

Chapter 46

Science Teachers' Continuous Professional Development: A Preliminary Finding

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Abstract Numerous studies on science teachers' professional development status reported that despite having attended the required centralized courses and in-house trainings, there are those who still struggle to plan for and implement appropriate, well-structured lessons. This study has been carried out to identify aspects relating to instructional practices that science teachers are still lacking in, to investigate the nature of training that they have attended as well as the ones they would like to go for; and to unearth issues surrounding their training for professional growth. Twenty science teachers with less than 5 years of service were involved in this study. Data were obtained through qualitative means via interviews and document analysis. The findings revealed aspects that the science teachers had trouble in are associated with instructional strategies, content knowledge, understanding of learners, assessment and creativity in class. The teachers also raised concerns about the nature of existing and future trainings for the development of effective science teachers; on which recommendations are put forward and a possible professional development framework could be expounded.

Keywords Science teacher • Teacher training • Continuous professional development

46.1 Introduction

The philosophy of teacher education in Malaysia which was formulated in 1982 determines the direction of teacher training emphasizing in the desire to educate and produce teachers who are noble and caring, knowledgeable and skilful, creative and innovative, resilient and competent, scientific in outlook, committed to upholding

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the aspirations of the nation, proud of their heritage and dedicated to the development of the individual and preservation of a united, progressive, and disciplined society (Hazri et al. 2011). The Ministry of Education has also accentuated that one of its policies is to heighten the teaching profession by elevating the quality in teaching, promoting the profession as a career choice, with an uplift in teacher welfare (MOE 2013).

With the aspirations of shifting gears towards knowledge-based economy (K-economy) and sustainable development, Malaysia needs to invest in the development of human capital. Essentially, teachers may play their roles effectively as part in developing human capital for the nation through teaching and learning. For positive results, teachers must be provided with quality training programs that allow for continuous professional development (CPD) to prepare them for critical tasks. Concurrently, teachers must be given the opportunities to attend courses, seminars, and colloquiums to gradually develop their knowledge and skills. Such provisions may help improve the teachers' ability as instructors, improve their skills in classroom management and school or community events. Nevertheless, teachers also need to re-visit their personal educational philosophy; become aware of more recent learning theories, nature of student assessment with educational policies, and enhance various personal skills relating to technology use; also enhance their inter and intrapersonal communication.

As the core business of teachers is teaching, they are expected to possess high intellectual in content, pedagogical and communication abilities to provide quality learning environment via students' engagement and self regulation in learning. Nonetheless, such expectation can lead to stress, especially for beginning teachers who may lack the experience and skills in conducting lessons (Kyriacou and Stephen 1999). To improve the quality of their teaching teachers would attend various CPD programs carried out either either within or outside the school. In the effort of emphasizing the importance of attending trainings for enrichment and teacher professionalism, a certain number of training hours have been included as part of evaluation criteria for teachers' annual appraisal. Despite the availability of trainings there are teachers who are still not ready to deal with classroom challenges. A review of past studies on pedagogical issues and training of teachers suggests that educators across the profession are recognizing the importance of enhancing training and its practical elements (Clift and Brady 2005). Irrespective of the kinds of trainings that teachers had, Oh et al. (2005) believed that trainings should result in higher confidence for teachers to improve lessons, set alight teachers' satisfaction in their teaching career, and improve teachers' efficacy.

With emphasis in training, this study aims to unravel science teachers' continuous professionalism development in schools based on aspects relating to instructional practices, nature of internal and external trainings being conducted, and issues on training for professional growth as science teachers.

Specifically, this study is conducted to fulfil the following objectives:

- (i) to identify aspects relating to instructional practices that science teachers are still lacking;

- (ii) to investigate the nature of training that they have attended as well as the ones they would like to go for,
- (iii) to disclose issues surrounding their trainings for professional growth.

Based on the objectives stated, thus this study intended to answer the following research questions;

- (i) What are the aspects relating to instructional practices that science teachers are still lacking?
- (ii) What are the nature of training that being conducted for the science teachers?
- (iii) What are the types of training that the science teachers prefer to attend?
- (iv) What are the issues on training for professional growth that the science teachers faced?

