Man In India, 96 (6) : 1761-1773

CHEMISTRY TEACHERS' VIEWS OF MODELS OF TEACHING AND LEARNING IN PRACTICAL WORK IN MALAYSIA

Jenny Cheng Oi Lee and Mohammad Yusof Arshad

For a great many years, practical work has been regarded as one of the most important element of science education. Till today, very few researches investigate chemistry teachers' views of models of teaching and learning in practical work. The purpose of this study is to gauge views of models of teaching and learning in practical work among chemistry teachers from urban and non-urban schools in the Southern West of Sabah, Malaysia. To answer this objective, a descriptive qualitative research was employed. Twenty chemistry teachers were involved as participants in this study. Semi-structured interviews that consist of a set of questions about chemistry teachers' views of models of teaching and learning in practical work were conducted. Data were analysed using content analysis. The research findings revealed that only 40% of the teachers were able to give definition on models of teaching and learning in practical work, whereas more than half (60%) of the teachers were not able to give definition. Furthermore, majority chemistry teachers were still using expository (*'recipe-style'*) learning (43.3%), followed by inquiry-based learning (26.7%), project-based learning (16.7%), problem-based learning (10.0%) and web-based learning (1%). The research findings will provide ideas and practical guidance for teachers who wish to rethink or reinvigorate their models of teaching and learning in practical work.

INTRODUCTION

Over the years, practical work has been viewed as an integrated feature of most science subjects especially in chemistry. Its benefits have well documented in the literature (Hofstein, Kipnis & Abrahams, 2013, Abrahams & Reiss, 2012; di Fuccia, 2012; Kennedy, 2012; Kidman, 2012; Mamlok-Naaman & Barnea, 2012; Toplis & Allen, 2012; Millar & Abrahams, 2009; Hofstein & Mamlok-Naaman, 2007). For most Malaysian chemistry teachers, practical work is part of teaching and learning chemistry. It provides opportunities for students to work together on analyzing and solving chemistry problems, help students to deepen their understanding through relating theory to practice, motivate students and stimulate their interest in the subject, as well as to develop skills and attitudes among students (Hofstein, Kipnis & Abrahams, 2013; Davies, 2008; Curriculum Development Centre, 2005).

However, evidence suggested that incorporating practical work successfully into the chemistry curricula can present a number of challenges. One of the biggest

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challenge is adopting the best models of teaching and learning to enhance smooth delivery and learning process. Numerous studies have shown that chemistry is a difficult subject and often incorporate many abstract concepts, which cannot be easily understood if these underpinning concepts are not sufficiently grasped by the students (Sim & Mohamad, 2014; 2013; Woldeamanuel, Atagana & Engida, 2014; Cardellini, 2012; Nurfaradilla *et al.*, 2010; Tsaparlis, Koliulis & Pappa, 2010; Nahum *et al.,* 2007; Sirhan, 2007). For this reasons, majority of students who take up chemistry are less motivated and attend the course simply because it is a prequisite (Cardellini, 2012; Nahum *et al.,* 2007). To improve the learning process, numerous researches have been conducted to understand the hurdle in order to develop effective models of teaching and learning in practical work (Hofstein, Kipnis & Abrahams, 2013; Nahum *et al.,* 2007).

In recent years, literature has documented numerous importance models of teaching and learning in practical work. These models of teaching and learning included expository (*'recipe-style'*) learning (Copriady, 2015; Mustapa, 2014; Pulle, Yates & Dicinoski, 2014), inquiry-based (open-inquiry) learning (Firdausi, 2014; Aksela & Bodtrom, 2012; Cheung, 2007), discovery (guided-inquiry) learning (Gaddis & Schoffstall, 2007), problem-based learning (Mohammed, 2015; Yuniar & Widodo, 2014; Tan & Arshad, 2014; 2013; Tosun & Taskesenligil, 2012; Domin, 2007; Donnell, O'Connor & Seery, 2007; Wang, 2005), project-based learning (Wheeler & Maeng, 2015; Guo & Yang, 2012), web-based learning (Mohammadi & Abrizah & Nazari, 2015; Frederick, 2014; Mustapa, 2014; Zhou et al., 2012) and etc.

