2006

Empowering Students' Learning Achievement Through Project-Based Learning As Perceived By Electrical Instructors And Students

Anuvat Tongsakul
King Mongkut's University of Technology

Kalaynee Jitgarun
King Mongkut's University of Technology

Tongsakul, A., and Jitgarun, K. King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Empowering Students' Learning Achievement Through Project-Based Learning As Perceived By Electrical Instructors And Students

Anuvat Tongsakul[1] and Kalaynee Jitgarun[2]
Learning Innovation in Technology Program,
Faculty of Industrial Education and Technology,
King Mongkut's University of Technology Thonburi
Bangkok, Thailand
A_tongsakul@yahoo.com
kalayanee.jit@kmutt.ac.th

Keywords: Empowering/Learning Achievement/Project-Based Learning/ Electrical Field/ Instructors/Students

ABSTRACT

Purposes of this research were to find out factors empowering electrical students' learning achievement through Project-Based Learning (PBL) as perceived by instructors' and students' opinions. The sample chosen for this study were 247 electrical power instructors at vocational education institutes and 161 electrical students in the 3 rd and 4th year who were studying in the 1st semester of academic year 2006 at Electrical Education Department, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi by using simple random sampling. The instrument used for data collection was 7 rating scales questionnaire. The reliability of the instrument calculated by Cronbach Alpha Coefficient was 0.8185 and 0.9839, respectively. The data were analysed by using mean ($\bar{X}$), Standard Deviation (S.D.) and Analysis of Factors by Principal Component Analysis technique: PCA, orthogonal rotation axis by Varimax Method. The results of the study on factors empowering electrical students' learning achievement through Project-Based Learning (PBL) were as follows: both instructors and students agreed on Interesting/Attention(0.799 and 0.885, respectively) while other factors such as Planning(0.722), Sharing Ideas(0.582), Thinking(0.576), Facilitating (0.547), Constructionism (0.540), Scientific Process (0.525), Multiple Intelligence (0.479), and Goal Setting(0.453) were perceived by instructors, and students' opinions were on Advising/Guiding(0.863), Thinking(0.661), Goal Setting (0.634), Multiple Intelligence(0.553), Scientific Process(0.528), Assisting(0.524), and Sharing Ideas (0.492), if not more so.

INTRODUCTION

The meaning of Project-Based Learning (or PBL) covers learners' opportunity to study, to search data, to set up goals/plans, then to design, to implement, to try out, to make a presentation on a report/a piece of work, and to evaluate their own learning according to their interest, aptitude as well as ability of his/herself as a group or individuality through thinking process, integrating, and system of scientific process at each step of operation (Mulkam, Suvit & Oratai 2002; National Primary Education Commission 2002). Moreover, while working on PBL, learners can share ideas, think and solve problems together under instructors' supervision, guidance, and assistance (Buck Institute for Education 2002) until learners can create a meaningful and useful work towards themselves. What's more, PBL is necessary for today's educational system in enhancing one's capability to construct body of knowledge through thinking process and performing by oneself (Rung Kaewdaeng 1998). This complies with National Education Act, B.E. 2542 (1999) and Amendments (Second National Education Act, B.E. 2545 2002) section 24 (2) and (3) which reads: "In organizing the learning process…(2) provide training in thinking process, management, how to face various situation and application of knowledge for obviating and solving problems…(3) organize activities for learners to draw from authentic experience; drill in practical work for

complete mastery; enable learners to think critically and acquire the reading habit and continuous thirst for knowledge" (Office of the National Education Commission, B.E. 2545). In this way of thought, learner's thinking and learning process can then be developed according to his/her potential. However, problems regarding instruction nowadays are that though teachers see the strengths of PBL, they do not understand this kind of instructional process, and that being a facilitator will burden their responsibility and work. Therefore, teachers still emphasize on content-based courses which are believed as separated pieces of mind but not to be a holistic one. What's more, instructional behaviours are still insipid, and focusing on learning by heart, without giving learners an opportunity to decide and/or to do practical work. Thus, learners will lack of skills to learn, to think and to develop themselves. This is why learners hardly see the relationship of learning, skills and its content (Prawase Wasee 1999), resulting in being unable to apply their knowledge and skills to the future use.

