An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia

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DECLARATION

I, Yousef Alhaggass, declare that the PhD thesis entitled, 'An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia' is no more than 100,000 words in length, including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

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29-06-2015

ABSTRACT

This thesis addressed the issue of professional learning activities for teachers as an important factor that may affect students' achievement in physics. It is recognised that it is not the only one. Other factors that could influence students' achievements include availability and use of learning resources, classroom size and climate, family background characteristics, and students' attitudes toward physics. Professional development can play a vital role in helping teachers to improve their teaching skills, knowledge and competencies. However, research shows that many professional development programs have failed to improve teaching practice (Birman, Desimone, Porter & Garet, 2000; Newmann, King, & Youngs, 2001; Armour & Yelling, 2004; Hofman & Dijkstra, 2010). This is also the case in Saudi Arabia for physics teachers where there are many opportunities for training and professional development, but these are not being reflected in student achievement. As seen in the disparity of results, with Saudi Arabian students in secondary schools obtained a low mean score in physics compared with chemistry, biology and geology (Educational Information Centre, 2010). This lack of training effectiveness may occur due to: poor analysis of teacher training needs (Alnooijm, 2005; Abo Atwan, 2008); failing to provide teachers with appropriate content during training courses (Kildan, Ibret, Pektas, Aydinozu, Incikabi, & Recepoglu, 2013); or trainers' not being adequately skilled (Mansour, 2003; Al-Shehri, ٢٠٠٦). Such deficiencies reinforce that more effective approaches, such as Guskey's (2002) five levels of Continuing Professional Development (CPD) and Transformative Professional Development (TPD) (Johnson & Fargo, 2010), should be drawn upon to inform training approaches.

This situation has generated the need to evaluate the effectiveness of professional learning programs as a first step to identifying improved strategies for physics teachers, and ultimately contributing to improved outcomes for students. Consequently, the aim of this research is to examine the effectiveness of current professional learning being offered to physics teachers at intermediate and secondary schools in Saudi Arabia, and to identify effective contexts and approaches for them to learn professionally. The research was based in the city of *Onaizah*, Saudi Arabia involving 36 schools using mixed methods design across two separate studies.

The first study utilized a quantitative approach to examine the effectiveness of professional learning training programs. The provision and content of these programs designed for this study consisted of three modes of delivery: on-the-job training (based at the school), off-the-job training (based at a training centre) and combined training programs that combined both on- and off-the-job training programs. A survey was administered to 62 male teachers of physics at both intermediate school (13 years old, grade 7, 14 years old, grade 8 and 15 years old, grade 9 in the educational system of Saudi Arabia) and secondary schools (16 years old, grade 10, 17 years old, grade 11 and 18 years old, grade 12). This cohort included 41 teachers from 24 intermediate schools and 21 teachers from 12 secondary schools. To examine the effects of the three different modes of training on physics teachers' professional learning a Multivariate Analysis of Variance (ANOVA) was used. Chi-square analyses were also undertaken to examine the training preferences of participants prior to undertaking a professional development program.

The second study collected qualitative data to explore the themes revealed within the survey data in order to evaluate the effectiveness of physics teachers' professional learning in general. This study used semi-structured interviews with a selection of 14 education professionals recruited from the larger sample in study 1, including 6 teachers, 6 principals, one supervisor, and one trainer.

The pre-training quantitative surveys indicated that teachers had low expectations for training programs, with post training surveys indicating the teachers found training to be beneficial in the areas of planning physics classes, knowledge, teaching style, and students' practice management. In addition, no significant differences were found between the expectations of physics teachers and their experiences in the area of professional learning activities, location and venue or across the three different modes of training. The qualitative findings indicated that Saudi physics teachers are more likely to learn professionally and further develop their teaching performance when they are involved in training programs outside their schools rather than by participating in supervision activities inside their schools.