However, each of these models of teaching and learning does has its weaknesses. For example, Copriady (2015) reported that expository learning is a conventional, teacher-structured approach, where each step of a procedure is vigilantly prescribed. Very often, this kind of laboratory activity is known as *'recipe lab'* (Domin, 1999), whereby students unable to think creatively (Copriady, 2015). Ellis and Allan (2010) have also commented that expository learning is a *'spoon-feeding'* approach. Whilst, Shiva & Mani (2014) claimed that traditional teaching models or *expository models* persisting into 21st century are no longer relevant. Tosun and Taskesenligil, (2012) claimed that problem-based learning could be perceived as an alternative to traditional method of education. In a similar study by Pullen *et al.* (2014), they commented that problem-based as a teaching method represents the opposite of an expository approach. Despite this, Wheeler and Maeng (2015) proposed that another method used to restructure traditional chemistry laboratories is project-based learning, in which it provides students the opportunity to work collaboratively and to actively engage in an authentic problem to gain scientific knowledge. Similar studies reported by Gua and Yang (2012) showing that project-based learning provides the greatest support for teachers and students.

Admittedly, various models of teaching and learning are in place to improve the quality of teaching and learning in practical work in school science in Malaysia. However, the question being addressed by this study was: *what are the chemistry teachers' views of models of teaching and learning in practical work?*

OBJECTIVES

To answer the research questions, the focus of this study was to gauge views of models of teaching and learning in practical work among chemistry teachers from urban and non-urban schools in the Southern West of Sabah, Malaysia.

METHODOLOGY

A qualitative descriptive research was employed in this study. According to Shields and Rangarajan (2013), a qualitative descriptive research is used to describe population or phenomenon being studied. The utmost goal is to improve practice. Such study design is seen useful to build an in-depth and contextualized understanding about complex issues in the social context (Yin, 2003).

RESEARCH SAMPLES

A total of 20 chemistry teachers from urban and non-urban national schools in the Southern West Coast Division of Sabah, Malaysia were participated in this study on a voluntary basis as shown in Table 1. These chemistry teachers were selected using purposive sampling technique. Their age were ranged from 30 to 48 years old. In details, 11 teachers aged 30-34, 5 teachers aged 35-39, 1 teacher aged 40-44 and 3 teachers aged 45-49. All of these teachers possessed at least a Bachelor's Degree in Education with option in Chemistry. The participants selected were expected to have literacy levels sufficient enough to understand questions and articulate their feedbacks. Other criterion for selecting the participants is they must also have at least one year experience in teaching chemistry.

RESEARCH INSTRUMENT

A semi-structured interview was conducted with each participant in this study. Each interview session took about approximately 45 minutes. A consent form was given to each participant. The interview instrument consists of a set of questions, which focused on chemistry teachers' views of models of teaching and learning in practical work. The instrument aims to elucidate chemistry teachers' views about two aspects of models of teaching and learning which include '*views on the definition of models of teaching and learning in practical work*', and '*views on the type of models of teaching and learning used in practical work*'. All interviews were audiotaped and transcribed. All transcripts were in English except three in Malay. The Malay transcripts were then translated into English. The English transcripts were sent back to all the participants to check the accuracy. The

transcripts were then coded for emerging themes as suggested (Strauss & Corbin, 1990) and the themes were then grouped based on the research questions. The following are examples of questions of the interview related to views of models of teaching and learning in practical work:

1. Do you know about models of teaching and learning in practical work? Can you explain briefly the definition of models of teaching and learning?
2. Have you heard of expository learning, inquiry-based learning, problem-based learning, project-based learning and web-based learning? What are the models of teaching and learning that you use in practical work?

DATA ANALYSIS

Data were analysed using content analysis. Content analysis is the procedure for categorization of verbal data for the purpose of classification, summarization and tabulation. The content can be analysed on two levels descriptive and interpretative.

FINDINGS AND DISCUSSIONS

In this section, chemistry teachers' views of models of teaching and learning in practical work will be discussed in detail. We illustrate our findings with interview extracts.

Views on the Definition of Models of Teaching and Learning in Practical Work

In this study, 20 chemistry teachers have been interviewed to gauge their views on the definition of models of teaching and learning in practical work. The results were shown in Figure 1. The findings revealed that only 40% of the teachers were able to give the definition on models of teaching and learning in practical work, whereas more than half (60%) of the teachers were unable to give definition on models of teaching and learning in practical work.

Among the 40% of the chemistry teachers (8 person) who able to give definition on models of teaching and learning in practical work, only 1 teacher (*Sim*) who able to give a more accurate definition, followed by 6 teachers (*Calicia, Erisiah, Lendah, Lydia, Mohamad* and *Pang*) who able to give moderate answers and 1 teacher (*Wilfred*) who able to give a simple definition. The first dialogue illustrate views on the definition of models of teaching and learning in practical work among these teachers.

