Laboratory Development of Transformer Using Discovery learning

Somyot Seesansui, Surachai Thammayarit*, Nutthapong Gatvongsa
Department of Electrical, Srisongkham Industrial Technology Collage,
Nakhonphanom University 48150,Thailand
E-mail:joynui415@gmail.com

ABSTRACT
This study was set to perform a comparative study of learning achievement between discovery laboratory learning approach and conventional teaching approach on the topic of transformer principle. The sampling group consisted of 30 second year vocational education diploma students from the department of electrical power, Srisongkram College of Technology. They were split into 2 groups of 15 people: control and experimental groups. Before the treatment, the sampling group was given a test about previous knowledge and they had to reach the requirement of 80%. The experimental group was given discovery laboratory approach. The control group was given conventional teaching approach. The research results revealed that the efficiency of discover laboratory Learning was at 82.1/86.6, which was higher than 80/80 as already identified by the criteria. The research results were that the discovery laboratory teaching approach could help the experimental group achieve learning achievement in the area of memory and the learning achievement of the experimental group was higher than that of the control group at the statistical significance of 0.05 level. It was confirmed that the Discovery Laboratory adopts the problem-based learning approach, where students are given a high performance to explore the application of various technologies which are relevant to technology practice. With a specific set of innovation and industrial grade equipment assigned to them, students can define their own project outcome and conduct experiments under the supervision of academic supervisors and teaching assistants who have in-depth knowledge of the subject matter.

Keywords: Transformer Principle / Discover Laboratory / Conventional Laboratory/ Learning outcome

1. Introduction

Two decades ago, the shift from the traditional instruction paradigm to the learning paradigm was advocated in the vocational education. Since then, educators across the globe have answered the call for this paradigm of various learner-centred approaches in vocational education. The instructors usually give lecture to students or solve problems in front of the classroom so that students can learn how to imitate and do practice at the end of each chapter. However, to gain higher understanding and idea and to solve problems require the application of various teaching methods so that learners can use brains to tackle with the contents and develop understanding inside the learners. Therefore, the researchers would like to conduct a comparative study of academic achievement between discover laboratory learning approach and conventional teaching approach on the topic of transformer principle.

In this study on the comparative study of learning achievement between conventional teaching approaches and discovery laboratory learning on the topic of the transformer principle, students were divided into 2 groups: Group 1 was the experimental group while Group 2 the control group.

II. Discovery laboratory Set.

The discovery laboratory learning set are consist of the following section as shown in Fig.1.

1. Transformer
2. Voltmeter
3. Ammeter
4. Correct connection signal LED lamp
5. Wrong connection signal LED lamp

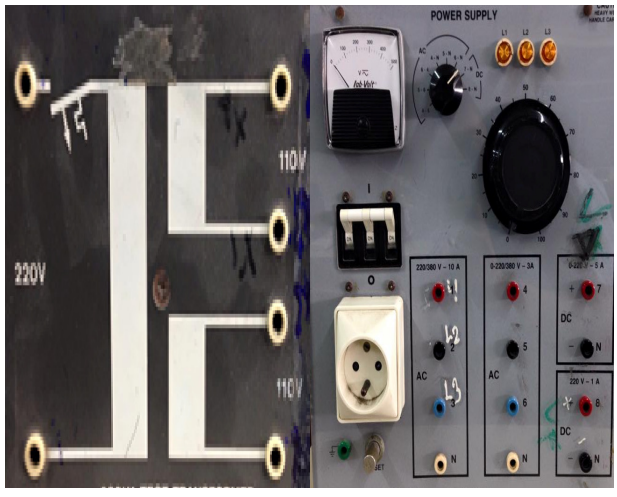

Fig.1. Discovery Transformer Laboratory Set

II. Theory

The pedagogical design of this course is based on the Experiential Learning Theory. Learning is best