In conclusion, the study found that effective professional learning for physics teachers in the city of *Onaizah*, Saudi Arabia can occur when on-the-job training is complemented with off-the-job training, and both supervisor and trainer apply the elements of professional learning collaboratively. Different needs of teachers should be identified and classified into the three area of teachers' knowledge that are content knowledge (CK), pedagogical knowledge (PK) and pedagogical content knowledge (PCK), in order to develop the efficacy of the learning program. Furthermore, the skills of supervisors and trainers should be developed to strengthen collaboration of the different training modes with a focus on planning, implementing and evaluating in-service training activities.

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Alhaggass, Y. (2014). *Time impact on training effectiveness of physics teachers in Saudi Arabia*. Paper presented at the International Teacher Education Conference, Dubai, UAE.

Alhaggass, Y. (2014). *The in-service training needs analysis of physics teachers in Saudi Arabia*. Paper presented at the International Conference: New Perspectives in Science Education, Florence, Italy.

Alhaggass, Y. (2014). *The impact of physical environment on training effectiveness of physics teachers in Saudi Arabia*. Paper presented at the International Conference on Green Technology, Semarang, Indonesia.

Alhaggass, Y. (2015). *Effects of group size on the in-service training effectiveness of physics teachers in Saudi Arabia*. Paper presented at the International Conference for Academic Disciplines, Vienna, Austria.

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LIST OF ACRONYMS

AAAS	American Association for the Advancement of Science
ASTD	American Society for Training and Development
CK	Content Knowledge
CPD	Continuing Professional Development
EPLAQ 1	Expectation Professional Learning Activities Questionnaire
EPLAQ 2	Experience Professional Learning Activities Questionnaire
K–12	The sum of kindergarten (K) and the 1st through the 12th grade
ANOVA	Two-Way Mixed Design
NSTA	National Science Teachers Association
P	Principals
PCK	Pedagogical Content Knowledge
PD	Professional Development
PL	Professional Learning
PK	Pedagogical Knowledge
PLA	Professional Learning Activities
S&M	Science and Mathematics Centre
SD	Standard Deviation
SU	Supervisors
T	Teachers
TPD	Transformative Professional Development
TR	Trainer

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CHAPTER 1: INTRODUCTION

Statement of the problem

Teachers' professional development is a vital component of any educational system. Therefore, many regulations have been made in Saudi Arabia regarding this area. Although there are a large number of professional development activities for teachers, students' achievement in physics is not satisfactory according to the Department of Educational Supervision (2010). Ineffective teaching practices in physics is prevalent in schools and consequently, the desired outcomes of learning physics are not adequately achieved. This assessment of the teaching of physics is evident in the results achieved by students. For example, the students in secondary schools who complete the final examination in Grade 10 in the city of *Onaizah*, Saudi Arabia, obtained a low mean score in physics (70.39%) when compared to the average student scores in chemistry, biology and geology (87.95%, 82.71% and 84.82% respectively) (Educational Information Centre, 2010). This result has the potential to negatively impact on the academic achievement of students in the field of physics, when they move to the university. Focussing on this location required less time and expense for the researcher, who is working in *Onaizah* and has extensive knowledge and familiarity with the area as a resident of the city.

Students' achievements in physics can be influenced by a number of factors, such as classroom size and climate, family background characteristics, and students' attitudes toward physics. In addition, ineffective teaching practices in physics which is prevalent in schools, is one of these factors (Ganyaupfu, 2013). For instance, physics topics especially in intermediate schools are taught by non-specialist physics teachers. Because of the shortage of qualified physics teachers, specialists in any field of science, such as chemistry and botany, are often required to teach physics, which can lead to instructional complications (Al-Huthaifi, 2000). In addition, 25.4% of physics teachers in the city of *Onaizah* do not have formal educational training qualifications (Educational Information Centre, 2010) resulting in these teachers not having the required skills to teach the complex topics of physics with pedagogical integrity (Ganyaupfu, 2013). This situation has generated the need to evaluate the effectiveness of the current practices of professional development activities for physics teacher. The results of such an evaluation will be the first step in identifying improvement strategies for physics teachers that may positively contribute to improved outcomes for physics students.