It is important for the researchers to recognize the problems, dilemmas, triumphs and opportunities weathered upon science teachers in schools so that appropriate strategies could be formulated to address and further enhance the qualities of teachers. The researchers also will examine the teacher readiness to teach science in schools and its influence based on their knowledge and experiences.

46.2 Review of Related Literature

Training on instructional practices is one of the most crucial aspects for the development of teacher professionalism in schools. It is generally believed that knowledge and skills to teach can be learned through training and practical application (Collins 1989). Teacher trainings provide the opportunities for teachers to put the theories they learnt into practice. Lock (1977) suggested that the challenges faced by teachers should be considered as they are able to provide information for the improvement of teacher professionalism while simultaneously diminishing encountered challenges. Briggs and Richardson (1992) cautioned that the various problems faced by teachers, especially on instructional practices may be signs of future conflicts. Similarly, Chan and Leung (1998) advocated that it was necessary to focus on the concerns expressed by teachers.

46.2.1 Challenges in Teaching

In a study carried out on the challenges faced by teachers and how these challenges might have affected various aspects in teacher education revealed that the gravities they experienced during instructional practices prevented the teachers from engaging positively in theory and practice (Ong et al. 2004). Although the teaching processes bridge the teachers with the experience to develop personal competence and professional identity as teachers (Dobbins 1996), the teaching experience was also

fraught with difficulties and concerns which might have influenced the development of teachers professionalism especially among novice teachers. Schön's (1983) has drawn the argument that in the teaching profession, the theoretical facets are embedded in and inseparable from practice. Using Schon's idea, the actual teaching would probably be the best form of training as highlighted in the old proverb that "experience is the best teacher".

During teaching, novice teachers experience a learning situation that are different from the way they learnt in universities. Instead of having friends as audiences during microteaching, they have to confront real students with varying personalities, habits, attitudes, abilities and styles. They will no longer be confronted with make-belief teaching and learning issues; and some of the classroom realities can actually make or break them. Hence, the novice teachers must be courageous and willing to explore and acquire new knowledge and skills related to teaching; they too must understand the psychology of learners if they are to capture and stimulate students' interest to learn. It is through the activities of integrating content knowledge, understanding about teaching and good grasp about learners that shape novice teachers into professionals who are knowledgeable with respect to the content of the subject (Shulman 1987).

However, different issues has been brought up by Aldrich (1990) and Pushkin (2001) who claimed that novice teachers generally do not know how to teach (Siti Zohara Yassin 2005). The claim was supported by Darling-Hammond (2006) who agreed that novice teachers are still fresh and are being influenced by their school and college experiences. In terms of their ability to teach, many scholars found that the newbies do not have content-knowledge and they did not know the appropriate teaching method for their students (Darling- Hammond 2006). Being inexperienced, these teachers were also found to have adjustment issues in schools.

Another aspect that the novice teachers have to deal with is their self-awareness, namely the formation of a new social identity or a "new persona as teachers" (Polio and Wilson-Duffy 1998). Ishihara (2005) highlighted that while teaching in the classroom, there are many other concerns that has been raised on novice teachers, such as language proficiency and self-esteem as well as cultural knowledge of the content matter (Polio and Wilson-Duffy 1998). Hanipah (2004) finds that teachers seldom question their assumptions and the beliefs they developed in teaching. Ong et al.'s (2004) study however, discovered many positive aspects of teaching practice. It also highlighted – too a very disturbing trend – that almost 55 % of the novice teachers discovered their teaching practice failed to provide opportunities for them to engage in theory and practice due to overwhelming realities of actual classrooms. Ong et al. (2004) also identified some challenges that burdened the novice teachers – environment, workload, pedagogical knowledge and content knowledge – but never probes into the strategies adopted by the teachers to overcome those challenges, implying perhaps the teachers were never given the chance to reflect upon the strategies that they drew upon to confront those challenges.

When dealing with science subjects, it is known that subjects like Physics, Chemistry, Biology or even general Sciences are among difficult subjects to be taught and learned. This in turn creates a huge challenge for science teachers.

