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ICT Used in Problem-Based Learning: Case Study of a Thai University

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Abstract: The study demonstrates the practice and attitudes of students during their online problem-based learning session which was conducted during the pandemic lockdown. Extended activity theory by Engstrom is utilized to conduct a survey. The results were analyzed along with their academic achievements. The results lead to a full fruit discussion on how best to facilitate students learning during their project work.

Keywords: PBL, POPBL, CL, collaborative tools, problem-based learning, problem oriented project-based learning, online collaborative learning

1. Introduction

Problem-based learning is an active learning form rooted from constructivism which utilizes problem as its starting point. It can be applied to another learning approach, project-based learning which aims to produce a deliverable product. The approach is implemented at Mae Fah Luang University in many programs. Usually, students have more chance to meet face to face to conduct their project, however, during the pandemic, meeting face-face is nearly impossible. Most students stayed away from the campus. All classes conducted online only. Such a situation only allowed students to work remotely. Several tools were utilized to make it possible to conduct their projects.

PBL has been introduced to Thailand for years, however, to facilitate students working on project we need to understand who students adopt tools to work on their projects (Hallinger & Lu, 2011; Wicha, 2014).

Research questions are:

1. How do students work on their project as a holistic?
2. To what extend students use their tools to facilitate their work?
3. What is the students' most satisfied from the project?

2. Literature Review

2.1 POPBL

Problem-Oriented Project-Based Learning or POPBL is a combination of project-based learning and problem-based learning. Both approaches have their own strength and weakness. Problem-based approach is knowledge construction oriented by using an authentic problem as its starting point. Therefore, the outcome of the learning may not be practical. The approach could be ideally for social sciences, medical but not engineering. In contrast, project-based approach is product oriented. It aims to let learners to get hand on doing a certain thing to achieve a competency. However, it may not focus on the novel of the product but rather its functionality and quality. POPBL is an effort to bring advantages of both together. It starts by an authentic problem for investigation, then analysis and design and may end with production (Lehmann et al., 2008; McLoone et al., 2014).

2.2 PBL ICT Facilitation

Learning facilitation is the roles of institution or teachers. It is a key challenge to what and how to

facilitate students doing projects. Project phases, tasks and tools used for each task have been discussed (Khalid et al., 2012; Rongbutsri et al., 2011; Yu et al., 2015). We can see students can find their tools and adopt them to their tasks. Especially social media or social networks have been used heavily for their group communication.

3. Research Design

3.1 Activity Theory

Project work is a complex activity, students can design their own topic, tools, methodology, and analysis. Specially when it is a social activity. Activity theory (Subject, Tool and Object) was formed by Vygotsky can be used as a guideline for understand human activity (Vygotsky, 1978)**.** However, Engstrom has extended it by putting community perspectives (Rules, Community and Division of Labour) into the model (Engeström, 1987). The model is utilized widely in both social sciences and engineer. The model provides different components of an activity and different levels (Engeström & Pyörälä, 2021; Graham et al., 2020; Valverde-Berrocoso et al., 2020).

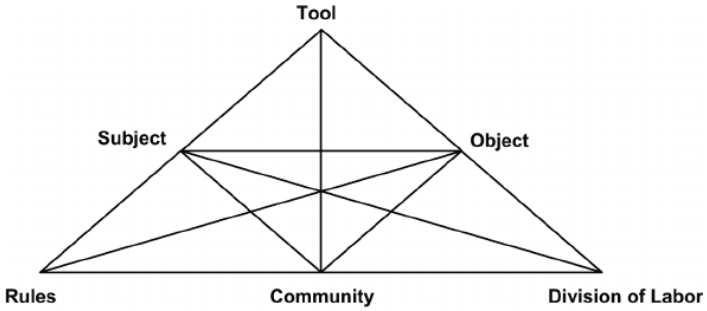

Figure 1. The extended of activity theory by (Engeström, 2001).

3.2 Survey

This research data primarily collected by survey. An online survey was launched at nearly the end of the semester to let students reflect their practice and attitude of their project work of a course on introduction Information Technology course. There were 467 students enrolled the course. The survey questions were formed concerning activity theory components. The survey data was cleaned and compare with students' academic achievement during the analysis.

4. Results

There were 467 students in the class; there were 401 valid observations after cleaning. The responses were analyzed from their frequency on each topic. These are the results.

