

## High Self Efficacy Belief with High Critical Thinking Ability

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**Abstract:** *This research mainly probed into the effect of Project-based Learning (PjBL) on facilitation of learners' self efficacy belief and critical thinking ability in vocational high school. The new curriculum design rationale of Business and Management Cluster in 2010 reconsider knowledge building through 2 approaches, that is, PjBL emphasizes knowledge integration while the spiral thinking stresses the knowledge transfer. This research believes that when teachers encourage students to do project writing with applying important economic concepts and principles, and to do subjective exploration with the inspiration of intrinsic motivation and learning interests, then, students' learning achievement should react to their meta-cognition adjustment with high self efficacy belief after their exploration, and also reflect how learners integrate important economic concepts and transfer through the spiral thinking with high critical thinking ability. The survey sampling in this research took the students of Business and Management Cluster from 3 vocational high schools in central Taiwan as research subject. The research instruments included the General Self-efficacy Scale by Scholz, Doña & Schwarzer, and Watson-Glaser Critical Thinking Appraisal (WGCTA). The results showed that there was a positive correlation between students' belief in high self-efficacy in pre-PjBL curriculum and high critical thinking ability in PjBL curriculum.*

**Keywords:** project based learning, self-efficacy, critical thinking

### 1. Introduction

#### 1.1. Research Background and Motivation

Taiwan Ministry of Education, MOE, hosted "The Eighth National Conference on education (MOE, 2010)" and brought David Hargreaves's view into forum, the expert in developmental psychologist, to emphasize that students must learn the core competencies in a knowledge economy era. These competencies included (1) meta-cognitive abilities and techniques, (2) the abilities of integrating formal and informal learning, declarative knowledge and procedural knowledge, (3) the abilities of entering the world full of information and choosing and evaluating knowledge, (4) the abilities of developing and applying multiple intelligence, (5) the abilities of working and learning effectively in a group, (6) the abilities of creating, changing and transferring knowledge, (7) the abilities of conquering obscure situation, unpredictable problems and unforeknowable environment, (8) the abilities of facing multiple careers, learning self reorganizing, settling down at a workplace, choosing and taking related education and training.

Whereas new curriculum design and human development needed, PjBL offers educational practice for fundamental capabilities and self-learning abilities. Learners can bring up practicable proposals or solutions to solve problems. These abilities, such as planning and executing activities, proposing and problem-solving, are what Taiwanese students lack of. The blind spots in thinking, the flaws in logic, the loopholes in statement, and the defects in theory should be mended especially through cooperative learning. Guided with thorough consideration, analysis and evaluation, learners could make the most proper decisions and judgments. Thus, vocational high students of Business and Management Cluster would possess the most powerful academic, research, work and life abilities (Cottrell, 2011).

#### 1.2. Research Questions

The purpose of this research is to understand the effect of PjBL in promoting students' self-efficacy and critical thinking ability. There are three research questions in this study:

- (1) Does PjBL promote learners' sense of self-efficacy?
- (2) Does PjBL promote learners' critical thinking ability?
- (3) What is the correlation between the sense of self-efficacy and critical thinking ability in PjBL?

## **2. Literature Review**

### **2.1. Project-based Learning**

Project-based Learning (PjBL) firstly appeared in the period of Renaissance (1590-1765). Lately, it became a part of the industrial school teaching program of the USA (1765-1880). During the years of 1880-1915, Dewey claimed that school education was to cultivate good citizens of a democratic society and brought up the philosophy of "learning by doing" which the principle of curriculum was activity, project and problem-solving.

PjBL is the integrated construction combining multiple discipline domains. Domestic scholar, Xu (2001), proposed that PjBL was a construction-orientated learning method, providing students with highly complicated and authentic project plans, allowing them to find a topic, design a theme, plan action, collect data, execute solution, make a decision, complete exploration and present works. Its main purpose was to solve the problem which learners could not utilize their knowledge. With the project of knowledge or technique, the concepts in subject domains could be integrated. Teachers arrange complicated tasks and design the contexts which can develop motive, meta-cognitive strategies, and cooperative learning. As a result, learners could learn not only the knowledge and ability of problem solving but how to apply them (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991).

