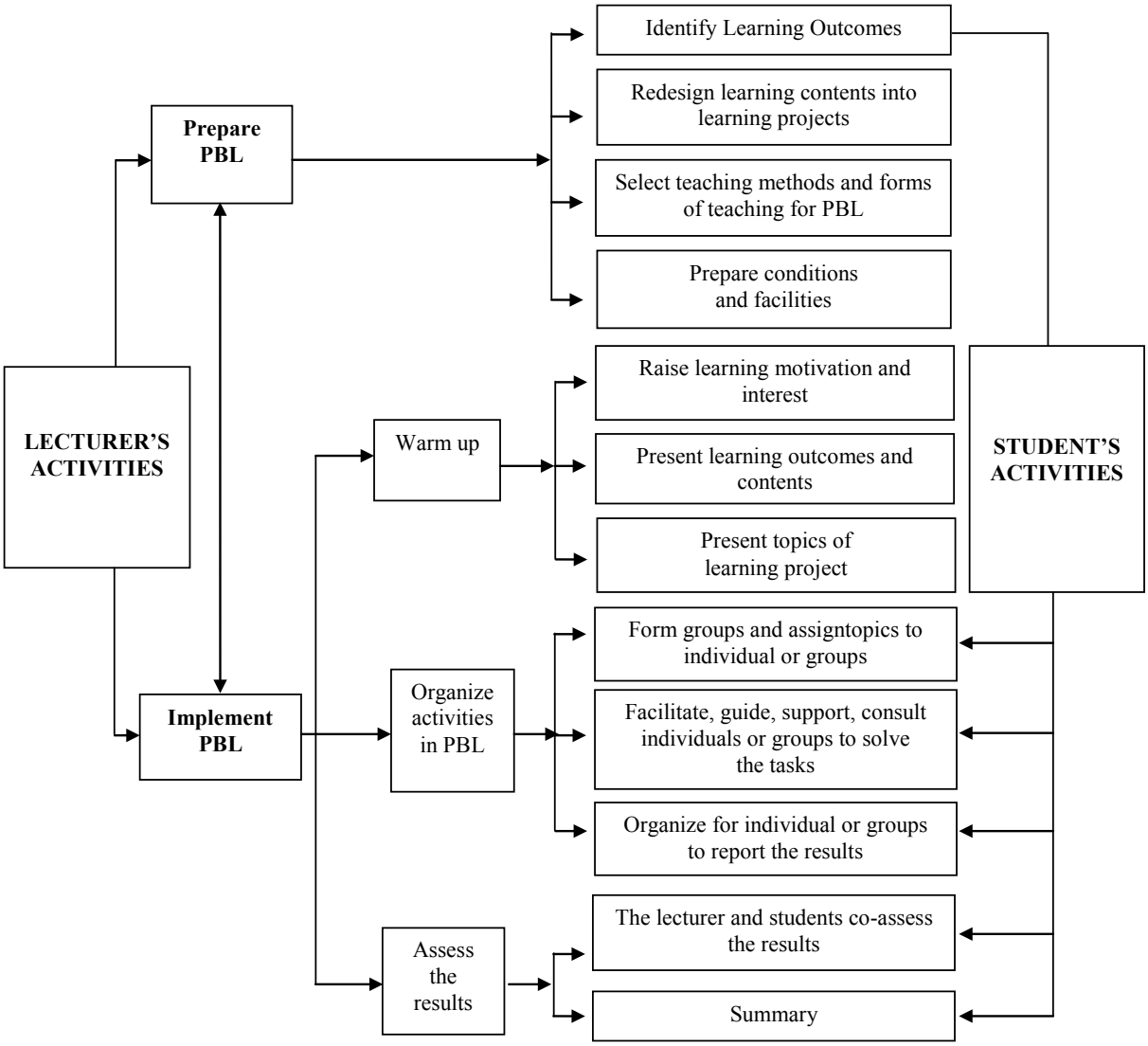
Real-world Project-Based Learning: The real-world project stems from the requirement of dealing with real problems within the community and enterprises. The connection between schools, businesses and the community through the real-world learning projects helps students experience different steps in the product creation process: problem identification, design, implementation, experimenting and execution. Furthermore, the process of implementing a real-world learning project usually lasts for one or several semesters and the inter-subject/major knowledge is necessary to be applied in order to cope with real situations, thus, students will gain the opportunity to analyze, learn, explore, be given insights into theories and develop practical working skills. The EPICS program (Engineering Project In Community Service) (1995) of Purdue University (USA) is the most complete evidence for the value of Real-world Project-Based Learning in the technical/core competencies development of students whose majors are engineering and technology.