4.1 Teaming Up Communication

The first question asking students about the approach to form their group. Because students were away from the campus, a Facebook was created by the teachers and introduced to students. Students could propose in the group; however, from the survey more than half students knew each other before hand, they approached each other by using their private social media rather than the formal approach. A few students approached face-face.

Table 1. *Students Teaming Up Approaches*

	% of answers

1. Via personal social media	54.86
2. Via online formal group discussion	25.19
3. Face-face discussion	18.45
4. Conference tools	1.25
5. Known friends	0.25

4.2 Reasons To Choose Their Topics

The second question is about how groups chose their topics. The course gave a wide range of themes and let groups set their own topics. The results shows that most group choose from their own interest. Very few the topics were assigned by their group leaders.

Table 2. *Students' Choosing Topics Approaches*

	% of answers
1. Self interest	72.82
2. The group agreement	23.44
3. Instruction	3.49
4. Assigned by the group leader	0.25

4.3 Devices Used in Projects

When ask about devices, students reported that most students chose to work on desktop or laptop computers. Few students also reported they use paper to work on their project work. Apart from the table 3, the analysis also finds 20% of students use tablets as their main devices and 6.5% use their smart phone as their main devices.

Table 3. *Devices Used in Project*

	% of answers
Desktop/Laptop	73.07
Tablet	49.38
Smartphone	41.90
Paper	0.50

4.4 Internet Connection Used in Projects

When asking about their internet connection used for their project, most of them use their private mobile connection or home connection, this is because most students stayed at their resident. The analysis also finds that home connection was used as their main connection at 47.38% more than private mobile network which is at 35.41%. This shows the potential to let students go mobile. When they use connection from their mobile devices, they are easy to move around.

Table 4. *Students' Internet Connection*

Connection	% people use	% primary connection
Mobile network	66.08	35.41
Home network	63.09	47.38
Campus	35.41	15.21
Cafe WIFI	17.96	
Other organisation network	8.48	

4.5 Online Communication Tools

Students reported they used a lot of their personal social network for their group communication. 85.04% reported used Line as their main communication channel. Very few reported using their email or meet face-face approach.

Table 5. *Students' Online Communication Tools*

	% of answers
Line	85.04
Facebook	35.42
Other social media	3.14
Conference tools	1.25
Email	0.50
Face-Face	0.50

4.6 Language Used

There were mainly Thai students in the university, but there were also some international students. They also reported that 30% of the students used more than a single language for group communication.

Table 6. *Language Used in Groups*

	% of answers
Thai	92.27
English	33.92
Chinese	2.74
Burmese	1.00

4.7 Roles /Division of labor

Students reported nearly 30% they knew how to work on project work so they set roles and division of labor in advanced. However, nearly 70% tasks were divided and assigned at a weekly meeting.

Table 7. *Roles Assign Approaches*

	% of answers
Task dividing happens during a weekly meeting	69.58
Set up a role in advanced	29.93
Each module	0.25
Leader Assign	0.25

4.8 Tool Selection

64.34% students reported that they did not have much discussion on choosing tools for their project because they usually agreed on the same tools. Only 35.66% had variety of tools and to use voting to decide on what tools to be adopted.

Table 8. *Choosing Tool Approaches*

	% of answers
We all agree on the same tools	64.34
Voting	35.66

4.9 Self-Evaluation on Group', Self' And Mates' Performance

When asking students to reflect their performance of themselves, mates and group, students reported they quite satisfied with their performances including groups and team mates.

Table 9. *Self-Evaluation Towards Group, Self and Group Mates Performances*

	Group	Self	Mates
1 (Lowest)	0.25	0.50	0.50
2	1.50	1.25	2.00
3	19.20	19.95	14.96
4	37.16	42.64	40.15
5 (Highest)	41.90	35.66	42.39
Average	4.19	4.12	4.22

4.10 To Improve Aspects

Students (44.89%) reported they could perform better if their plan and set rules well. Secondary (27.18) it would be better if they could be more focused. The points are very challenging for students when they stayed away, it could be hard to keep them tie on a group work.

Table 10. *Improving Aspects*

	% of answers
Good planning and rules	44.89
Better focus and concentration	27.18
Choosing the right teammates	20.45
Choosing the right tools	6.98
Already good	0.50

4.11 Most Impressive Aspects About the Projects

When asking what perspectives students most like about the project, this was an open-end question, later the researcher classified into categories of the activity theory. 43.64% students like the community perspective e.g. getting to know friends and working together; 33.67% students like their project work that let them applied several tools to achieve an academic project. There were also 2.24% students did not find the approach was good.