conceived as a process, not in terms of outcomes. This proposition of learning determines the assessment of students . With such a format, the assessment aims to evaluate the performance of students in Kolb's Experiential Learning Cycle , which consists of abstract conceptualization, active experimentation, concrete experience and reflective observation. The preparation stage is where students engage with abstract conceptualization: they are given information about the system they are assigned to and think about what to achieve and how to tackle foreseeable technical challenges. The execution of experiments allows students to go through the learning cycle several times. This means through active experimentation, students obtain concrete experience of the various aspects of the process from the perspective of a practicing engineer. To further enhance their understanding, students also perform reflective observation of the process and summarize their learning in abstract conceptualization. The Design-Analysis-Evaluation Cycle captures this learning process effectively, as students have to write down:(1) experiments completed,(2) key findings from these experiments,(3) issues/risks identified, and(4) actions to be taken in response to (2) and (3).The Design-Analysis-Evaluation Cycle is performed by the students every two days and assessed by the academic supervisor. For each project in the Discovery Laboratory, the teaching is delivered by an academic supervisor and a teaching assistant. The academic supervisor oversees the entire project thus ensuring students are on the right track to achieve the learning outcomes. The teaching assistant is in charge of supervising students during the laboratory sessions, monitoring student safety and proper use of the equipment. To enhance student learning, the academic supervisor and teaching assistant act as the experiential educators. By playing different roles in the Educator Role Profile interchangeably, they match the teaching styles with the learning styles of students to facilitate the learning process. Being the expert in the relevant subject matter, the academic supervisor mainly serves as the subject expert and facilitator. Assessment of learning outcome This project incorporates both summative and formative assessments in order to enhance student learning. The summative assessment is designed to assess the level of subject mastery by the students at different stages of the project.

III. Research Methodology

1. A test about previous knowledge in the design of the transformer principle was given to students from both experimental and control groups until students from both groups passed 80% requirement.

2. The pretest of 40 questions with 4 multiple choices was given to both experimental and control group.

3. The experimental group was taught in accordance with discover laboratory learning approach whereas the control was given conventional teaching approach.

4. The posttest was given as a learning achievement and this was the same pretest but the items and choices were rearranged for both experimental and control groups. The model is shown in Fig. 2.

5. The data were analyzed and the score from both groups was compared with previous knowledge, learning achievement, and behavior through t-test statistical technique.