Hence, the use of appropriate teaching approach during science lesson is crucial. To have well-structured lessons for quality teaching in classrooms and to keep up with current educational demands, continuous training on instructional practice must be adequately provided. Melor et al. (2010) stated that among the main challenges faced by novice science teachers include addressing cultural differences, relating science theory to its applications, selecting appropriate teaching methodology or strategy to teach a specific science topic, and classroom management. Additionally, some novice science teachers might encounter challenges in dealing with the needs of unmotivated learners and learners with different levels of achievement (Kyriacou and Stephens 1999; Swennen et al. 2004; Mehmet 2008).

46.2.2 Readiness to Teach

“Practice makes perfect” is a quotation that can be used to stress on the importance of preparation towards perfection in teaching. Perfect teaching can lead teachers to become very effective in their teaching. Shulman (1987) suggests that certain knowledge is necessary for the teachers to become an effective teacher. Besides content knowledge, teachers are also required to have not only pedagogical knowledge, but also pedagogical content knowledge. To become effective teachers, they must be proficient in aspects which are further discussed in the next section.

46.2.2.1 General Pedagogical Knowledge and Beliefs

According to Borko and Putnam (1996), this domain includes knowledge and beliefs about classroom management, instructional strategies and learners that transcend particular subject matter domains. Knowledge of classroom management has been described as an important element in this domain. For example, teachers should possess knowledge on how to keep a number of pupils working together and oriented toward classroom tasks. A conception of classroom management that is in line with a cognitive psychology offered by Doyle (1986) suggests that the major tasks of classroom teaching are promoting order and learning.

The task of promoting order is mainly for the purpose of establishing and maintaining an environment that promote learning. Thus, Borko and Putnam (1996) stressed that to accomplish a given task, teachers must have strategies for establishing rules and procedures, organizing groups, monitoring and pacing classroom events, and reacting to misbehaviour. Apart from knowledge of classroom management, Borko and Putnam (1996) also explained that teachers need knowledge of how to structure classroom activities, as well as repertoires of strategies and routines for interacting with pupils, for ensuring pupils' participation and engagement, and for keeping lessons running smoothly. Besides that, Kennedy (1990) mentioned that teachers who are fluent in a subject are distinguished from others in at least three respects: they know a great deal of specific content, that is facts and ideas; they

have formed a variety of complete relationships among pieces of content; and they understand how to approach new problems or dilemmas and how to produce new ideas within the subject. On that note, a number of local studies reviewed found that novice science teachers in Malaysia are generally deficient in pedagogical knowledge and the skills in preparing effective lessons (Nabilah and Nurshamsida 2011).

46.2.2.2 Subject Matter Knowledge and Beliefs

In addition to general pedagogical knowledge and beliefs, effective teaching for understanding also requires flexible, thoughtful, conceptual understanding of subject matter (Borko and Putnam 1996). Because subject matter knowledge means different things to different people, it is important to determine exactly what is meant by subject knowledge (Turner-Bisset 2001). Borko and Putnam (1996) also noted that several important distinctions within knowledge of subject matter have been made by researchers studying teachers' knowledge and learning. Shulman (1986) outlined the original division of content knowledge into three categories: subject matter, content knowledge (the knowledge of a subject), pedagogical content knowledge (teaching knowledge of subject matter), and curricular knowledge.

46.2.2.3 Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) constructs have served as an important catalyst for considering the ways in which teachers need to think about the subjects they teach (Borko and Putnam 1996). Shulman (1986, 1987) conceptualized pedagogical content knowledge as a combination of subject matter knowledge and general pedagogical knowledge. He emphasized that pedagogical content knowledge goes beyond knowledge of subject matter in the dimension of subject matter knowledge for teaching. Shulman (1986) explained that pedagogical content knowledge includes;

“The most useful forms of representation, the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject to make it comprehensible to others... It also includes an understanding of what makes the learning of a specific topic easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons.” (p.9)

Shulman (1987) further explained that pedagogical content knowledge identifies the distinctive bodies of knowledge for teaching. For Shulman, teaching must begin with a teacher's understanding of what is to be learned and how it is to be taught. He goes on to explain that teachers must have an understanding of how particular topics, problems, or issues need to be organised, represented, and adapted to different interests and abilities of learners. Meanwhile, Carter (1990) used the term pedagogical content knowledge to mean what teachers know about their subject matter

and how they translate that knowledge into classroom curricular events. This explanation shows that pedagogical content knowledge represents a class of knowledge that is central to teachers' work, that differentiates expert teachers in a subject area from other subject area experts (Cochran et al. 1993; Marks 1990), and seemingly important for teaching (Rovegno 1992).