This research adopted Blumenfeld et al. (1991) viewpoints to interpret how learners learn through PjBL. Learners convert the problems they encountered in actual life experience and self-learning to integrated knowledge. Problem-based Learning integrates the authentic complexity of problems, inspires students' learning motivation, and encourages students to actively learn from the process of problem solving. However, during the process of problem solving, students' technique of cooperation and ability of critical thinking are especially required. Through discussion, the viewpoints or consideration could be examined one by one. Accordingly, personal solution could be chosen among many strategies to solve problems and create new knowledge. Therefore, problem-based learning and cooperative learning complement each other in cultivating students' creativity (Wang, 1999) which is different from what Dewey emphasized that "thinking appeared in the situation of confusion and problems." The researcher claimed, by cultivating learners' ability of self-learning, and exploring the core of questions, through the correction and examination of meta-cognition, learners could avoid being tripped over the same stone, better than not to probe until a problem happens.

### **2.2. Self efficacy belief**

Self efficacy, widely believed to affect learning performance (Bandura, 1986, 1997; Moos & Ringdal, 2012), and defined as the personal confidence in being capable of achieving a goal or an outcome, whether positive or negative, affects the choices that the learner makes about actions and the environment (Bandura, 1986). Moos and Azevedo (2009) find out monitoring understanding mediates the relationship between self-efficacy and prior domain knowledge within hypermedia learning. In this study, we examine the relationship between self-efficacy and critical thinking (Ennis, 1996), not only concerning how reasoning quality is limited by the deficiency of prior knowledge, but also reacting to cognitive economy theory explanation for error logic practicing (Gabbay & Woods, 2007).

Although the contributions of perceptive factors such as relationship between prior knowledge and self-efficacy, and relationship between prior knowledge and critical thinking, are empirically supported by the literature, no study has built the relationship between self-efficacy and critical thinking in project based learning. This study therefore uses

self-efficacy and critical thinking as the variables of cognitive factors and hypothesis testing in accordance with recent studies in the meta-cognition learning field.

### **2.3. Critical thinking ability**

Critical thinking is a kind of complicated mental activity, with such various dimensions as knowledge, skills and attitude. Shen & Chen (2006) defined critical thinking as: The advice, recommendation or evaluation made by a person concerning the matters being faultless, pursuing more reasonable, practicable and preferable outcomes, comparing and inferring the already-known pattern and expectation through observation, understanding and criticizing in order to find out the parts that can be revised, improved or learned.

When discussing critical thinking ability, Shen and Chen also pointed out that the amount of background knowledge would affect the performance of critical thinking. The more background knowledge an individual possessed, the more authentic data and experience he/she could cite; the more correctly, reasonably and properly he/she could apply the theories; and the more insight and preciseness his/her inference would display. In addition, Ennis (1996) regarded critical thinking as a reasonable self-reflection thinking concerning making rational decisions with what to believe and what to proceed, and developing evaluation through dispositions and abilities (Ennis, 2011).

Ennis (2011) evaluated the dispositions of critical thinking with his/her care for what was believed, care for facing each other's position, care for other's intentions. Yeh (1999) developed the critical thinking intention scale with four elements, including systematic analysis, open mind and empathy, intellectual curiosity, and holistic reflection.

The critical thinking ability proposed by Ennis (2011) included paying attention to a difficult problem, analyzing and proving, challenging and clarifying, judging the reliability of data source, observing and judging the observation, inducing and judging the induction, applying materials to inferring, making judgment and evaluating the judgment, defining and judging the definition, identifying the unspecified presumption, thinking of proposition without being interfered by the opposite hypothesis, integrating intentions to make decision and defense, continuing to possess reasonable opinions, maintaining sensitivity to others' knowledge and ability, disposing proper metaphorical strategies for discussion and presentation, and properly responding to the faults of the opposite side.