Table 11. *Most Impress About the Project*

	% of answer
Community	43.64
Objective (project)	33.67
Tools	15.71
Outcome (learning)	2.74
Nothing	2.24
Division of Labour	1.75
Rules/Planning	0.25

5. Discussion

In Thai context PBL has been introduced for years (Hallinger & Lu, 2011; Panwong & Kemavuthanon, 2014; Wicha, 2014); however, we still lack of the information on how students do their projects. To better facilitate students, institution need to investigate how students learning including tools used in their tasks. During the pandemic lock down period. Meeting face-face was considered as risk. Students stayed at their residents either homes or dormitories. This research shows that without support most of the students they can form their own group. However, a small portion still need the initiation from teachers to find their group mates. The majority students can choose their own topics based on their

interests and the agreement with their group mates. However, there are a small population still rely on instruction or group leader decision. A desktop or laptop is considered as the most convenient to work on a project. However, they are some students who use a tablet or a smartphone as their main device for their contribution. This is also supported by the later point, majority students used their mobile connection to work on their project, this leads to another observation, they want to mobile their work. Apart from their writing, they heavily use their social media (Line) as their main communication tools. They are nearly 70% students who set up weekly meeting to divide their tasks and gathering information; another portion they set up their roles and tasks in advanced. There were few discussions about tools used in their projects, because it has been defined from the lecturer but when they need to make decision, they vote. They quite satisfied their own project performance and learning their got including the collaboration from teammates and group as the activity outcome. Students think they could do project better if they plan well and set some more rules. Another point to be improve is to be better focus on their project work. Students satisfied most about their community perspective when they work in groups, they learn their remote social interaction. They feel this is the most challenge for them. Apart from that they satisfied about the project and to learn new tools to accomplish their academic tasks.

References

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Orienta-Konsultit Oy. http://lchc.ucsd.edu/MCA/Paper/Engestrom/expanding/toc.htm

Engeström, Y. (2001). Expansive learning at Work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, *14*, 133–156.

Engeström, Y., & Pyörälä, E. (2021). Using activity theory to transform medical work and learning. *Medical Teacher*, *43*(1), 7–13.

Graham, S., Kiuhara, S. A., & MacKay, M. (2020). The effects of writing on learning in science, social studies, and mathematics: A meta-analysis. *Review of Educational Research*, *90*(2), 179–226.

Hallinger, P., & Lu, J. (2011). Assessing the instructional effectiveness of problem-based management education in Thailand: A longitudinal evaluation. *Management Learning*, *42*(3), 279–299.

Khalid, M. S., Rongbutsri, N., & Buus, L. (2012). Facilitating Adoption of Technologies for Problem and Project Based Learning Activities. *Proceedings of the 8th International Conference on Networked Learning*.

Lehmann, M., Christensen, P., Du, X., & Thrane, M. (2008). Problem-oriented and project-based learning (POPBL) as an innovative learning strategy for sustainable development in engineering education. *European Journal of Engineering Education*, *33*(3), 283–295.

McLoone, S., Lawlor, B., & Meehan, A. (2014). *On Project Oriented Problem Based Learning (POPBL) for a first year engineering circuits project*.

Panwong, P., & Kemavuthanon, K. (2014). Problem-based learning framework for junior software developer: Empirical study for computer programming students. *Wireless Personal Communications*, *76*(3), 603–613.

Rongbutsri, N., Khalid, M. S., & Ryberg, T. (2011). Mapping Students Use of Technologies in Problem Based Learning Environments. *The 19th International Conference on Computers in Education*, 723–727.

Valverde-Berrocoso, J., Garrido-Arroyo, M. del C., Burgos-Videla, C., & Morales-Cevallos, M. B. (2020). Trends in educational research about e-learning: A systematic literature review (2009–2018). *Sustainability*, *12*(12), 5153.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wicha, S. (2014). PBL framework with industrial participation the empirical study of improving software design and development skills. *Wireless Personal Communications*, *76*(3), 615–626.

Yu, W.-C. W., Lin, C. C., Ho, M.-H., & Wang, J. (2015). Technology Facilitated PBL Pedagogy and Its Impact on Nursing Students' Academic Achievement and Critical Thinking Dispositions. *Turkish Online Journal of Educational Technology-TOJET*, *14*(1), 97–107.