In their extensive review on teachers' knowledge and beliefs, Borko and Putnam (1996) organized pedagogical content knowledge into four categories which are: overarching conception of teaching a subject, instructional strategies and representations; students' understanding; thinking and learning in a subject; and, curriculum and curricular materials. Borko and Putnam argued that teachers' overarching conceptions of teaching a subject can limit their efforts to learn to teach in new ways and can be resistant to change. They also claimed that teachers have limited knowledge of subject specific instructional strategies and representations, and of the understanding and thinking of their students about particular subject matter content. In similar vein, Bullough (1992), Rovegno (1992), Borko et al. (1988), and Veal (2004) found that novice teachers have a relative lack of pedagogical content knowledge. Because novice teachers have limited notion of how children learn specific content, of what children find difficult or exciting, and of common misconceptions children hold, they encounter difficulties in representing content appropriately for helping pupils learn (Rovegna 1992). These findings suggest that teachers, particularly beginners, need assistance in developing PCK because limited PCK does affect lesson planning and teaching.

46.2.2.4 The Nature of Pedagogical Content Knowledge

In addition to teachers' subject matter (content) knowledge and their general knowledge of instructional methods (pedagogical knowledge), pedagogical content knowledge was originally suggested as a third major component of teaching expertise by Shulman (1986, 1987), and his colleagues and students (e.g. Carlsen 1987; Grossman et al. 1989; Gudmundsdottir 1987a, b; Mark 1990). Ashton (1990) described pedagogical content knowledge as a type of knowledge that is unique to teachers, and is based on the manner in which teachers relate their pedagogical knowledge (what they know about teaching) to their subject matter knowledge (what they know about what they teach). It is the integration or the synthesis of teachers' pedagogical knowledge and their subject matter knowledge that comprises pedagogical content knowledge. According to Shulman (1986) pedagogical content knowledge:

"... embodies the aspects of content most germane to its teachability. Within the category of pedagogical content knowledge I include, for the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others . . . [It] also includes an understanding of what makes the learning of specific concepts easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning." (p. 9)

Hauslein et al. (1992) compared the organization of subject matter knowledge between groups of experienced science teachers, experienced research scientists, novice science teachers, subject area science majors, and preservice science teachers. They found both science majors and preservice teachers demonstrated similar, loosely organized subject matter knowledge; and that the subject matter knowledge of the novice, experienced teachers and the research scientists were much deeper and more complex. However, compared to the researchers (who showed a flexible subject matter structure), the teachers showed a more fixed structure, hypothesized to result from curriculum constraints. Cochran et al. (1993) revised Shulman's original model to be more consistent with the constructivist perspective on teaching and learning. They described a model of pedagogical content knowledge that results from an integration of four major components, two of which are subject matter knowledge and pedagogical knowledge. The other two other components of teacher knowledge also differentiate teachers from subject matter experts.

46.3 Methodology

This study employed a qualitative approach whereby data were gathered mainly through interviews and supported by document analysis. A qualitative research is deemed appropriate as the researchers need to acquire rich data and information to answer the outlined objectives. A set of guidelines on what to ask the respondents was prepared prior to the interviews. The study used a purposive sampling. The target population was novice science teachers in a secondary school who has served less than 5 years around the state of Selangor. Twenty science teachers agreed to participate. All interviews were tape recorded and transcribed for analysis according to specific themes that correspond to the objectives of the study.

46.4 Findings

The discussion on findings focuses on the following; (a) aspects relating to instructional practices that the novice science teachers lack; (b) the nature of existing continuous professional development programs they attended and (c) the science teachers' view of future training for continuous professional development.

