HOW EFFECTIVE ARE OUR TEACHING METHODS FOR VOCATIONAL EDUCATION

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Abstract : In vocational education, students' attitudes are often overlooked in its pedagogy deployment. The theme of this paper is to investigate how to measure the effectiveness of teaching in student's affective domain.

The research experiment was designed with time-span of 15 weeks. A set of questionnaires was designed as the instrument of the investigation. Prior to the experiment, students were split into two groups. Subsequently, these two groups of students went through different approaches of teaching. At the end of the experiment, the same questionnaires were used to probe students' attitude. Data analysis was used to measure the shift of attitude before and after the experiment of these two groups of students.

Apparently, one group of students has more positive attitude. However, data analysis shows we cannot conclude it was caused solely by imposing one particular teaching method. Likewise, even with the fact that many students of the experimental group favored one particular type of teaching method, there is no evidence that this teaching method can have higher impact in students' attitude. This study provides a useful viewpoint in the planning and evaluation when conducting a novel teaching methodology.

1. Background of teaching and learning in HKIVE

The Department of Electrical & Communications Engineering (Dept. of EE) at Hong Kong Institute of Vocational Education (HKIVE) has offered several Higher Diploma courses since the opening of the Hong Kong Technical College (now as HKIVE) in 1993. Conventional lectures and tutorials are the major means of these taught courses. In many lectures, class-size of 80 students is common. In some cases, there are lectures with as many as 160 students.

In this type of teaching, lecturers are the only people who do most of the talking in lecture theatres. In fact, many students feel bored in this type of one-way communication. In many cases, students have expressed strong resentment. It was felt that some alternatives might be used to enhance the learning outcome of the students at HKIVE(TY).

2. Lab-based teaching

Over the past decade, teaching methods in the courses that involve engineering disciplines have evolved significantly beyond the “lecture & laboratory” format. Experience has shown that, for effective teaching of many science and engineering subjects, practical exercises in the form of laboratory exercises need to be an integral part of the courses [1,2,3]. In particular, computer usage in the laboratory and computer-assisted homework has been very successful. Students have found that learning difficult concepts can be done more effectively when those concepts can be presented and explored visually or in a form for experimentation.

Laboratory approach teaching seems to be the natural alternative. Essentially, lab-based teaching makes use of a heuristic approach to learning which advocates "I see – I forget; I hear – I remember; I do – I understand". Learning by doing is a common teaching and learning method: "active learning" is an essential part of student-centered learning [4]. To make the coordination between the practical and theoretical work better, it is believed that lab-based teaching can provide the integration and it can deliver as part of the course plan. In this way, lab-based class can well integrated according to an overall course plan.

The activities of lab-based teaching/learning are largely student-based and monitored by instructors. It also emphasized small group teaching and learning in which students are encouraged to organize their thinking by comparing ideas and interpretations with each other and to give expression, and hence form, to their understanding of a subject. The role of the lecturer/instructor seems to be particularly critical in the lab-based teaching.

Using lab-based approach to teaching, students spend a considerable proportion of their time in the laboratory. During the exercise, it is effective for students to establish a positive attitude toward their professional in an environment similar to that of their future workplace.

3. Questionnaires – measurement of attitudes

In vocational education, students' attitudes are often overlooked in its pedagogy deployment. The theme of this paper is to investigate the effectiveness of teaching in student's affective domain by comparing the shift of attitude of two groups of students. The overall design of the experiment consists of the following steps and it can be depicted in Figure 1[5,6].

	Time →	→	→
Group under investigation	T1	*X*	T2
Control Group	T1	*Y*	T2

Where T1 : Questionnaires administrated to all students
T2 : Questionnaires administrated to all students
X : lab-based teaching
Y : conventional teaching

Figure 1*: Overall design methodology*

Questionnaires are the principal instruments used in attitude measurement. The measurement of attitude can be done by the levels of agreement with a series of statement are combined to give an attitude score.

4. Likert scale

In constructing a questionnaire, one wants to use scales at the *interval* level or at least *ordinal* level whenever possible[7,8]. All of the more powerful techniques of statistical analysis demand such scales, rather than simple *nominal* measures. One of the most frequently used ordinal-type scales is a single item (question) on a Likert-type scale. A Likert-type item consists of a single statement, followed by a usually five-point choice with each choice described in words. A common response in Likert-type scale are choices from Strongly Agree (SA), Agree (A), Uncertain (U), Dis-agree (D) and Strongly Disagree (SD). These responses are mapped with score from 1 to 5. Respondents are presented with questionnaires in which they use a choice to indicate how well the choice matches their feeling about the concepts. The measurement of attitudes is usually based on a form of attitude

scale which levels of agreement with a series of statements are combined to give an attitude score. That is, the total attitude score is the **sum** of the individual question scores.