Lastly, according to the rationale and problems mentioned above, the researcher felt the needs to conduct a study entitled "Empowering Project-Based Learning as Perceived by Electrical Instructors and Students." Consequently, the results of this study will be useful in designing and developing activity process to comply with Project-Based Learning. This study will also prove that if learners study through direct experience and/or real situation, they will be able to think, to do, to create a new body of knowledge, and to become a life-long learner at last.

Objective of the Study

The objective of this study was to find out factors empowering electrical students' learning achievement through Project-Based Learning (PBL) as perceived by instructors' and students' opinions.

Outcomes of the Study

Teachers can apply the results of this study regarding factors empowering electrical students' learning achievement through Project-Based Learning (PBL) to the development of learners' behaviour to learn. Educational institutes can apply the factors empowering electrical students' learning achievement through Project-Based Learning (PBL) to the development of teachers and learners in Vocational Education so that each individual has thinking and learning process according to their potential.

Conceptual or Theoretical Framework

Conceptual framework or theoretical framework used in this study to find factors affecting Project-Based Learning (Buck Institute for Education 2002; Rung Kaewdaeng 1998; Autodesk Foundation 1999; Suchin Petcharak 2001) was shown as in Figure 1:

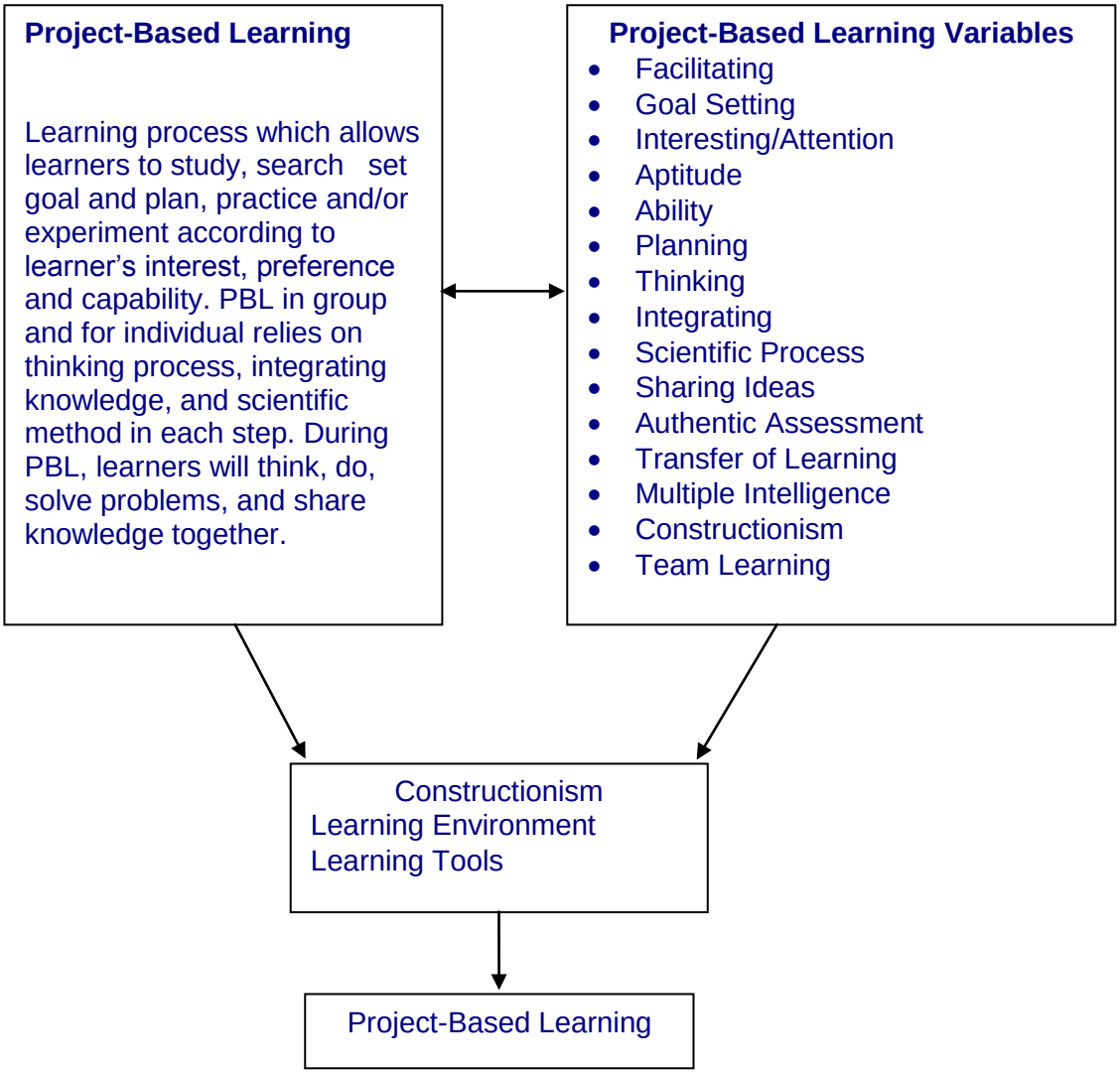

Figure 1: Conceptual Framework or Theoretical Framework of Project-Based Learning

Figure 1 shows 15 variables of conceptual framework or theoretical framework of Project-Based Learning consisting of 15 variables as follows: (1) Facilitating, (2) Goal Setting, (3) Interesting/ Attention, (4) Aptitude, (5) Ability, (6) Planning, (7) Thinking, (8) Integrating, (9) Scientific Process, (10) Sharing Ideas, (11) Authentic Assessment, (12) Transfer of Learning (13) Multiple Intelligence, (14) Constructionism, and (15) Team Learning.

RESEARCH METHODOLOGY

The researchers utilized the methods as follows:

a. Sample

The sample chosen for this study were 247 electrical power instructors at vocational education institutes and 161 students in the 3 rd and 4th year who were studying in the 1st semester of academic year 2006 at Electrical Education Department, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi by using simple random sampling..

b. Tool for Data Collection

Tool used for this study was 7 rating scales questionnaire. The researchers collected the data as follows: receiving a permission document from Graduate School, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, collecting data from Electrical Power instructors under Vocational Education Commission. However, for remote areas, questionnaires were sent and received by post. For nearby areas, data collection was done by the researchers.

c. Data Collection