Aims of the study

This study will explore the issue of professional development of physics teachers as a professional learning tool to meet their training needs and consequently assisting them to teach physics topics effectively. The principal approach adopted will involve reviewing the effectiveness of in-service training activities in the city of *Onaizah*, Saudi Arabia. The study will also consider the professional learning connection with the three areas of expected knowledge of physics teachers; content knowledge (CK), pedagogical knowledge (PK) and pedagogical content knowledge (PCK) (Shulman, 1986).

Research questions

This study has a primary research question supported by some sub-questions, which provide a guiding framework for the study and exploration of teacher professional development:

Primary question

The main research question to be examined in this study is:

What are the most effective formats for physics teachers in the city of *Onaizah*, Saudi Arabia to learn professionally?

Sub-questions

1. What are the expectations of physics teachers concerning the effectiveness of their on-the-job training, off-the-job training and combined training programs?
2. What are the reported experiences of physics teachers concerning the effectiveness of their on-the-job training, off-the- job training and combined training programs following training?
3. What similarities and differences exist between the expectations and experiences of physics teachers concerning the effectiveness of the different modes of their professional learning?
4. How do supervisors, trainers, principals and teachers evaluate the different modes of in-service training as a tool of professional learning of physics teachers?

Significance of the study and contribution to knowledge

Although a number of studies on the professional development practices of science teachers have been conducted in different countries (e.g., Asunta, 1997 in Finland; Mac, Yip & Chung, 1999 in Hong Kong; Johnson, 2006 in the central US; Boitshwarelo, 2009 in Botswana), there are few that focus explicitly on physics teaching (e.g., Eryilmaz & İlaslan, 1999; Lavonen, Jauhiainen, Koponen & Kurki-Suonio, 2004; Morge, Toczek & Chakroun, 2010; Jauhiainen, 2013). Furthermore, none of these investigations were implemented under conditions similar to the requirements of teaching physics in Saudi Arabia. Therefore, a study on the professional development practices of physics teachers in Saudi Arabian context is warranted.

The findings of this study could make a contribution toward the theoretical understanding of professional learning purposes. Resultant outcomes of the research could also provide the educational field with a clearer explanation of the effect of professional learning on physics teachers' practice and the potential impact on their students' learning. Moreover, the results of this study, will contribute to the improvement of the training strategies adopted in the area of the professional development of teachers of physics in Saudi Arabia in the short and longer term.

In the short term: The Directorate of Education in *Onaizah* city can use the results of this study to make a decision about assisting teachers of physics to teach more effectively by finding out:

- Which mode of in-service training (on or off-the-job training) is the more effective way for physics teachers to learn professionally?

- In order to most effectively direct funding and professional endeavour, which Department (Educational Training or Educational Supervision) should be given priority to manage professional development?

In the longer term: The Ministry of Education in Saudi Arabia could use the results of this study to make decisions regarding the organizational structure of professional development by determining if the:

- Department of Educational Training should cease to operate, be modified, or left unchanged?
- Department of Educational Supervision should cease to operate, be modified, or left unchanged?
- Department of Educational Training and the Department of Educational Supervision should be merged?
- Both departments (Educational Training and Educational Supervision) should be abandoned and a new department established?

In addition, the Ministry of Education can use the results of this study to develop new policy in the areas of teachers' professional development including:

- The mode of professional learning and the number of training programs teachers should attend
- Where and when the training programs should be implemented

Organisation of the thesis

The structure of this thesis is organized into seven chapters. Chapter one introduced the statement of the problem, the aims of the study, research questions, the significance of the study and contribution to knowledge in addition to the structure of the dissertation. In the second chapter, specific literature relevant to the study is reviewed. Physics pedagogy and professional learning in Saudi Arabia are described in the third chapter. Chapter four presents the quantitative study including sampling, measures, data collection procedures, data analysis and results. Chapter five presents the qualitative study including sampling, measures, data collection procedures, data analysis and results. A general discussion of the findings is presented in the sixth chapter outlining a proposed model for professional development of physics teachers in the city of *Onaizah*, Saudi Arabia. The last chapter brings the findings together connecting the discussion to a general understanding of professional development, and recommendations for the improvement of professional development in the city of *Onaizah* and Saudi Arabia in specifically.