With 03 forms of project-based learning mentioned, students are given deep insights into each subject and major throughresearching/finding/discovering/experimenting and solving learning tasks associated with real life and occupation. The article proposes the progress of organizing research-based learning project as follows (see Diagram).

As a result, in the current trend of shifting from a teacher-centered teaching approach to student-centered teaching, project-based learning creates opportunities for students to learn through work/practice/experiment and solve practical situations of life and career, thereby developing comprehensive competencies (both expertise and core) of learners.

Organize experiential learning in System Thinking subject at Ho Chi Minh City University of Technology and Education System Thinking is a subject belongs to the general education knowledge block in the Engineering Technology training program at Ho Chi Minh City University of Technology and Education. System Thinking equips students with a comprehensive problem-solving approach through deep understanding of reality in numerous perspectives and establishing the relationship between things and situations to propose wide-range and sustainable solutions. After finishing the course, the System Thinking perspective can be applied to help students design a friendly system and develop a number of common/core competencies such as problem solving, teamworking, critical thinking and creative thinking. The subject plays a role in expanding students' technical creativity and excitement through experiential teaching such as mini project-based learning and game-based learning to give students an impetus on learn through working, practicing and examining in a collaborative learning environment. The article introduces several experiential teaching plans for some of the subject's contents as follows (Table 1).

Diagram 1: The process of organizing Project- Based Learning



Based on the project-based learning's organizing process, the article introduces 02 learning mini-projects and 01 learning game having been applied in System Thinking teaching. Activities to experience System Thinking are organized by lecturers through forming learning groups (from 4-6 students) to implement learning projects and games.

During their participation in learning groups, students not only deal with learning situations but also learn to listen, to share and criticize in group activities. In order to handle situations in learning, they need to identify problems, collect and analyze information, propose solutions, perform problem solving and evaluate results. The above actions are considered manifestations of the ability to work in groups and resolve problems. Analyzing Rubrics with assessment criteria and corresponding scores is what quantifies the competencies of students.

In order to apply the theory of systems into designing a system using real materials, students are required to complete the following learning project: "Building a system made of secondhand materials".

The project's implementation time is 2 weeks. Under the orientation and organization of the lecturers, students, with available materials in life, have built many systems such as smart houses, lift bridges, boats... Smart House was designed by 05 freshmen, with the lighting system being controlled by smartphone (see Figure 1).

The Smart Home product indicates that students have closely cooperated to deal with problems given by the learning project (see Figure 1). Therefore, in this learning situation, students have experienced creating their own real system (planning ideas, designing, manufacturing and operating) in a collaborative working environment.

As for the "Basic Operations of Thinking" learning content, teachers will organize for students to experience the basic manipulations of Game-thinking. The class will be divided into small groups (from 4-6 students) to play the game: "Using 7 wooden pieces having different shapes and kinds in order to create the given pattern in the fastest time possible". The difficulty level of the pattern is

gradually increased during the play time of the class.

In order to find the clue for this learning game, students in each group will need discuss the features of a given pattern together.. In each study group, analyzing/ synthesizing/evaluating/comparing/generalizing the characteristics of the model and determining the relationship between different parts of the model with 7 pieces of wood are all plausible actions. A glance at students' puzzle activities indicates that, the fastest groups to successfully form the model are those with every members cooperate to analyze/compare/synthesize the characteristics of the model, thereby figuring out the problems of the puzzle and unifying it. Failure will come into existence when some members of the group have their own experience with puzzles and doing their own way. Activities of analyzing/comparing/generalizing the problems of the figure and general discussion to come to an agreement on how the puzzles be solved are less likely appeared in this type of learning groups during implementation time.