In this research, the measurement of critical thinking ability was adopted as the response variable and presumed that (1) learners had higher critical thinking ability in PjBL curriculum, and (2) learners' self-efficacy was related to their critical thinking ability.

## **3. Research Method and Procedure**

### **3.1. Research methods and instruments**

This research was a blended study of qualitative and quantitative. In order to deeply understand the self-efficacy in PjBL and critical thinking ability of vocational high students, the following research methods were adopted.

#### **(1) Questionnaire**

The measurement was carried out with questionnaire in order to understand the self-efficacy and critical thinking ability in PjBL, and the correlation as well. The research instruments included Scholz, Doña & Schwarzer's General Self-efficacy Scale.

The above-mentioned Scholz, Doña & Schwarzer's General Self-efficacy Scale was a six-point scale. As for the scoring, respondents, according to their true opinions, circled the options from "very disagree", "disagree", "slightly disagree", "slightly agree", "agree", "very agree" among which "very disagree" for 1 point, "disagree" for 2 points, "slightly disagree" for 3 points, "slightly agree" for 4 points, "agree" for 5 points, and "very agree" for 6 points. Valid data from pilot study were analyzed with SPSS 19.0 for Windows.

After pilot test, during September 1 and September 15, 2011, students from the Department of International Trade in Taichung Home Economics and Commercial High School were measured as the pilot test samples. In this pilot test,

72 copies of questionnaire were sent out and 72 of them were retrieved. The total valid samples were 72 (12 males, 60 females). The reliability of this research adopted Cronbach  $\alpha$  coefficient for the internal consistency. After the analysis, Cronbach  $\alpha$  reached .816 showing high reliability.

Table 1. Content of General Self-efficacy Scale

No.	Item
1.	When I must calm down to do things, I couldn't do it. (Negative)
2.	When I run into something I cannot do, I would keep trying until I can do it.
3.	I seldom achieve the important objectives that I set for myself. (Negative)
4.	After I make a project, I can put it into practice.
5.	I usually give up something before finishing it. (Negative)
6.	I would avoid facing difficulty. (Negative)
7.	If things look complicated, I would even not try doing them. (Negative)
8.	Even it's what I don't like to do, I still insist on doing it.
9.	When I decide to do something, I would do it immediately.
10.	When learning something without success in the beginning, I would soon give it up. (Negative)
11.	I am not able to deal with the problems properly which I did not expect in advance. (Negative)
12.	When new matters look too difficult, I would avoid learning them. (Negative)
13.	Failure would make me work harder.
14.	I am not confident of my ability in doing things. (Negative)
15.	I am an independent person.
16.	I tend to give up when encountering matters. (Negative)
17.	I seem unable to deal with most of the problems in my life. (Negative)

#### (2) Watson-Glaser Critical Thinking Appraisal (WGCTA)

The test of Watson-Glaser Critical Thinking Appraisal (WGCTA, Chen, H. C., Chen, C. Y., Chen, M. F., Chen, H., & Chen, W. W, 2006.) correlates with the aptitude test in the first grade of senior high ( $R=.53$ ). Based on the percentile norms in Taiwan, the scores of 40 items consisting of five parts, including inference, identification of assumption, deduction of conclusion, explanation and evaluation, were evaluated with the "discrimination of inference between right or wrong, identification of assumption or hypothesis, determination of the reliability of deduction, conclusion and distinction of contention and position" to measure the critical thinking ability of students of Business and Management Cluster in vocational high schools.

#### (3) Techniques of data collection and analysis

In this research, the subjects of survey for the General Self-efficacy Test and WGCTA were the students in the second and third grade of Business and Management Cluster in three vocational high schools in central Taiwan, including National Feng Yuan Commercial High School, National Taichung Home Economics and Commercial High School, and National Chang-Hua Senior School of Commerce. The period of the test was from 2011/09/16 to 2012/01/15. There were totally 357 questionnaires, including 30 invalid copies and 327 valid ones.

