Annual Academic Sessions 2011
ISSN 2012-9912; ©2011 Open University of Sri Lanka

THE EFFECTIVENESS OF A NOVEL INSTRUCTIONAL METHOD IN ENHANCING THINKING SKILLS IN AN UNDERGRADUATE CHEMISTRY EXPERIMENT

M. N. K. deZoysa[1*], G. Bandarage[1], E. A. D. N. D. Edirisinghe[2], R .U. Tantrigoda[1] and K. C. Weerakoon[2]

[1]*Department of Chemistry,* [2]*Department of Zoology, The Open University of Sri Lanka*

INTRODUCTION

In the past, it was thought that what is expected in an undergraduate chemistry laboratory class is to produce personnel to be employed in chemistry related professions who are engaged in laboratory bench work (Reid & Shah, 2007). Thus the focus in traditional laboratory classes had been on developing laboratory techniques and routine analytical skills. Today, many chemistry graduates are not employed as bench chemists in industry. Therefore rather than training in specific laboratory skills, what is more important is the understanding gained during experimentation which can later be applied in other situations. In today's context, laboratory classes are seen as opportunities where students develop inquiry based learning and also develop many other skills such as team work and problem solving (Hofstein & Lunetta, 2004).

The first year chemistry practical course in the B.Sc. Degree Programme at The Open University of Sri Lanka, so far had been carried out to a certain extent in a traditional manner where a demonstrator demonstrates how to conduct an experiment at the beginning of the laboratory class. Thereafter the students perform the experiment by following the procedure, given step-by-step, in the laboratory manual. In this paper we describe the impact of a slight modification in the delivery mechanism done to improve thinking skills of students. The modification was designed in such a manner so that it had minimal impact on the psyche of teachers and students. This research study focuses on the experiment involving Galvanic cells in the Practical Chemistry course, CMU1121, in the B.Sc. Programme.

METHODOLOGY

A one day workshop was held in advance of the commencement of practical classes in CMU1121 where the subject specific concepts involved in experiments and the general skills involved in the chemistry laboratory were discussed with the students. Conducting a workshop in a laboratory course is a new practice. There one hour was spent on the practical on Galvanic cells. After presenting a brief introduction to the concepts involved in the experiment the students were required to do two activities to improve their understanding and thinking related to the experiment on Galvanic cells.

On the day of the experiment, the broad objectives of the experiment were explained. The importance of knowing the reasons for both performing each step of the experiment and the way it is performed was emphasized. Though the procedure, step by step, was given in the handout, designing the layout and making the electrical connections in the associated circuit were presented as problems. The students were required to perform the experiment in groups of two. They were given time (about 30 min) to read the handout and discuss among themselves as to how to perform the experiment. They were then required to show their layout and describe how they were going to perform the experiment to a demonstrator when they were ready to perform experiment. The demonstrators were instructed not to give direct answers to student questions or directly intervene with difficulties. They were expected to guide the students towards the correct solution by counter questioning. The students were allowed to perform the experiment only when the demonstrator was satisfied with their layout and techniques were acceptable. A pre-laboratory

* All correspondence should be addressed to Ms. M. N. K. de Zoysa, Department of Chemistry, The Open University of Sri Lanka (email: mnzoy@ou.ac.lk)

questionnaire was administered just before they started the experiment, to collect some information on the impact of the peer-discussions on the design of the layout and their understanding of the procedure of the experiment. A post-laboratory questionnaire was administered at the end of the experiment. In addition, face to face interviews were held with a selected number of students to gather more data on the experiment on Galvanic cells. The demonstrator feedback was also obtained through interviews. This paper presents the data and their analysis.

RESULTS AND DISCUSSION

The pre-laboratory and post-laboratory questionnaires were administered on a student sample of size 133 who attended the laboratory class at the Colombo Regional Center.

Age (years)		Gender		Employment status		Marital status	
< 25	25 – 35	Male	Female	Employed	Unemployed	Married	Unmarried
79	21	23	77	35	65	31	69

Table 1: Student sample (n = 133) characteristics as percentages.

Majority of the students in the sample were young females who were unmarried and unemployed.

Figure 1 indicates the student perceptions on the statements in Table 2 on a five point Likert scale.

No.	Statement
1	*I have carefully read the procedure of this experiment in the handout given at the beginning of this lab session..*
2	*The discussion we had within our group was useful in understanding most of the steps in the procedure given in the handout of this experiment.*
3	*I am confident that I have understood most of the steps in the procedure given in the handout of this experiment.*
4	*The instructions given by staff at the beginning of the experiment was useful in designing the layout of this experiment.*
5	*Understanding most of the steps in the procedure (as given in the handout) of this experiment was useful in designing the layout of this experiment.*

Table 2: Statements used in recording student perceptions *before* performing the experiment.

Statements 1, 2 and 3 are related to the reading of the procedure of the experiment in the handout and understanding the steps in it. Figure 1 indicates that the students felt that the peer–discussions helped them in understanding the procedure. Student feedback on statement 4 indicates that they felt that the instructions given by staff, at the beginning of the experiment, was useful in designing the layout. Responses on statement 5 indicate that the students understood the positive correlation between understanding the steps in the procedure and the designing of the layout which provides evidence that the students have been motivated to think.