Data collection consisted of 5 steps as follows: (1) developing questionnaire, (2) validating questionnaire, (3) collecting data from sampling group, (4) analyzing the data, and (5) interpreting the data.

d. Data Analysis

Testing the adequacy of 247 electrical power instructors at vocational education institutes and 161 students in the 3 rd and 4th year who were studying in the 1st semester of academic year 2006 at Electrical Education Department, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi returned questionnaires by Kaiser–Meyer–Olkin Measure of Sampling Adequacy (or KMO). The adequacy was 0.915 (more than 0.5 but less than 1.00), that means sampling group was suitable for Factor Analysis.

Analysing data by SPSS (Statistical Package for the Social Sciences) v. 11.0 by these methods: Mean ($\overline{X}$), Standard Deviation (S.D.) of each variable and average score to judge the validation. Pearson's Product Moment Correlation of each variable to show relation matrix and test signification.

Using significant variables with Factor Extraction method by Principal Component Analysis technique (or PCA), and Maximum Likelihood Method (or MLM), to test which method can describe the best variance and the best method will be used to extract factors.

Analysing variables by using Principal Component Analysis technique (or PCA) and Factor Rotation with Orthogonal Rotation axis by Varimax Method. The researchers identify factors by eigen values which are higher or equal to 1-0 and have at least 3 variables describing that factor and each variable has weight value more than 0.40 (Samran Meechang, 2001).

Interpreting factors and labelling them with new variables. This step requires experience in labeling and giving meaningful name to each factor by considering variables for such factor. People involved in this step were a researcher, a dissertation chairperson, and experts.

Results of the Study

The factors empowering electrical students' learning achievement through Project-Based Learning (PBL) as perceived by instructors' and students' opinions are as follows:

Phase I: Analysis of each variable by using mean and standard deviation as perceived by electrical power instructors' opinions.

The mean of 91 variables were between 5.955-4.329 and standard deviation was between 0.962-1.873. This indicates that these factors were average to greater levels and there was a dispersion of data at the greater level. The highest mean were Giving Suggestion and Guidance (Teacher), Endeavor to Finish Project (Learners), Giving Comfort and/or Helping Learner to Learn Easily (Teacher), Eagerness to Learn and to Know (Learners), and Stimulating Ideas to Learner (Teacher). On the other hand the lowest mean were Gender (Learners), Ability to Absorb and Reach Music Appreciation (Learners), Controlling and Expressing through Organs of Every Part of Body such as Hands and Feet (Learners), Knowing, Perceiving, along with Distinguishing the Differences Among Emotion, and Impulse as well as Feeling (Learners), and Complex Idea Skill (Learners).