At the end of the presentation on the puzzle's results, the lecturer will orient and guide students to connect the way

Table 1: Lesson plan for Sysstem Thinking subject

Learning Outcomes	Contents	Teaching methods	Expected outcomes
Chapter 1: Overview of system			
Identify characteristics of a system Describe a system Develop a system Develop core competences such as problem-solving, teamwork.	Definition of System Describe a system Analyse and Design a system	Research Project-Based Learning: Building a system made of secondhand materials	A developed system by recycling waste materials. Core competences of technical students will be developed.
Chapter 2: Thinking and Technical Thinking			
Apply thinking manipulations and the struture of technical thinking to develop a system. Develop core competences such as problem-solving, teamwork.	1. Overview of thinking: Definition of thinking Characteristics of thinking Thinking manipulations	Learning games: Using 7 wooden pieces having different shapes and kinds in order to create the given pattern in the fastest time possible.	A specific shape as a given pattern in the least amount of time. Core competences of technical students will be developed.
	2.Technical Thinking: Definition of technical thinking Characteristics of technical thinking Structure of Techinical Thinking	Research Project-Based Learning: Building a flying egg system	Eggs will not be broken when dropping the system from 4th floor of Central Building - HCMUTE. Core competences of technical students will be developed.

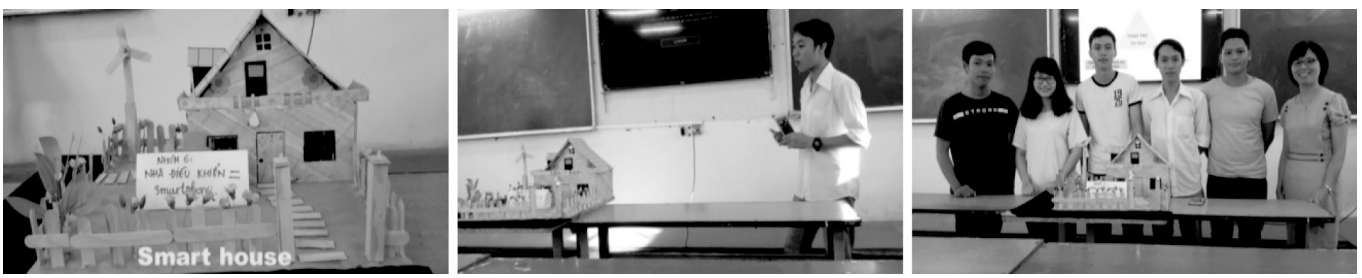


Figure1: Smart housecontroled by Smart Phonemade of secondhand materials

Figure 2: Building a flying egg system - Systematic Thinking Class - SYTH220505E - Group 01CLC

of analyzing/comparing/generalizing the pattern when solving the puzzle with basic manipulations of Thinking. With this experiential learning activity, students have created their own knowledge about the basic operations of Thinking through the experience of "learning games". Comparing the results of solving learning tasks of student groups with the Rubrics scale indicates that a part of students still struggle to identify problems and reach an agreement ideas in group activities.

In order to apply the knowledge of Technical Thinking Structure to creating a technical system, students are required to complete the following learning project: *Topic*: Building a flying egg system; *Tower construction time*: 60 minutes; *Materials*: 01 fresh egg, 5 sheets of A4 color paper, 5 sheets of A4 white paper and 1 roll of tape; *Requirement:* Eggs will not be broken when dropping the system from 4th floor of Central Building - HCMUTE; *Assessment tool*: Problem-solving Rubric and teamwork.

For this learning project, during self-study class, students have been oriented to prepare the idea of the system and sketch the model of the flying egg system. In class, they have experienced building the system according to the concept and the designed model. The result of this learning project is assessed using Analytical Rubrics.