Summary

This introductory chapter describes the background of the study. It introduces the statement of the problem, the aims of the study, research questions and explains significance of the study and the contribution to knowledge expected from this thesis. The structure of the thesis is also outlined.

The next chapter reviews the literature regarding the professional development for teachers. This includes the necessity of the in-service training for teachers, effective professional learning, professional learning approaches, skills needed for teaching physics, modes of professional learning training for physics teachers and factors affecting the implementation of teachers' professional learning.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter will broadly examine the literature pertaining to teachers' professional learning, and more specifically in relation to why, how, when and where to implement professional development for physics teachers. The literature explores topics that include professional development for teachers, effective professional learning, professional learning approaches, the three knowledge areas for teaching physics, modes of professional training and factors affecting the implementation of teachers' professional learning. These areas are important for this study as the literature review explores a broad scope of topics, and considers the findings of related studies and links resultant interpretations to the investigation being reported (Drew, Hardman &Hops 2008).

Definitions of main terms

The following glossary defines specific terms utilized in this thesis.

Teachers' professional development: A lifelong learning process designed to enhance professional knowledge, skills and attitudes of teachers in order to support them to assist their students to learn.

Training: Activities that assist employees (teachers) in undertaking professional duties in their current jobs.

In-service training: Education for employees (teachers) which takes place after they begin work responsibilities to assist them to develop their skills in a specific occupation.

On-the-job training: A type of professional learning that usually occurs in an actual work environment.

Off-the-job training: A type of professional learning process that usually occurs out of an actual work environment (e.g. Educational Training Centre). This can include programs such as morning/evening short courses.

Supervision: An aspect of on-the-job training of teachers within their schools. This usually takes place twice a year by a qualified educational supervisor from the Directorate of Education in Saudi Arabia.

Educational supervisor: A qualified teacher selected by the Directorate of Education to assist teachers to undertake professional learning within their schools.

Educational trainer: A qualified teacher selected by the Directorate of Education to assist teachers to undertake professional learning at the Educational Training Centre.

Non-specialist physics teachers: Teachers in intermediate schools who specialise in any field of science other than physics. This includes teachers who may have backgrounds in areas such as chemistry, biology, botany, zoology and agriculture.

Intermediate school: Grades 7, 8 and 9 in the educational system of Saudi Arabia.

Secondary school: Grades 10, 11 and 12 in the educational system of Saudi Arabia.

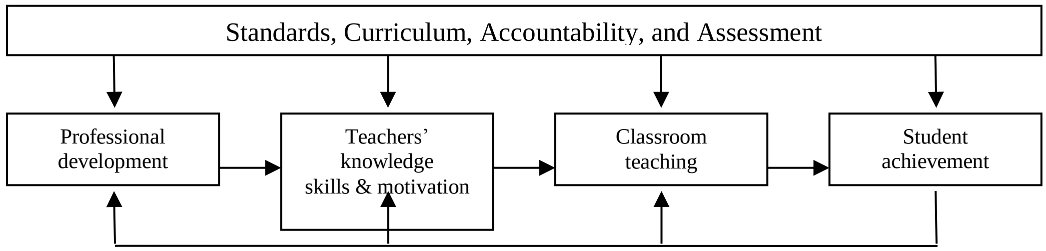
Professional development for teachers

Professional development for teachers plays a vital role in school improvement (Newmann, King, & Youngs, 2001; Borko, 2004; Moskowitz, 2008; Melville & Yaxley, 2009; Agharuwhe & Akiri, 2013). It can benefit teachers in many ways, as various researchers found including Tamir, (1989), Al Ketheri, Sallam & Al Huthaifi (1990), Mac, Yip & Chung (1999), Eryilmaz & İlaslan (1999), Buckley & Caple (2004) and Bahar, Bað & Bozkurt (2008). These benefits ranged from supporting graduate teachers by addressing their deficient pedagogical knowledge acquired through their pre-service programs through to equipping teachers with modern, relevant instruction techniques.