With regards to instructional practices, it was found that the research participants have problems choosing appropriate teaching strategies to teach certain science topics. Lack of experience appears to be one of the main reasons cited. Although the novice teachers are familiar with various teaching approaches, strategies and techniques, they are clearly grappling, exploring and learning which methods would work best during the teaching and learning process, as indicated in the following excerpts:

"... I'm afraid that the methodology chosen is not really suitable to implement with those students... time constraint if used other method during teaching and learning process."
Teacher 11

"I try to use different style of teaching technique, but sometimes it's hard to find the suitable teaching styles to the students..." Teacher 15

While some teachers are unsure of which teaching method to use, there are those with inferior content knowledge. This situation poses great challenges as indicated by the three teachers below:

"...my major is chemistry but I'm not master enough chemistry concept. Sometimes, I cannot explain it well to students. I also teach general science, since the topic for science subject mostly from biology subject, therefore I had problem to master the topics first before teaching students..." Teacher 5

"... my major is biology but I have difficulty in delivering the biology lesson in the simplest way. ...some how I feel my knowledge is limited which I need to study and do extra reading to make sure I really understand the topic that I'm going to teach..." Teacher 8

"... I think I need to improve my content. Sometimes, I lost while teaching and cannot elaborate more on a certain concept..." Teacher 1

Specifically, the novice teachers will be challenged when teaching high achieving students who tend to be knowledgeable or those who have learnt the subject prior to the classroom session. Teachers with inferior content knowledge often find it difficult to respond to students' questions, to elaborate and explain concepts, and to give good examples. Also, they may neither know how to gauge students' understanding nor develop good test items to assess students' learning. Sub-standard content knowledge are also common among non-option teachers having to teach general science subject matter.

With respect to classroom management, the research participants had problems understanding learners, managing misbehaviours and dealing with their attitude. In Malaysian classrooms, the average number of students is 30 to 40 per classroom. For the novice teacher, handling one problematic student may be difficult enough; bigger class size poses greater challenges hence problems. Below are some of the novice teachers' views relating to classroom management:

"...understanding students is important in order to to make sure the teaching and learning process were goes smoothly and effectively. ...sometimes I also unable to control the class, especially during lab session..." Teacher 1

"...in the last class, sometimes I feel difficult to control the classroom..." Teacher 3

"... ask students to form group is really difficult, they tends to form groups with their friends. ...if I being stricto them, they will be rebellious, refuse to learn and I can feel negative aura from the students..." Teacher 18

Interview data also reveals that the novice teachers are neither well versed with assessment of, nor for students' learning. Knowledge on assessment is important because most often, assessment drives teaching. Among more senior teachers, the way teaching is carried out is very much dependent on how their students will be assessed. The research participants admitted to having used tests constructed by senior teachers instead of developing their own.

"Mostly is used my senior colleagues assessment to give to my students... not creative enough to plan a variety teaching methods and assessment..." Teacher 7

"I follow the way of experience teacher in my school teach in the class, and I also used most of the assessment from her..." Teacher 17

The above responses also suggest other possible traits of the novice teachers. Not putting effort to create own assessment may be the result of being lazy, lack of creativity or neither having enough time nor the drive to explore and plan for better teaching and assessment of students as implied in the excerpts below:

“...I think I've been using the same pedagogy and teaching methods. I've forgotten all the methods that I've learned. Maybe I'm not creative enough...” Teacher 20

“...hard to attract students to be able active in learning and focus in class during my explanation” Teacher 1

“... sometimes, I have problem to motivate my students...” Teacher 4

All teachers – novice teachers included – are required to attend Continuous Professional Development (CPD) programs. The main goal of CPD practices is to enhance teacher quality, to promote teacher professionalism (Greene et al. 2012; Lilia Halim and Subahan 2002) and to improve on the implementation of school curriculum. However, to answer the second research objective, data revealed that existing CPD practices failed to meet the professional development needs and training expectations of the novice science teachers. To begin with, most of the participants are in unison that their CPD courses were held at venues that are not conducive.