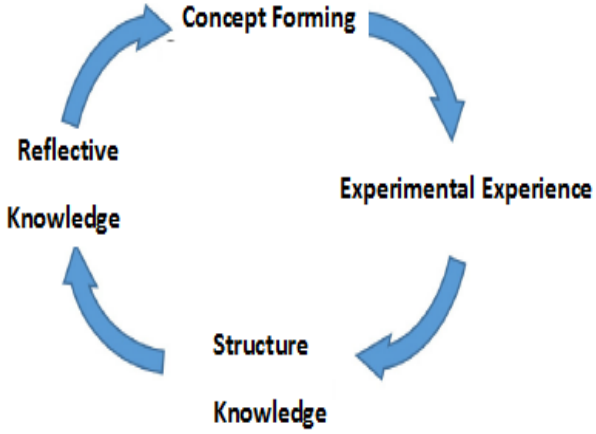

Fig. 2. Discovery Learning Model

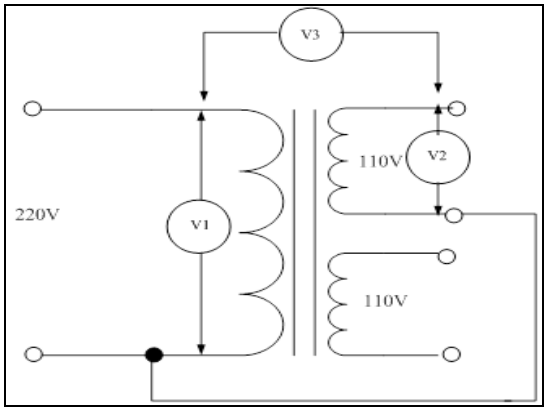

Fig.3 Experimental Transformer Polarity Principle

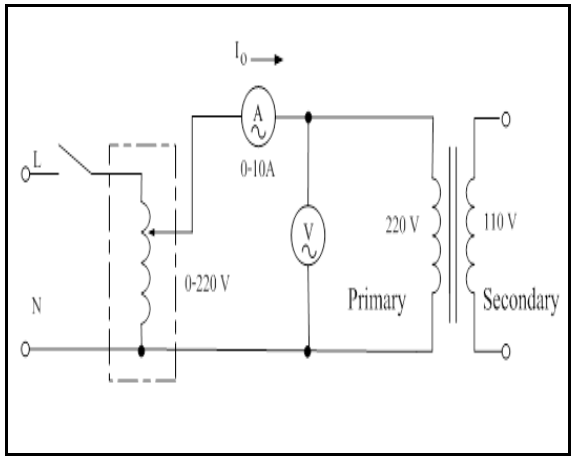

Fig.4 Experimental Transformer no load Principle

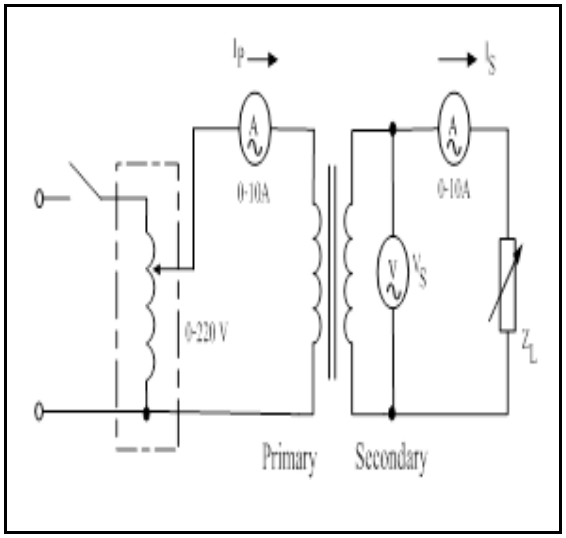

Fig.5 Experimental Transformer on load Principle

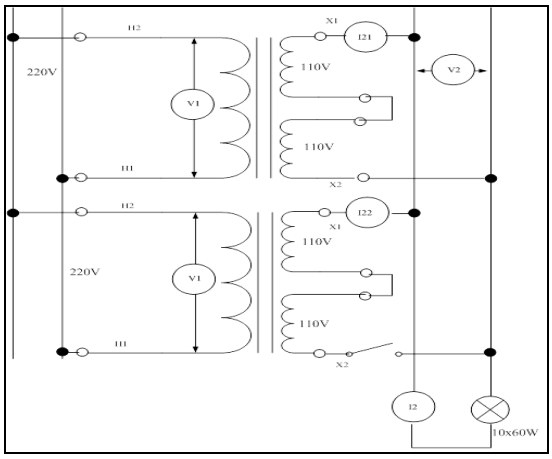

Fig.6 Experimental Transformer Bank

IV. Results

The research on the learning achievement of both experimental and control groups through learning achievement test containing 40 items of 4 multiple choices. Their scores were compared through t-test statistical technique. It was found that the experimental group and the control group showed significantly different learning achievement at the statistical level of 0.05. This means that the experimental group showed higher learning achievement than the control group. Discovery laboratory learning approach could help the experimental group achieve better scores than the group with conventional teaching approach.

Table 1 Comparison of learning achievement between the experimental and control groups

Sampling group	N	$\bar{X}$	S.D.	t-value
Experimental group	15	31.4	1.78	-3.22
Control group	15	27.3	2.43	

According to the analysis of the data from Table 1, it was found that the value was statistically significant (0.01, df = 28). The t value from the table was 2.557 and the t value from calculation was -3.22. This means that the experimental group and the control group had statistically significant difference for their learning achievement.

Table.2 shows the mean, standard deviation and t-test value for the learning achievement pretest of the experimental group.

Experimental group	N	$\bar{X}$	S.D.	t-value
Pretest	15	17.25	1.78	-13.89
Posttest	15	24.35	1.49	

According to the analysis of Table 2, it was found that the t value was statistically significant (0.01, df = 28). The t value from the table was 2.557 whereas the t value from the calculation was -13.89. This means that the learning achievement from pretest and posttest for the experimental group was statistically significant. Students with discover laboratory learning approach showed higher learning outcome.

Table.4 shows the mean, standard deviation and t-test value for the learning achievement pretest of the control group.

Control group	N	$\bar{X}$	S.D.	t-value
Pretest	15	16.35	2.53	-4.57
Posttest	15	21.85	1.41	

According to the analysis of Table 4, it was found that the t value was statistically significant (0.01, df = 28). The t value from the table was 2.557 and the t value from calculation was -4.57. This means that the learning outcome for pretest and posttest of the control group was statistically significant.