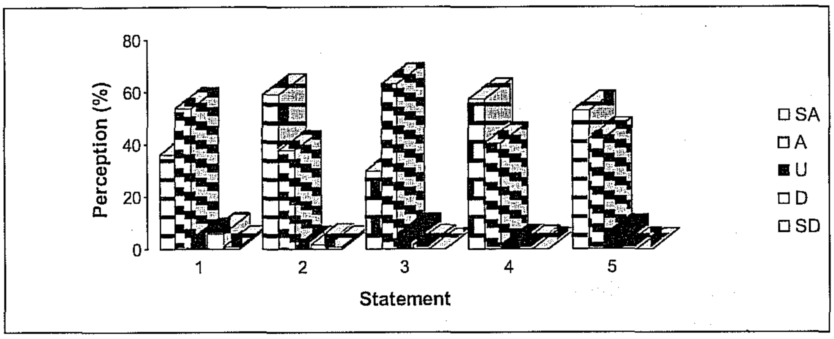

Figure 1: Student perception on statements in Table 2.
SA = Strongly Agree, A = Agree, U = Undecided, D = Disagree and SD = Strongly Disagree

Figure 2 indicates the student perceptions on the statements in Table 3 on a five point Likert scale.

No.	Statement
1	*I am confident that we performed this experiment with* *understanding* *as to why we were performing each and every step in the procedure.*
2	*The instructions given by* *staff at the beginning* *of the experiment prompted me to think as to why I have to perform a step in the procedure when I was performing that step.*
3	*During the experiment my group encountered problems which were solved by us.*
4	*During the experiment my group encountered problems which were solved with the help of* *staff.*
5	*My understanding of what is meant by the error in an experimental measurement* *improved* *after performing this experiment.*
6	*My* *understanding* *as to why we have to perform each and every step in the procedure* *improved* *after performing this experiment.*
7	*The approach used in performing this experiment is different from the experiments I have done so far (either in the BSc programme, in school, in A/L tuition class etc).*
8	*I enjoyed doing this experiment.*

Table 3: Some statements used in recording student perceptions *after* performing the experiment.

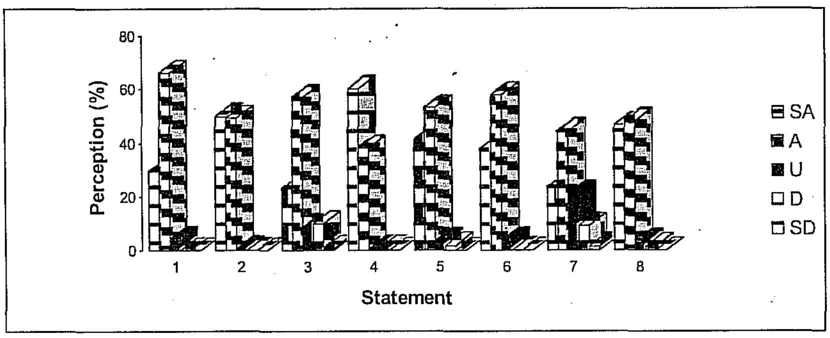

Figure 2: Student perception on statements in Table 3.

In a traditional laboratory class a student may perform experiments without understanding the processes that go on. In the present method the students were motivated to understand the experiment before they performed it. The perception on statement 1 indicates that the students felt that they performed the experiment with understanding. Perception on statement 2 indicates that communication of the importance of thinking about what you are doing motivated the students to think while they were performing the experiment. Perception on statement 3 indicates that the students had the ability to solve problems they encountered while performing the experiment. Perception on statement 4 shows that there have been some problems which needed demonstrator intervention. This indicates that there is room for improvement in student understanding of the experiment. Responses to statement 5 indicate that the students felt that the understanding of error in a measurement improved after performing the experiment which supports the belief that the students have thought about the processes that are going on in the experiment. Perception on statement 6 indicates that the understanding of the processes that occur in the experiment has improved by performing the experiment which may be considered as secondary evidence that the students were mentally engaging with the experiment while performing it. Perception on statement 7 indicates that the approach taken in performing the experiment is novel for majority of the students. Perception of statement 8 indicates that the students have enjoyed performing the experiment.

Seven students out of 133 were interviewed. Analysis of these interviews indicates that the students enthusiastically participated in peer discussions which helped them perform the experiment.

Interviews of five demonstrators confirm that the students enthusiastically participated in peerdiscussion, enjoyed performing this experiment and that they believed that the experiment helped the students improve their thinking skills.

CONCLUSIONS/RECOMMENDATIONS

Explaining the concepts involved in the experiments and promoting peer-discussions are useful in motivating students in performing experiments in a meaningful manner where they think about the processes that occur in an experiment while performing an experiment.

ACKNOWLEDGEMENT

This study was an outcome of a workshop on "Research Methodology in ODL" held at The Open University of Sri Lanka (OUSL) in 2010. Authors wish to acknowledge the guidance and encouragement extended by Professor G. I.C. Gunawardane, Commonwealth of Learning Chair at OUSL. We gratefully acknowledge the support given by Dr. Sithy Iqbal, Senior Lecturer in the Department of Chemistry, in this project. Our grateful thanks are also to the staff of the Department of Chemistry for assistance given in numerous ways.

REFERENCES

Avi Hofstein and Vincent N. Lunetta (2004), The laboratory in science education: Foundations for the twenty-first century science education, 88(1), 28–54.

Norman Reid and Iqbal Shah (2007), The Role Of Laboratory Work In University Chemistry, Chemistry Education Research and Practice, Volume 8(2): 105-273.