Dialogue 1

Interviewer: *Do you know about models of teaching and learning in practical work? Can you explain briefly the definition of models of teaching and learning?*

Sim: *As far as I understand, it is a guidelines with underlying framework and theory which can assist teacher in both planning and guiding students to achieve the desired learning outcomes.*

Calicia: *A model whereby learning outcomes achieved.*

Erisiah: *Well, we can see the students engage with one another…*

Lendah: *An effective ways to have students experience hands-on activities…*

Lydia: *I think it is ways to create students' curiosity and interest towards practical work…*

Mohamad: *A teaching method where there is involvement of the students and able to enhance learning…*

Pang: *A method to enhance students' higher order thinking …*

Wilfred: *A framework which emphasis on the students' scientific skills…*

In this situation, Sim defined models of teaching and learning in practical work as *'a guidelines with underlying framework and theory which can assist teacher in both planning and guiding students to achieve the desired learning outcomes'*. Meanwhile, Calicia, Erisiah, Lendah, Lydia, Mohamad and Pang expressed their views that models of teaching and learning in practical work refers to *'ways to engage students'*. In addition, Wilfred defined model of teaching and learning in practical work as *'a framework which emphasis on the students' scientific skills'*. These findings correspond with previous studies showing that a model of teaching and learning is a "pattern or plan which can be used to shape a curriculum or course, or select instructional materials and to guide a teacher's actions" (Joyce, Weil & Calhoun, 2014). The second dialogue describes the situation of the 60% chemistry teachers (12 person) who were not able to define models of teaching and learning in practical work.

Dialogue 2

Interviewer: *Do you know about models of teaching and learning in practical work? Can you explain briefly the definition of models of teaching and learning?*

Barbara: *I don't know… no idea about it…*

Christina: *Ahem… frankly speaking… I don't know…*

Chua: *Can't remember… it's too long time after I heard from it last time …*

Faiyani: *Heard of it before… but never bother about it…*

Jamu: *I've forget… just follow the text book to teach…*

Khairulza: *Previously not teaching chemistry, this year only ask back to teach... Can't remember what the definition of models is…*

Nack: *I can't really remember what models of teaching and learning are in practical work... I just follow chemistry practical book…*

Norhafiza: *Don't know… cause never use it…*

Rosna: *Never use it before… really don't know what it means…*

Sharleen: *I don't know the definition of models of teaching and learning in practical work…*

Siti: *No idea … no information about it…*

Tan: *I don't use model, so can't remember what it means…*

In this situation, 7 chemistry teachers (*Barbara, Christina, Faiyani, Norhafiza, Rosna, Sharleen* and *Siti*) expressed that they do not have knowledge about models of teaching and learning in practical work. However, after re-assured their background, these teachers were in the age group (30-34), with teaching experience in chemistry, and all of them possessed at least a Bachelor's Degree in Education with option in Chemistry. With this criteria, these teachers should have enough knowledge about models of teaching and learning in practical work especially those who are teaching chemistry. If this situation continued to happen, it will cause worries especially in promoting effective chemistry teaching. These results relate to the work of Etiubon and Benson (2014), who identified teacher qualification and experience as determinants of quality chemistry education.

Meanwhile, 5 teachers (*Chua, Jamu, Khairulza, Nack* and *Tan*) expressed that they have forgotten the definition on models of teaching and learning in practical work. Chua, Jamu, Nack and Tan who have been teaching for more than 10 years indicated that they do not remember the definition of models of teaching and learning whereas Khairulza indicated that she has not been teaching chemistry after a long period and only last year was asked to teach chemistry. These findings correspond with previous studies showing teaching experience is the determinant of effective chemistry teaching (Etiubon & Benson, 2014).

Views on the Type of Models of Teaching and Learning Used in Practical Work

Although working under centralized curriculum, the 20 chemistry teachers used different models of teaching and learning to teach practical work in the laboratory. The results obtained were shown in Figure 2.

Based on the findings, majority of the chemistry teachers were still using expository or *'recipe-style'* learning (43.3%), followed by inquiry-based learning (26.7%), project-based learning (16.7%), problem-based learning (10.0%) and web-based learning (1%) as shown in Figure 2. The third dialogue describes the chemistry teachers' views on the type of models of teaching and learning used in practical work.