In this research, the reliability of formal General Self-efficacy Test was proved its internal consistency with Cronbach  $\alpha$ . Cronbach (1951) proposed a criterion for the determination of reliability:  $\alpha$  less than .35 for low reliability;  $\alpha$  between .35 and .7 for medium; and  $\alpha$  larger than .7 for high reliability. The Cronbach  $\alpha$  of "the belief in self-efficacy in other curriculum of students in PjBL" reached .861 indicating a high reliability. Also, the Cronbach  $\alpha$  of "the belief in self-efficacy after the PjBL of students in PjBL" reached .872 indicating a high reliability, too.

Finally, the explanatory variable was the learners of PjBL while the response variables were self-efficacy and critical thinking ability. The correlation was examined and analyzed with SPSS.

## 4. Results and Discussions

#### **4.1. The test for “The belief in self-efficacy of students in PjBL is higher than that in other curriculum.”**

This research adopted Paired-Samples T Test to examine the research hypothesis 1. In the 17 items of self-efficacy scale, the belief in self-efficacy “I usually give up something before finishing it” of students in PjBL, the average score of PjBL ( $M=4.57$ ) is higher than that in other curriculum ( $M=4.44$ ). Their Paired-Samples T correlation coefficient is .351 and the significance value is .000 indicating that there is significant positive correlation for students’ belief in self-efficacy between in other curriculum and in PjBL. And, the value of Paired-Samples T test is -1.954; the df is 326; the significance value ( $p$ ) reaches .052, approaching significant level ( $\alpha=.05$ ). Though it does not reach significant level, they are two items approaching significant difference among the 17 items of self-efficacy scale.

For the inference from this research, PjBL could reduce the effect of “I usually give up something before finishing it” showing that students could increase patience and perseverance during PjBL because PjBL emphasizes students’ thinking progress and attitude, and inspires their critical thinking ability. Therefore, even when facing challenging problems, students would still persevere, do their best to accomplish their tasks, and never give up.

Another item approaching significant difference is PjBL students’ belief in self-efficacy of “When new matters look too difficult, I would avoid learning them.” The mean of PjBL ( $M=4.36$ ) is lower than that of other curriculum ( $M=4.49$ ). Their Paired-Samples T correlation coefficient is .410 and the significance value is .000 indicating that there is significant positive correlation for students’ belief in self-efficacy between in other curriculum and in PjBL. And, the value of Paired-Samples T test is 1.947; the df is 326; the significance value ( $p$ ) reaches .052, approaching significant level ( $\alpha=.05$ ). Though it does not reach significant level, it is the second item approaching significant difference among the 17 items of self-efficacy scale.

For the inference from this research, PjBL could reduce the effect of “When new matters look too difficult, I would avoid learning them” showing that limited by the time and completion of works, learners had to estimate the difficulty in project tasks more. In the range of their capability, they set a target and devote themselves to it, for example, “Vocational high students of Business and Management Cluster have difficulty in making subjects, and they have to consider many aspects and the extent of subjects.”

#### **4.2. The test for “Vocational high students in PjBL have higher critical thinking ability than in other curriculum.”**

According to the results of formal WGCTA test, the average score of critical thinking (totally 40 points) in project curriculum of PjBL students ( $M=25.27$ ,  $S=4.364$ ) is lower than in other curriculum ( $M=25.55$ ,  $S=3.583$ ). The standard deviation also shows that students in project curriculum have a higher degree of divergence in critical thinking ability indicating their critical thinking ability has lower stability. Their Paired-Samples T correlation coefficient is .263 and significance value is .000 indicating that there is significant positive correlation for students’ belief in self-efficacy between in other curriculum and in PjBL. And, the value of Paired-Samples T test is 1.046; the df is 326;  $p=.296$  which does not reach significant level ( $\alpha=.05$ ).