Bahar, Bað and Bozkurt's (2008) study indicated that many pre-service teachers had insufficient knowledge to facilitate meaningful learning for students on both subject matter and pedagogy. Professional development can support graduate teachers by addressing the gap between the knowledge and skills required and that acquired through their preparation programs (Birman, Desimone, Porter & Garet, 2000; MacPhail, 2011). Improving graduate teachers' knowledge through ongoing training has the potential to improve students' achievement through more effective classroom practice. For experienced and graduate teachers alike it can also equip them with current instruction techniques such as using multimedia technology that is appropriate for 21st century learning (Al-Wreikat & Bin Abdullah, 2010; Behlol & Anwar, 2011).

According to Yoon, Duncan, Lee, and Shapley (2008) professional development affects student achievement as portrayed in Figure 2.1. Firstly, professional development enhances teachers' knowledge, skills, and motivation, which in turn positively impacts students by improving classroom teaching and student achievement. Thus, in sum, a positive effect from professional development on student learning is possible through improved teachers' knowledge, skills, and motivation, leading to more effective instruction in the classroom.

Figure 2.1 Logic model of the impact of professional development on student achievement (Yoon, Duncan Lee &Shapley, 2008, p. 3)



Source: Yoon, Duncan, Lee, and Shapley, 2008, p. 3.

Professional development activities can have a positive impact on teachers' knowledge and skills (Powell, Terrell, Furey & Scott-Evans, 2003; Knight, Tait & Yorke, 2006; Gabriel, Pereira & Allington, 2011; Harris, Cale & Musson, 2011). However, some professional development activities fail to improve teachers' performance. For example, Kildan, Ibret, Pektas, Aydinozu, Incikabi, and Recepoglu (2013) found in evaluating the effectiveness of teacher training in Turkey that no improvement in teaching practice or school experience occurred. This is the case with many professional development programs that have demonstrated limited capacity to improve teaching practice and ultimately students' achievement levels are not being raised (Birman, Desimone, Porter & Garet, 2000; Newmann, King & Youngs, 2001; Armour & Yelling, 2004; Hofman & Dijkstra, 2010).

The model (see Figure 2.1) provides a framework to examine how professional learning can be informed by curriculum standards and students' achievement. However, it does not acknowledge the complexity of school environments and the many factors that can influence the implementation of professional learning by teachers in their classrooms including teacher’s motivation, student background, school principal support, and school context (French, 1997; Joyce & Showers, 2002; Cole, 2012).

Often professional development programs do not address the needs of the teacher and the context of the school, comprising unfocused, fragmented, low-intensity activities that have inappropriate content knowledge (Newmann, King, & Youngs, 2001; Mansour, 2003; Al-Shehri, ٢٠٠٦; Kildan, Ibret, Pektas, Aydinozu, Incikabi, & Recepoglu, 2013). Ineffective programs are often one-off affairs with no follow up of how those teachers who attended the program are applying the techniques and concepts presented (Sparks, 2002). Thus these types of programs fail to provide teachers with effective professional learning and follow up, hindering their ability to transfer new ideas into their classroom instruction (Guskey, 2002; Uysal, 2012).

The effectiveness of professional development programs is enhanced when school principals provide strong support for these programs (French, 1997; Joyce & Showers, 2002; Department of Education and Training, 2005). However, school principals can unintentionally undermine the transference by teachers of concepts and practices developed from professional learning activities to the classroom. As Cole (2012) identified in his study about linking effective professional learning with effective teaching practice; when principals do not allocate professional learning resources to support implementation, or do not ask teachers who have been engaged in professional learning to present the benefit of their professional learning to the rest of the school staff, a negative message is being conveyed.