5. Design of questionnaires

It is desirable to know whether there is shift of attitude toward two main concepts: “engineering lesson in HKTC” and “engineering as a profession”. Subsequently, a questionnaire with 26 questions was designed to probe the students’ attitudes towards these two concepts. The questionnaires consist of two sections. The first section is attitude toward engineering lesson at HKTC. Student’s attitude is measured with a set of 11 questions. These questions are measured in Likert-type scale and they are corresponding to a 5-point scale. The attitude score is the total of these responses. As shown in Figure 2, 11 items with Likert-type scale are used and sample's scoring of each question in tallying the composite attitude score. A problem with the Likert technique is the modest attitude score can be obtained by many patterns of response such as giving middle scores on all items. In constructing Likert-type and similar scales, some of the items should be positive and others should be negative. It is used to avoid "response-set". Noted that four of them are negative questions and they are marked with asterisks.

1. There is usually sufficient equipment and materials
2. Students put a lot of effort into what they do
3. The lectures lessons are well organized
4. The tutorial lessons are well organized
5. The laboratory lessons are well organized
6. Student waste time doing nothing in laboratory (*)
7. Most students really pay attention to what the lecturer says
8. Very few students take part in class discussions (*)
9. Student don’t do much work in lab (*)
10. Because equipment is scarce, students don’t get much practical work completed (*)
11. Student really enjoy their lessons

***Figure 2**: Questionnaires to probe students’ concept of a engineering lessons at HKTC. (note : questions in asterisk are negative questions); Answer with choices of SD, D, N, A, SA.*

The second section is to measure their attitude toward engineering as profession. A total of 15 questions are asked in *semantic differential* scale from 1 to 5 and details are shown in Figure 3. The first survey was done before the experiment. Another survey with the same questionnaire was carried out to identify any change of attitudes from these two groups of students.

A job working in Communications Engineering Area is						
Interesting	1	2	3	4	5	Boring
Make you tense	1	2	3	4	5	Make you relaxed
Successful	1	2	3	4	5	Unsuccessful
Unfriendly	1	2	3	4	5	Friendly
Modern	1	2	3	4	5	Out-of-date
Safe	1	2	3	4	5	Risky
Difficult	1	2	3	4	5	Easy
Requires work in a team	1	2	3	4	5	No team work required
Demanding	1	2	3	4	5	Undemanding
Requires much experience	1	2	3	4	5	Requires no experience
Technical	1	2	3	4	5	Non-technical
Non-specialized	1	2	3	4	5	Specialized
Active	1	2	3	4	5	Passive
Useful to others	1	2	3	4	5	Not useful to others
Involves much responsibility	1	2	3	4	5	Involve little responsibility

Figure 3: Questionnaires to probe students' concept of a job working in communications engineering area.

6. Summary of results

The first part of the questionnaires concerned with students' perceptions in the matters of engineering lesson. The summation of 11 scores of Likert scales to make up a "attitude score". After the completion of the experiment, as shown in Table 1, we can observe that attitude score of experiment group (Group B) changed from 33.83 to 35.58 while the control group's attitude score changed from 31.33 to 32.67. Details of the data analysis indicated the significance of these are 0.166 and 0.533. This means that there is a high chance that pretest and posttest attitude score are effectively equal.

Likert scale	control		experimental		t-value	2-tail significance
	mean	std	mean	std		
pretest (1,2)	31.3333	4.416	33.8333	2.368	-1.68	0.110
posttest (3,4)	32.6667	4.472	35.5833	3.502	-1.68	0.110

***Table 1**: Summary of data analysis (comparing the effect of the treatment)*

In the second part of the questionnaires, another 15 questions were used to probe students' attitudes toward engineering as a profession. Data analysis was carried out to test whether there is a shift of attitude after the experiment and the results are shown in Table 2. Although each question uses the same semantic differential scale, they represent different concepts. Thus, the data from each of the 15 questions are analyzed separately. In this analysis, *t*-test was carried out to test whether there was shift of attitude toward engineering as a profession. The lowest probability value from these evaluations is 0.075. None of these has a 2-tail significance lower than 0.01 (i.e. $p > 0.01$). It was concluded that there were no significant differences in students' attitude after the experiment.

Question	**Pretest**		**Posttest**		**t-value**	**2-tail significance**
	Mean	STD	Mean	STD		**(*p*)**
Q12	2.8333	0.718	2.7500	0.622	0.30	0.764
Q13	2.4167	0.515	2.8333	0.577	-1.87	0.075
Q14	2.6667	0.778	2.8333	0.577	-0.60	0.557
Q15	3.6667	0.651	3.0000	0.853	2.15	0.043
Q16	2.9167	0.669	2.4167	0.793	1.67	0.109
Q17	2.2500	0.754	0.2533	0.669	-1.15	0.264
Q18	2.6667	0.778	2.7500	0.452	-0.32	0.752
Q18	2.6667	0.778	2.7500	0.452	-0.32	0.752
Q19	2.3333	0.651	2.3333	0.651	0.0	1.00
Q20	2.7500	0.754	2.5000	0.522	0.94	0.355
Q21	2.7500	0.754	2.4167	0.669	1.15	0.264
Q22	2.6667	0.888	2.5000	0.522	0.56	0.581
Q23	3.0000	0.426	3.1667	0.718	-0.69	0.496
Q24	2.5833	0.669	2.6667	0.651	-0.31	0.760
Q25	3.0000	0.426	2.7500	0.622	1.15	0.263
Q26	2.7500	0.754	2.7500	0.452	0.00	1.000