Table.5 shows the mean, standard deviation, t-test value of the academic achievement by the experimental

and control groups as classified by the learning behaviors.

Learning behaviors	Experimental group			Control group			t-value
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	
Memory	15	19.8	1.5	20	15.2	2.6	-3.668**
Understanding	15	19.2	2.34	20	13.8	4.40	-2.125
Application	15	19.2	2.98	20	15.8	3.58	-2.845**

** Statistically significant at the 0.01 level

According to data analysis from Table 5, it was found that the t-value was statistically significant (0.01, df = 38). The t-value from the table was 2.457 whereas the t-value from the calculation was -3.668, -2.125 and -2.845 for the learning behaviors as in memory, understanding and application, respectively. The average of the experimental group was higher than that of the control group.

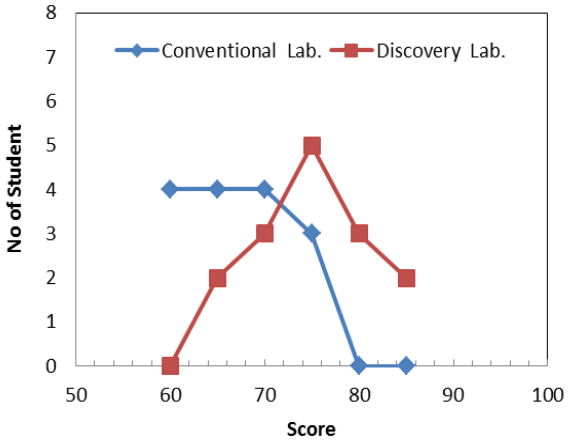

Fig.7 Conventional and Discovery Laboratory Score.

According to Fig.6., it was found that the discovery laboratory learning outcome score are higher than Conventional Laboratory Score. The assessment scheme for the Discovery Lab has been designed to assess a broad range of skill sets required for developing students into early stage researchers. However, as can be seen from Fig. 7, this is not the case here. In fact, the distribution of marks for Conventional and Discovery Lab for the same cohort of students using different group sizes and assessment schemes is broadly similar.

IV. Conclusion

According to the research on the learning achievement between the experimental and control groups through learning outcome of 40 items with 4 multiple choices, the scores were analyzed using t-test technique with 2 independent sampling groups and it was found that the experimental group and the control group showed statistically significant difference in their learning achievement at the level of 0.05. It was confirmed that the Discovery Laboratory adopts the problem-based learning approach, where students are given a high performance to explore the application of various technologies which are relevant to technology practice. With a specific set of innovation and industrial grade equipment assigned to them, students can define their own project outcome and conduct experiments under the supervision of academic supervisors and teaching assistants who have in-depth knowledge of the subject matter. A total of eleven projects are available, covering a wide range of industrially relevant technologies. The course is designed based on the experiential learning theory incorporating both summative and formative assessments. It was explicitly stated that they enjoyed the freedom to conduct their own research and the support given by academic supervisors and teaching assistants. This shows that the course framework is able to deliver the intended outcomes of the course, which is to support student-centred experiential learning.

References

[1] De Cecco ,J.P .,1968 The Psychology of Learning and Instruction Educational Psychology , New Jersey , Printice – Hall , Inc , pp.387-427

[2] Schiever , S.W ., 1991 , A Comprehensive Approach to teaching Thinking Massachusetts , allyn and Bacon , pp . 3-34

[3] Kausmeier , H.J. and Ripple , R.E. 1971 , Learning and Human Ability , 3rd ed , New York , Harper of Row Publihers , pp 397-402

[4] Herriman , P.L 1947 , Dictionary of Psychology , New York , Philosophical library , p.124

[5] Woolfolk , A.E., 1993 , Education Psychology , 5th ed , Messachusetts , allyn and Bacon , pp. 3-34

[6] Chusak Pleanphoo, 2002 , Principle , Department of Electrical Technology Education ,Faculty of Industrial Education and Technology , King Mongkut's University of Technology Thonburi, pp. 1-3

[7] Wichai Wongyai , 1989 , Instruction on Generalization and Principle , Journal of Research on Education (Local), No. 3 , pp. 19-32