Cole (2012) also found that teachers could poorly implement what they had learnt into their classroom practice if they were not committed to the professional learning.

Levels of commitment may be influenced by teachers' belief in the professional learning activities and if they will be held accountable through reporting back their learning experience or demonstrate the implementation of their teaching practice. Finally, if there are limited materials and resources, and/or lack of time for lesson preparation using innovative approaches, changes in classroom practice are unlikely to occur (Hofstein & Lunetta, 2003; Yoon, Duncan, Lee, and Shapley, 2008).

Consequently, for professional learning to be effective many factors must be taken into account. These include the complexity of school environments and influences on teachers' professional learning.

Effective professional learning

Effective learning by teachers needs to be primarily focused on improving teaching practice with the aim of maximizing student learning (Guskey, 2000; Speck & Knipe, 2001; Department of Education and Training, 2005; Cole, 2012). Researchers have highlighted the features of effective professional learning that lead to an improvement in teaching. These features include needs-based training, linking content to practice, varied learning activities, follow up and sustainability.

Needs-based training

Teachers' readiness to learn can occur as a result of realization that the training program is relevant to their daily lives (Rogers, 1971; Knowles, Holton, & Swanson, 2005). Thus, in order to improve teachers' knowledge, skills, and motivation, it is important to expose them to quality professional development in its design and implementation (Yoon, Duncan, Lee, & Shapley, 2008). For example, training needs must be accurately identified before creating any program through an analysis of teachers' performance to identify any gaps between the required knowledge and skills and their current knowledge and skills (Kroehnert, 2000). Identifying training needs provides several benefits including the specification of learning objectives, determining learning content knowledge and the learning strategies to be applied (Salas & Cannon-Bowers, 2001; DeSilets, 2007; İnceçay & Bakioğlu, 2010). These elements should be used to frame the training process, the design, delivery and evaluation of the program.

Linking content to practice

Teachers have a range of professional and life experiences that impact on their learning. At the start of the learning process these experiences are recovered from memory and applied to prevailing challenges. Thus, such experiences should be considered as valuable learning resources during training programs (Knowles, Holton & Swanson, 2005). However, successful professional learning programs must also go beyond teachers' current experience and provide them with research-based knowledge about pedagogy and pedagogical content knowledge to build their professional knowledge base (Rohann, Taconis & Jochems, 2010). Consequently, teachers should be equipped with modern, relevant instruction techniques such as inquiry-based approaches and using multimedia technology that is appropriate for current societal perspectives of learning (Al-Wreikat & Bin Abdullah, 2010; Behlol & Anwar, 2011).

Varied learning activities

Professional learning programs can involve a range of areas, subject content knowledge, teaching and learning approaches, use of technical equipment, classroom management or student assessment (General Directorate of Educational Training and Scholarship, 2002). To effectively address both content knowledge and pedagogical knowledge a range of instruction methods are required (Kroehnert, 2000). This includes approaches such as role playing, group study, demonstration, simulation, games and case study. Furthermore, effective instructional models should involve teachers' actual practice rather than descriptions of practice (Elmore & Burney, 1997; Garet, Porter, Desimone, Birman & Yoon, 2001; Newman, King & Youngs, 2001; Yoon, Duncan, Lee, and Shapley, 2008).

In order to meet different training needs, professional development should involve ongoing learning activities rather than offering single one-off workshops (Garet, Porter, Desimone, Birman & Yoon, 2001; Adey, 2006; Timperley, Wilson, Barrar & Fung, 2007; Helmer, Bartlett, Wolgemuth & Lea, 2011). Ongoing professional learning could be either internal activity based at the school or external learning opportunities such as postgraduate study, workshops and seminars. Nevertheless, research shows that the most meaningful learning experiences occur within schools. Sandholtz (2002), for example, reported that teacher's value school-based opportunities where they can address issues of learning and teaching connected with their daily work rather than group sessions outside school. This school based learning can be enhanced through collaboration, where a skilled colleague or those with external expertise work closely with teachers at the school. This type of professional learning can include assisting the teacher in the planning and delivery of teaching and providing useful feedback on classroom practice (Elmore & Burney, 1997; Newmann, King & Youngs, 2001; Gabriel, Pereira & Allington, 2011). More general collaboration with peers can also promote successful professional development. For example, John and Gravani (2005) argued that teachers need a collegiate atmosphere in which they can share their own experiences of both subject matter and pedagogy with peers. Teachers often also accept their peers' views more readily than external experts (Sandholtz, 2002).