Phase II: Analysis of each variable by using mean and standard deviation as perceived by 3 rd and 4th year students' opinions.

The mean of 91 variables were between 6.193-5.148 and standard deviation was between 0.768-1.552. This indicates that these factors were average to greater levels and there was a dispersion of data at the greater level. The highest mean were recalling their roles and responsibilities (Learners), determined to create project (Learners), loving to learn (Learners), sharing responsibilities (Learners), and having leadership (Learners). On the other hand the lowest mean

were age (Learners), depending on scientific skills and attitude (Learners), testing hypothesis (Learners), having special talent (Learners), and being able to appreciate music (Learners).

Phase III: Analysis of factors affecting Project-Based Learning of students as perceived by electrical power instructors

The results of the study showed that there were 9 major factors of Project-Based Learning of students as perceived by electrical power instructors as follows:

- Sharing Ideas of which factor loadings consisted of 15 components could be weighted 0.415 – 0.689 and the eigenvalues was 7.707 or 10.705%
- Multiple Intelligence of which factor loadings consisted of 9 components could be weighted 0.519 – 0.774 and the eigenvalues was 7.592 or 10.544%
- Interesting/Attention of which factor loadings consisted of 10 components could be weighted 0.457 – 0.738 and the eigenvalues was 7.425 or 10.313%
- Scientific Process of which factor loadings consisted of 8 components could be weighted 0.498 – 0.706 and the eigenvalues was 6.761 or 9.391%
- Facilitating of which factor loadings consisted of 10 components could be weighted 0.492 – 0.812 and the eigenvalues was 6.668 or 9.261%
- Constructionism of which factor loadings consisted of 7 components could be weighted 0.473 – 0.695 and the eigenvalues was 5.213 or7.240%
- Thinking of which factor loadings consisted of 7 components could be weighted 0.462 – 0.612 and the eigenvalues was 4.557 or 6.329%
- Goal Setting of which factor loadings consisted of 3 components could be weighted 0.690 – 0.764 and the eigenvalues was 3.138 or 4.358%
- Planning of which factor loadings consisted of 3 components could be weighted 0.536 – 0.728 and the eigenvalues was 2.623 or3.643%

These factors could be explained 72.171 % of the total variance. A study of Correlation Coefficient between 9 and 91 variables was 0.415 – 0.812 and Correlation Coefficient between 9 factors that affected Project-Based Learning of students as perceived by electrical power instructors was 0.453 – 0.799, which was in high level. The Correlation Coefficient within the 9 internal factors was 0.010–0.094, which was in low level. This is shown in Figure 2.

The regression or predicting equation of factors affecting Project-Based Learning of students as perceived by electrical power instructors was:

Y = 0.582(Sharing Ideas) + 0.479 (Multiple Intelligence) + 0.799 (Interesting/Attention) +0.525 (Scientific Process) + 0.547 (Facilitating) +0.540 (Constructionism) +0.576 (Thinking) +0.453 (Goal Setting) +0.722 (Planning).

The prediction equation had the power of prediction 44.444 % and error of prediction was 11.111 %.