Table 2*: the pretest and posttest result of the* ***experiment*** *group. All indicates there is no sign of significant that each pairs are different (i.e. p > 0.05)*

7. Analysis of the teaching methodology

The measurement of affective outcomes or evaluative judgment is usually based on a form of attitude scale of the respondents. Attitude scales, like other scales, need to be reliable and valid. There are many problems associated with the attitude measurement[7,8].

After the study, it was found there is only similar minor shift of attitude in both groups. We have little evidence that the change of attitude is due to the difference of teaching methodology. Again, we cannot make the conclusion that shift of attitude is due to lab-based teaching.

Ideally, the lab-based approach to teaching should emphasize learning and not teaching. Students are not working alone as they can build their own understanding under the guidance of instructor. There have been conflicting findings on the comparative effectiveness of laboratory based and lecture methods. Some research found no difference in cognitive achievement of learners

[9]. But other studies found that the lecture method was inferior to instruction based on problem solving, laboratory approach teaching.

Some of these findings therefore suggested that laboratory based method, could be effective in improving the achievement of students in science and engineering [9,10,11,12]. Researchers also suggested that students' perception to laboratory approach teaching will be more positive if they wish to solve the problem [13]. The results shown above simply reflect the outcome of this experiment. Many students also reflected their views that computer-assisted homework imposed many difficulties in assessment. As suggested by Morgan, assessment is one of the major factors that will change students' perception and approach to learning [14].

CONCLUSIONS

In this paper, some of features of lab-based teaching methodology are discussed such as "learning-by-doing" and the emphasis of student-centered principle. Although the author cannot conclude there is a significant in shift of attitude after imposing the lab-based teaching, some advantages of laboratory approach teaching were experienced. They are summarized as:

1. Lab-based class can well integrate according to an overall course plan;
2. Activities of lab-based teaching/learning are largely student-based and monitored by instructors; and
3. Lab-based teaching may be effective for certain students to establish a positive attitude toward the professional but may not be as effective for others.

REFERENCE

1. Chen, N., Kwon, Y.K., (1995), "Integration of Micromouse Project with Undergraduate Curriculum : A large-scale student participant approach", IEEE Transactions on Education, *IEEE*, Vol 38, No.38 May, 1994
2. Uribe, R.B, Haken, L and Loui, M.C, "A Design Laboratory in Electrical and Computer Engineering for Freshman", IEEE Transactions on Education, *IEEE*, pp.194-201, Vol 37, No.2 May, 1994
3. Marton & Saljo (1976). "An qualitative differences, outcomes and process I and II", *British Journal of Education Psychology*, 46, 1976, pp.4-11, 115-127
4. Curzon, L.B (1990), "Teaching in Further Education", Cassel Publication, pp258-271.
5. Moore, J.L (1994), "Course book for Research Methods and Data Analysis, Vol I", *University of Hull*
6. Wong, Y.L (1997), " The use of a laboratory approach for teaching engineering students", *MA(Ed) dissertation, University of Hull, UK*
7. Wong, Y.L (2000), " The use of a laboratory approach for teaching engineering students", *Summer 2000, IVETA 2000*
8. Gardner, P.L., "Attitude Measurement – a critique of some recent research", *Monash University*, Victoria, Australia.
9. Odubunmi, O and Balogun, T.A. (1991), "The effect of laboratory and lecture teaching methods on cognitive achievement in integrated science", National Association for Research in Science Teaching, *J.Wiley & Son Inc*., CCC 0022-4308/91/030212-12

10. Agne, R.M & Blick, J.D. (1972). “A comparison of earth science taught by using original data research approach versus classes taught by conventional approaches not using such data”, Journal of Research in Science Teaching, 9(1), 81-89
11. Griffiths P. (1992), “Problem-based learning in Automotive Engineering Design”, Improving the Quality of Student learning, edited by G. Gibbs, Bristol : Technical and Educational Service Ltd
12. Lai, P., Chu, K.C (1997), “Who Benefits from Problem-based learning?”, Austrian Journal of Higher Education , Sum 1997.
13. Biggs, J. (1992), “Why and how do Hong Kong students learn? Using the Learning and Study Process Questionnaires”, Education Paper 14, Faculty of Education, Hong Kong University
14. Morton A. (1993), “Improving your Students’ Learning – Reflections on the Experience of Study”, Kogan Page Ltd.

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