A glance at the flying egg system building activities of student groups indicates that they are very excited to build the system together (see Figure 2). In each learning group, members perform specific tasks assigned to them in a collaborative learning atmosphere: Creating framing systems in different shapes; Keeping eggs in the system and decorate the system. They interact closely with each other to construct the flying egg system. The results of dropping the flying egg system from the 4th floor of the Central Building - HCMUTE of the learning groups of the System Thinking classes of the first semester of the academic year 2019-2020 were none of eggs are broken when fell at this height. Hence, in this experiential learning activity, students have applied the knowledge in technical thinking structure to create a specific product in a collaborative learning environment.

3. Conclusion

Experiential teaching is not a novel teaching perspective of tertiary education in other countries around the world. Students can connect theory with practice through experience in practical learning situations and create specific products. The collaborative learning environment stimulates individuals to learn to be critical, collaborative, and harmonious in diverse groups. Project-based learning is a typical learning activity of experiential teaching: Lecturers are the ones to structure lessons/chapters/subjects into learning projects; Orient and organize students to research/practise/experiment/ dealwith learning situations through learning projects.

In the close interaction of teachers-students-students during experiential learning classes , students gradually form and develop ways to identify problems, propose measures and perform problem-solving with practical results. Thanks to the all-together experience in learning situations, students can listen to and respect others' opinions and be harmonious when handling disagreements in groups in order to successfully complete learning tasks. The result of resolving learning situations in small learning projects of the System Thinking subject is the first proof of the development of several core competencies of engineering students at HCMUTE.

References

[1] Christian.J.B&Magnusson.R.B,Vietnam Development Report, (2014), Skilling up Vietnam: Preparing the workforce for a modern market economy, Washington, DC, USA: The World Bank,2013.

[2] Online:http://documents.worldbank.org/curated/en/2013/11/18556434/vietnam-development-report-2014-preparing-work-force-modern-market-economy-vol-2-2-main-report.

[3] Kolb. D, (1984). *Experiential learning: Experience as the source of learning and development*. New Jersey: Prentice-Hall.

[4] Valerie J. K, (2012). *Recognizing Culture in Experiential Education: An Analysisand Frame work for Practitioners*.

[5] Silberman. M, (2006). *Active Teaching - A handbook of Techniques, Designs, Case Example and Tips* (Third Edition). Pfeiffer.

[6] Ukens. L. (2007). *Learning Games*. In Silberman. M. (Editor), The Handbook of Experiential Learning, John Wiley and Sons,Inc.

[7] Lei Li, Fan Cheung - Ning Wang - Lixing Lao - Yibin Feng, (2016). *An experiential teaching and learning module Chinese Medicine: Field trip*. International Education and Research Journal, Volume 2, Issue 9.

[8] Lee Hong Sharon Yam & Rossini. P, (2010). *Effectiveness of Project - Based Learning as a strategy for Property Education,* Pacific Rim Property Research Journal, Vol 16, No3.

[9] Efstrati. D, (2014). *Experiential education through project basedlearning*.

[10] Andreas Breiter, Go ̈rschwin Fey, and Rolf Drechsler, Project-Based Learning in Student Teams in Computer Science Education, SER.: ELEC. ENERG. vol. 18, No. 2, August 2005,165-180.

[11] Nichola Harmer, (2014). *Project-Based Learning _ Literaturereview*.

[12] Online: https://pdfs.semanticscholar.org/d392/99781973bfeab550f811eaed01a1ffc12bd9.pdf

[13] A Cummings, J Huff, W Oakes, C Zoltowski, (2013). *An Assessment Approach to Project - Based Service Learning*. American Society for Engineering Education.

[14] M.C. Padma &V. Sridhar,(Jan, 2015). *Intergrating Mini Project-Based Learning Approach in Teaching - Learning Process*. Journal of Engineering Education Transformations, Special Issue, ISSN2394-1707.