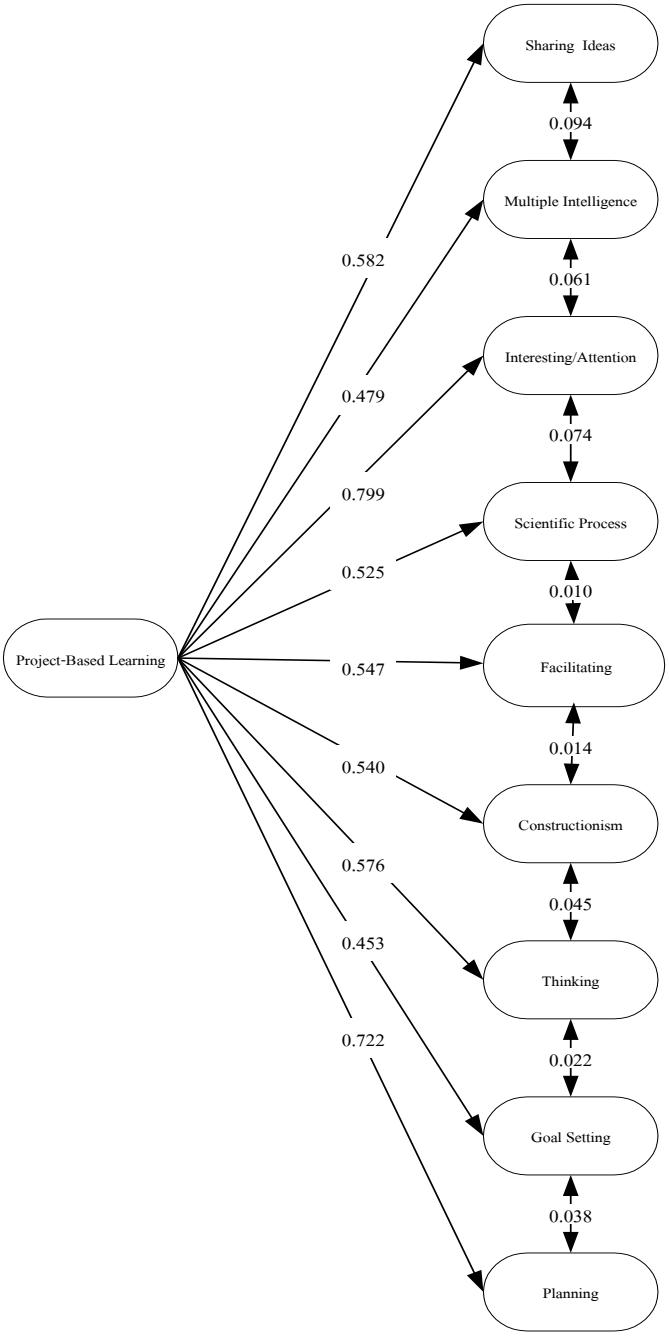

Figure 2: Confirmatory Model Showing Correlation Coefficient within 9 Internal Factors Affecting Project-Based Learning As Perceived by Electrical Power Instructors

Phase IV: Analysis of factors that affected Project-Based Learning as perceived by 3 rd and 4th year students' opinions.

The results of the study showed that there were 8 major factors of Project-Based Learning as perceived by students' opinions as follows:

- Multiple Intelligence of which factor loadings consisted of 7 components could be weighted 0.565 – 0.789 and the eigenvalues was 4.669 or 12.620 %
- Scientific Process Advising/Guiding of which factor loadings consisted of 5 components could be weighted 0.410 – 0.778 and the eigenvalues was 3.309 or 8.944 %
- Advising and Guiding of which factor loadings consisted of 6 components could be weighted 0.520 – 0.757 and the eigenvalues was 3.309 or 8.942 %
- Thinking of which factor loadings consisted of 3 components could be weighted 0.562 – 0.788 and the eigenvalues was 2.691 or 7.273 %

- Interesting/Attention of which factor loadings consisted of 4 components could be weighted 0.446 – 0.766 and the eigenvalues was 2.651 or 7.166 %
- Goal Setting of which factor loadings consisted of 5 components could be weighted 0.433 – 0.792 and the eigenvalues was 2.608 or 7.049 %
- Sharing Ideas of which factor loadings consisted of 4 components could be weighted 0.519 – 0.744 and the eigenvalues was 2.524 or 6.820 %
- Assisting of which factor loadings consisted of 3 components could be weighted 0.621 – 0.709 and the eigenvalues was 2.088 or 5.642 %

These factors could be explained 64.457 % of the total variance. A study of Correlation Coefficient between 8 and 91 variables was 0.410 – 0.792 and Correlation Coefficient between 8 factors that affected Project-Based Learning of as perceived by electrical power students was 0.492 – 0.855 which was in high level. The Correlation Coefficient within the 9 internal factors was 0.017–0.094, which was in low level. This is shown in Figure 3.

The regression or predicting equation of factors affecting Project-Based Learning of students as perceived by students' opinions was :

Y = 0.553 (Multiple Intelligence) +0.528 (Scientific Process) + 0.863 (Advising/Guiding) + 0.661(Thinking) + 0.885 (Interesting/Attention) + 0.634 (Goal Setting) + 0.492 (Sharing Ideas) + 0.524(Assisting)

The prediction equation had the power of prediction 50.000 % and error of prediction was 12.500 %.