Dialogue 3

Interviewer: *Have you heard of expository learning, inquiry-based learning, problem-based learning, project-based learning and web-based learning? What are the model(s) of teaching and learning you use in practical work? Why?*

Barbara: *No... But, I usually followed the procedures given in the practical book… I guess I am using expository learning… moreover, most of my students are not the good students…*

Calicia: *Yeah… I've heard of these models… I use mainly inquiry-based learning… but sometimes I also use problem-based and project-based learning… to enhance students' high order thinking…*

Christina: *Seldom heard of these models… I just follow practical manual during my practical lesson… weak students mostly…*

Chua: *Nope… just follow teacher's manual during practical work and based on my own experience…*

Erisiah: *Yeah… I used inquiry-based learning most of the time… students will ask more questions… sometimes I also use project-based learning… give projects to my students… to promote high order thinking skills among the students… create curiosity…*

Faiyani: *Heard of it before… but use practical book only… not many outstanding students…*

Jamu: *Nope… just follow practical book and reference book… my students are very weak…*

Khairulza: *Rarely… often use expository learning…. follow instructions in the practical book…*

Lendah: *Yes… I often use inquiry-based learning in my teaching because it leads to important outcomes in practical class… quite good…*

Lydia: *Yeah... most of the time will use inquiry-based learning… sometimes will ask my students to do projects…*

Mohamad: *Yeah… heard before… but I use inquiry-based learning in my practical class…*

Nack: *No… just follow text book and practical book… low level students, can't do much…*

Norhafiza: *No… usually I will tell my student the outcomes of the experiments before they conduct any experiments…*

Pang: *Yes… I usually will mix inquiry-based learning, problem-based learning and project-based learning in my teaching…*

Rosna: *No… just follow text book and practical manual… very weak some of my students…*

Sharleen: *Nope… just follow teacher's manual when asking my students to do experiments…*

Sim: *Yes... to me I use all these models… but it depends on the level of students... for weak students, I need to use expository learning… for good students, I will use inquiry-based, problem-based and project-based… and for high level students, I will use web-based learning… because it is the most powerful tool to enhance students' high order thinking skills… especially in smart school with information and technology system...*

Siti: *No…. just follow text book and practical book…*

Tan Kim: *Nope… I just follow teacher's manual…*

Wilfred: *Yes… inquiry-based learning… students will participate actively and more creative…*

In this situation, most chemistry teachers choose expository learning because the teachers perceive that their students are not good students and not able to conduct any experiments if the learning outcomes were not predetermined. Meanwhile, teachers who choose inquiry-based learning emphasized that inquiry-based learning can lead to important outcomes in the practical class. Similar studies were reported in the literature (Firdausi, 2014; Sim & Mohammad, 2014, 2013; Aksela, 2012; Cheung, 2007), in which they emphasized on the importance of implementing inquiry-learning in chemistry laboratory. By implementing inquiry-based learning, students will actively make observations, collect, analyze, and synthesize information, and draw conclusions as well as developing useful problem-solving skills.

Although project-based and problem-based learning only comprised of 16.7% and 10.0%, respectively, findings indicated that these teachers tend to adopt a more advance models of teaching and learning in practical work. From the analysis of background of these teachers, some of them were master teachers in chemistry, and they indicated that by using project-based and problem-based learning, students' higher order thinking and problem solving skills will be enhanced. Similar studies were also reported in the literature (Mohammed, 2015; Yuniar & Widodo, 2015; Tan & Mohammad, 2014, 2013; Tosun & Taskesenligil, 2012; Donnell, O'Connor & Seery, 2007; Domin, 2007; Wang, 2005). Last but not least, only 1 teacher (3.3%) used web-learning as a model of teaching and learning in practical work. He expressed that web-learning is a useful method to enhance high order thinking especially for those experiments that were not able to be conducted in the laboratories. Similar studies were reported in the literature (Mohammadi, Abrizah & Nazari, 2015; Mustapa, 2014; Frederick, 2014; Zhou et al., 2012).

CONCLUSION

Clearly, many chemistry teachers from urban and non-urban schools in the Southern West Coast of Sabah, Malaysia unable to define models of teaching and learning in practical work. Moreover, some teachers claimed that they do not have knowledge about models of teaching and learning in practical work, in which indirectly gave an impression that our teachers' quality were very low and this situation really worry if it happened continuously. Nevertheless, more than half of the chemistry teachers were still practicing traditional models of teaching and learning in practical work such as expository (*'receipt-style'*) learning, in which students' high order thinking skills will be inhibited to enhance.