“...The program has involved teachers in all Malaysia, so, the venue being choose not suitable because not big enough. This makes the place is crowded and then, the concept of the program is talk, therefore I cannot focus and hear well because the crowded audience...” Teacher 2

“Before this I went to CPD courses in hotel, it's really comfortable to learn. Last year, I went to program in IPG hall, its really uncomfortable because crowded, due to the number of teachers attend increases and the place do not facilitate well...” Teacher 20

“...time constraint and venue affect my learning process in CPD courses.” Teacher 18

The boring manner in which training was conducted – partly contributed by unsuitable venues – also leads to dissatisfaction among the teachers, resulting in their lack of focus and unwillingness to listen.

“...The talk concept of the program, cannot focus because one way learning process, this due to a long time to listen to the talk...” Teacher 6

“To me also the program should be varied rather than talk only, for example the course can teach, teacher how to conduct the experiment in class and all the participant should do the experiment by themselves.” Teacher 18

A number of research participants also lamented the ineffectiveness of the cascade training model used by the Ministry of Education to enhance skills and knowledge among teachers:

“...most of the CPD program I had is only at school, which is in-house training. Which all the instructors are experienced teachers at my school who went to the centralized CPD programs and later share their knowledge” Teacher 7

“...I do not go a lot of CPD courses, because mostly all the expert teacher will go to CPD courses. I just had in-house sharing with them,... for one hour per session...” Teacher 9

Finally, most of the novice teachers also highlighted that core courses on improving teaching and learning are often sidelined to give room for introduction and

familiarization to new government policies; hence, they do not quite benefit from efforts to help improve the quality of teachers and teaching.

"...Most of CPD programmes just to give guideline about the new curriculum be implemented ... like the SBA, I-THINK and KBAT. But mostly... attended by expert teacher..."
Teacher 14

"Most of the CPD course that I attend is good and helpful in certain aspect only, especially for implementing new systems like SBA and Frog VLE, but for teaching and learning process in the class still lack." Teacher 15

Having specialized programs and courses that will help novice science teachers to improve on their generic pedagogical knowledge and skills; knowledge and skills in Science subjects; planning, managing and delivering science instruction; and diagnosing and evaluating students are partly what all science teachers must learn and acquire to be effective (Kamisah Osman et al. 2006). The following quotations extracted from the interview transcripts highlighted the novice teachers' needs and concerns about present and future CPD courses.

"...I think the courses should be a two way communication ...focus on the subject s/he teaches...to avoid overcrowding and to allow for more discussion...courses also need to be hands-on [for teachers to] directly implement the skills..." Teacher 8

"Before this I attend the short course on the state level for my subject, this short course is attended by all the teachers in this subject and we share and discuss about the best technique and method to teach the subject. All the experienced teacher also shares about technique for making paper. But the program was now being stopped because do not have funding..." Teacher 3

"...Instructor [of] the CPD courses... sometimes I feel [is of] the same level with me... also lack of experience but try to teach in class..." Teacher 13

In short, most of the novice teacher in this study coveted for CPD courses that address their weaknesses; hands-on and practical; that would benefit many while develop their professionalism. The novice teachers also point up that novice teachers should also be given equal opportunity to attend CPD courses which would address not only their weaknesses but also improve their practical skills, and uplift their professionalism. These teachers also emphasized that instructors of CPD courses should be those who have established credibility to conduct such courses.

46.5 Conclusion

From the study, teachers with less than 5 years experience need to improve their instructional practices to attain quality teaching that will result in enhanced students' learning. Improvement via attending CPD programs will also prevent them from being professionally stagnant at the same level over an extended period. Instructional-related aspects identified as requiring immediate attention and enhancement include (i) instructional strategies; (ii) poor content knowledge; (iii) understanding learners; (iv) assessment matters; and (v) being creative in class. Efforts to provide sound CPD programs nevertheless should be better than the ones currently offered or practiced; taking into account the actual needs of the novice

science teachers. Reconditioning of identified areas may improve CPD courses to be more structured and engaging. Other considerations in the implementation of CPD courses should include provisions of appropriate venue, appropriate duration, number of participants; scope of the course; credible instructors, and delivery mode. If Malaysia education is serious about improving teacher quality and the teaching quality in schools, it is only right that the suggestions put forward herein be given serious considerations.

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