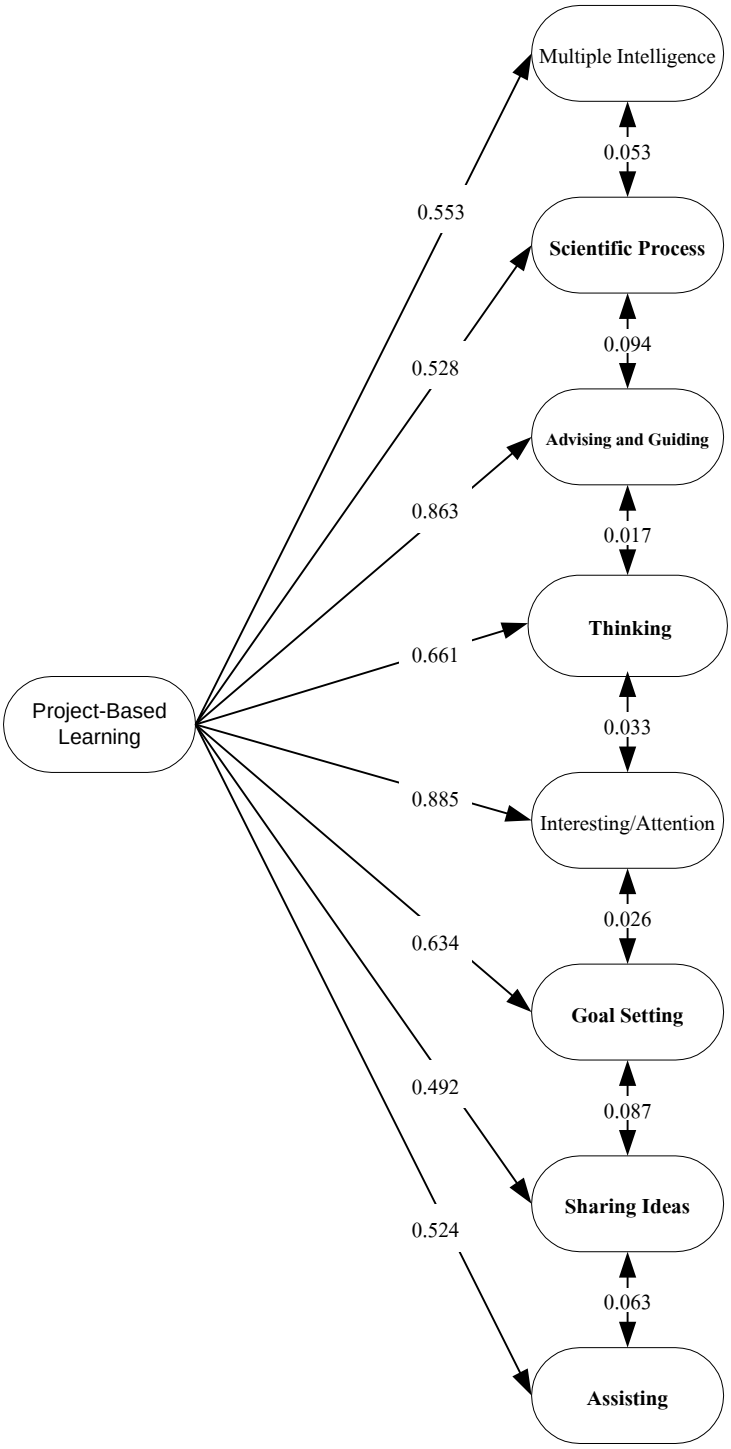

Figure 3: Confirmatory Model Showing Correlation Coefficient within 8 Internal Factors Affecting Project-Based Learning As Perceived by Electrical Students' Opinions

CONCLUSION AND DISCUSSION

As the results of the study concerning factors empowering electrical students' learning achievement through Project-Based Learning (PBL) of students as perceived by instructors' and students' opinions, it was found that at first start of PBL students should pay attention (both perceived by instructors and students as a factor affecting PBL) to what they are doing. Since Interesting/Attention is associated with the learners' ability to concentrate on the task in hand (Romiszowski 1984). The results of effort would make learners aware of problems and finish the project. Besides, paying attention refers to the brain's ability to take all of the stimuli around us,

immediately categorize and organize information as relevant or irrelevant, and focus the mind on one thing (WBGH 2002). On the other hand, if one lacks of attention, one might become easily distracted by irrelevant sights and sounds, make careless mistakes, rarely follow instructions carefully and completely, and lose or forget things needed for a task (WBGH 2002).