Hence, this study contributes to the existing literature on educational models of teaching and learning for laboratory instructions. Therefore, to achieve Vision 2020, Malaysia needs an education reform by considering the educational challenges in 21st century with the rapid social, economic and technological changes in the world. In particular, Malaysia should establish a great model of teaching and learning

in practical work that are needed to meet the educational challenges of the future, as well as seize new opportunities such as offered by information and communication technology (ICT). The research findings will provide ideas and practical guidance for both teachers new to teaching and for experienced teachers who wish to rethink or reinvigorate their approach.

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ANNEXURE A

TABLE 1: PARTICIPANTS' AGE, SCHOOLS AND EXPERIENCE IN TEACHING CHEMISTRY

Participant (pseudonym)	*Age*	*School*	*Experience in Teaching Chemistry (years)*
1 (Barbara)	30	Non-urban	6
2 (Calicia)	34	Urban	11
3 (Christina)	31	Urban	7
4 (Chua)	35	Urban	12
5 (Erisiah)	38	Urban	9
6 (Faiyani)	30	Urban	6
7 (Jamu)	40	Non-urban	16
8 (Khairulza)	35	Non-urban	3
9 (Lendah)	46	Non-urban	14
10 (Lydia)	30	Non-urban	3
11 (Mohamad)	30	Non-urban	5
12 (Nack)	35	Non-urban	11
13 (Norhafiza)	31	Urban	7
14 (Pang)	39	Urban	15
15 (Rosna)	32	Non-urban	10
16 (Sharleen)	31	Non-urban	2
17 (Sim)	30	Urban	4
18 (Siti)	30	Urban	7
19 (Tan Kim)	48	Non-urban	20
20 (Wilfred)	46	Urban	18

ANNEXURE B

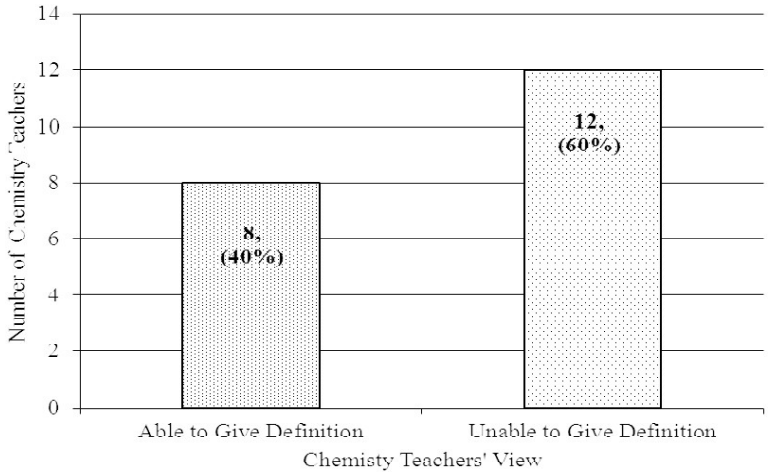

Figure 1: Chemistry teachers' views on the definition of models of teaching and learning in practical work

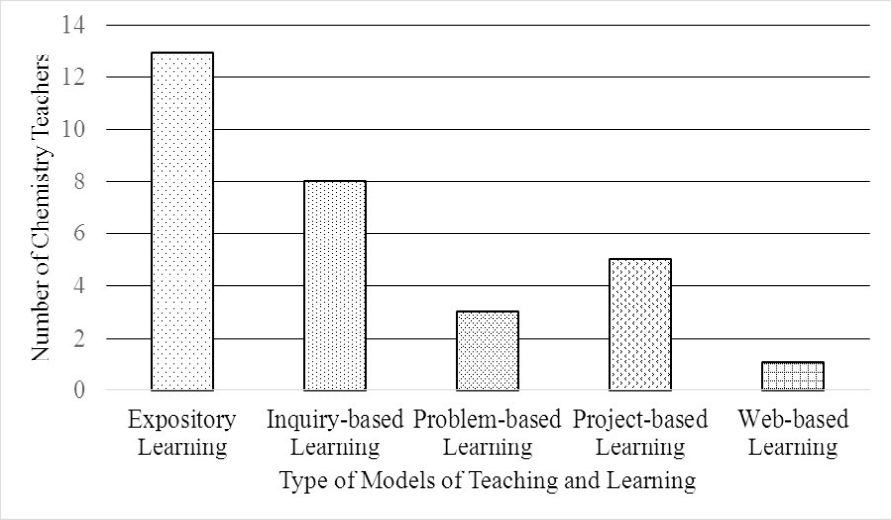

Figure 2: Chemistry teachers' views on the type of models of teaching and learning used in practical work