For the inference from this research, a well-structured project work is dedicated by students’ discrimination of inference between right or wrong, identification of assumption or hypothesis, determination of the reliability of deduction, conclusion and distinction of contention and position. However, during the progress of project design in Business and Management Cluster, it is observed that the more divergent the students’ critical thinking ability is, the higher instability and risk their PjBL would have. In other words, compared with other curriculum, teachers in project curriculum should guide the students to have more control over the meta-cognition in discrimination of inference between right or wrong, identification of assumption or hypothesis, determination of the reliability of deduction, conclusion and distinction of contention and position in their works.

#### **4.3. The test for “The belief in self-efficacy in PjBL correlates with their critical thinking ability.”**

This research recoded the General Self-efficacy Scale and WGCTA. For a start, the scores of 17 items in the self-efficacy scale were summed up to obtain the average scores. These average scores were used to divide students

into high self-efficacy group (dummy variable recoded for 2) and low self-efficacy group (recoded for 1). The average score of self-efficacy in other curriculum was 73.50 while that in PjBL was 73.27. Meanwhile, the original scores on students' critical thinking ability were converted into percentile rank according to norms. Percentile rank 50 was used as the demarcation to divide students into high critical thinking ability group (dummy variable recoded for 2) and low critical thinking ability group (recoded for 1). The tetrachoric correlation after recoded was examined for Spearman rank correlation. The results showed that there was positive correlation between the belief in self-efficacy of students in PjBL acquired from other curriculum and the critical thinking ability cultivated in project curriculum (correlation coefficient=.127, significance=.022).

In Table 2, HLpr22 indicates PjBL students' high critical thinking ability in project curriculum. HLpr11 shows PjBL students' low critical thinking ability in other curriculum. HLSE22 displays PjBL students' high belief in self-efficacy in project curriculum. HLSE11 presents PjBL students' low belief in self-efficacy in other curriculum.

Table 2. The test for Spearman rank correlation between high/low critical thinking ability and high/low self-efficacy

		HLpr 22	HLpr 11	HLSE 22	HLSE 11	
<b>Spearman's rho coefficient</b>	HLpr22	Correlation coefficient	1.000	.233(* )	.058	.127(* )
		Significance (two-tailed)	.	.000	.297	.022
		Number	327	327	327	327
	HLpr11	Correlation coefficient	.233(* )	1.000	.032	.054
		Significance (two-tailed)	.000	.	.559	.333
		Number	327	327	327	327
	HLSE22	Correlation coefficient	.058	.032	1.000	.500(* )
		Significance (two-tailed)	.297	.559	.	.000
		Number	327	327	327	327
	HLSE11	Correlation coefficient	.127(* )	.054	.500(* )	1.000
		Significance (two-tailed)	.022	.333	.000	.
		Number	327	327	327	327

## 5. Conclusions and Recommendations

### 5.1. Conclusions

In this research of correlation between meta-cognition and critical thinking in PjBL of vocational high students of Business and Management Cluster, the results show that there is positive correlation between the belief of "self-efficacy" in other curriculum of students in PjBL and the "critical thinking" ability in PjBL. This result indicates that the belief in self-efficacy of students in PjBL obtained from other curriculum makes difference in the critical thinking ability in PjBL so as to generate the ability of knowledgeable transfer of different levels.

### 5.2. Research limitations and recommendations

Due to the limited test hours and the inconvenient acquirement of questionnaire, nine of the classes were not under control and not measured and surveyed at the same time. Their test for "PjBL curriculum" was three weeks away from that of "other curriculum". The time for survey and measurement in future researches should be under better control.

In addition, teacher professional development and the growth of learner's control over meta-cognition should be

devoted more to the “discrimination of inference between right or wrong, identification of assumption or hypothesis, determination of the reliability of deduction, conclusion and distinction of contention and position” of PjBL.

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