Then, the next step students try to setup goal. At this point students need instructors' Advising/Guiding for their projects. On the other hand, instructors can empower students by helping them plan, share ideas as well as think until they can get things through. The details of differences between electrical instructors' and students' opinions upon PBL will be shown in Table 1 as follows:

Table 1: Roles of Teacher and Learner in Project Management Process

Processes in PBL	Teacher Roles	Learner Roles
Making Project	Interesting/attention	Interesting/attention
Beginning Project	Planning Sharing Ideas Thinking	Advising/Guiding Thinking Goal Setting
During Project Process	Facilitating Constructionism Scientific Process Multiple Intelligence	Multiple Intelligence Scientific Process Assisting Sharing Ideas
Evaluating Project	Goal Setting	

From Table 1, it was found that during project process a learner must use Multiple Intelligence (M.I.) because he/she must use "Visual/Spatial Intelligence" in order to think in images and pictures as well as to visualize accurately and abstractly so that he/she is able to determine and clarify the goals. Then, his or her academic success and confidence increases. "Logical/Mathematical Intelligence" will help understand a causal system or to manipulate numbers, quantities, and operations. Next, a learner will use his/her whole body or parts of it (hands, fingers, arms) to solve a problem, make something, or put on some kind of production. This will be called "Bodily-Kinesthetic Intelligence". However, at this point of work a learner will have to use "Interpersonal Intelligence, and Intrapersonal Intelligence in order to complete activities as specified while "Verbal/Linguistic" or the capacity to use language to express what's on his/her mind and to understand other people, and Musical Intelligence will help improve their presentations (Gardner 2000). Moreover, since learners must work in team during project process, he/she must share ideas with peers and teacher all the time as well as supports from teacher as 'A Facilitator'. As for opinions given by teachers, they agreed with learners in M.I. and Scientific Process. But their opinions were at a lower than learner's one possibly because M.I was considered personal traits and/or beyond teacher's capability to help those learners. Therefore, a learner must empower himself/herself. The last point was that a learner would think whether a teacher evaluates his/her project as planned or not.

REFERENCES

Mulkam, Suvit and Oratai (2002) Instruction Methods: To Develop Morals, Values and Learning by Oneself, Phabpim, Bangkok, pp. 84-92.

National Primary Education Commission 2002, Project-Based Learning, Attapon, Bangkok, pp. 5-7.
Buck Institute for Education (2002) Project-Based Learning [Online], Available : http://www.bie.org/pbl/pblhandbook/intro.php [2004, September 14]

Rung Kaewdaeng 1998, Thailand Education Reform, Matichon, Bangkok, p. 110.

Office of the National Education Commission, National Education Act B.E. 2545 (1999) and Amendments (Second National Education Act B.C.2545 (2002)), p. 11.
Prawase Wasee, (1999) Ideas on Learning Development System, Reform Journal, Vol. 2, No. 13, March 1999, pp. 31-33.

Autodesk Foundation (1999) What is Project-Based Learning?, [Online], Available: http://www.k12reform.org/foundation/pbl/workbook/workbk1.htm [2005, February 2]

Suchin Petcharak (2001) Research Report on Constructionism in Thailand, National Education Commission, Bangkok, pp. 3-13.

Samran Meechang (2001) Advanced Statistics for Research, Department of Education, Faculty of Education, Naresuan University, p. 196.

A.J. Romiszowski (1984) Producing Instructional Systems, London; Kogan Page, p.124.

Stephen R. Covey, Begin with the End in Mind, [Online], Available: http://www.profitadvisors.com/beg_end.shtml [2006, June 14]

Gardner,H.(2000). What is the theory of multiple intelligenes(M.I)? http://www.thirteen.org/edonline/concept2class/mi/index.html. September 20,2006.

Romiszowski, A.J. (1984). Producing instructional systems, New york:Kogan, london/nichols publising, p.122.

WGBH, (2002). Basics of attention. http://www.pbs.org/wgbh/misunderstoodminds/attentionbasics.html. September 21,2006.

WGBH, (2002). Difficulties with Attention. http://www.pbs.org/wgbh/misunderstoodminds/attentionbasics.html. September 21,2006.