In addition, it has been found that professional development activities that have positive effects on teachers' practice in the classroom include collective participation of teachers from the same school, grade and subject area (Garet, Porter, Desimone, Birman & Yoon, 2001). Such collective participation can help to develop a common understanding of instructional goals, methods, problems, and solutions.

Follow up

Although some teachers attempt to apply new strategies into their classrooms following professional development, there is no guarantee that completing professional development programs leads to increasing the effectiveness of teaching practice (Guskey, 1999). For example, Sparks (2002) argued that, without the provision of follow-up activities and additional support, less than 10 per cent of teachers fully integrate new strategies into their classroom practice. Follow-up activities complement training by supporting teachers in transferring their professional learning to the classroom. Consequently, extra time is required to provide teachers with opportunities to participate in truly effective follow-up activities (French, 1997; Guskey, 1999; Sparks, 2002).

This follow up can be as simple as the observation of their teaching by peers and receiving feedback as a means of enhancing the implementation of new teaching practice. According to Hammersley-Fletcher and Orsmond (2004), peer observation aims to enhance teaching practice through the exchange of insights relating to the review of a specific teaching performance, and to identify areas of subject understanding and teaching activity which have particular merit or need further development. However, due to the lack of opportunities for teachers to observe each other, school principals or supervisors could provide this role (French, 1997). Two of Gosling's (2002) models of observation describe processes that use non-peer feedback. The first is an evaluation model, where senior staff can observe other staff and make judgments that feed into observee's subsequent promotion prospects. The second is a developmental model, where an expert observes others leading to recommendations for improvement that inform an action plan. Gosling's (2002) third model is a peer review, where teachers observe each other and mutually reflect in a non-judgmental atmosphere. All three approaches are focused on helping the teacher to reflect on their classroom practice.

Sustained

Substantive and long-term change in teachers' practice does not occur across a short time frame (Kennedy, 2005). Professional development should be a sustained and coherent process throughout a teacher's career. Continuous reflection on teaching practice may then contribute to an improvement in both schools and teaching practice (Newmann, King, & Youngs, 2001; Timperley, Wilson, Barrar & Fung, 2007; Yoon, Duncan, Lee, & Shapley, 2008). Furthermore, effective professional development should be targeted and ongoing, providing the support required for implementation of new practice.

Professional learning approaches

The key elements that provide a framework for any formal professional development system are the program, the learners, the facilitators and the context in which professional development occurs (Borko, 2004). These elements influence each other as portrayed in the following figure.

Figure 2.2 Elements of a professional development system (Borko, 2004, p. 4)

Source: Borko, 2004, p. 4.

According to Birman, Desimone, Porter and Garet (2000), teachers' professional development activities can be classified into two main categories: traditional and reform approaches. The traditional approach often assumes there is a deficit in teachers' knowledge and skills which can be ameliorated using activities such as bringing experts from outside into the schools to improve the instructional qualities of teachers through increasing their knowledge and skills (Melville & Yaxley, 2009; Hofman & Dijkstra, 2010). Traditional approaches also include workshops and formal training courses (Birman, Desimone, Porter & Garet, 2000; Malone & Smith, 2010), for example, a one-day workshop designed to improve lesson planning skills of physics teachers. This type of workshop has specific goals to help teachers identify learning outcomes, sequencing of learning activities and formative assessment of students' learning for individual lessons. Once completed, it is expected that physics teachers will apply these practices to their planning and in their classrooms.

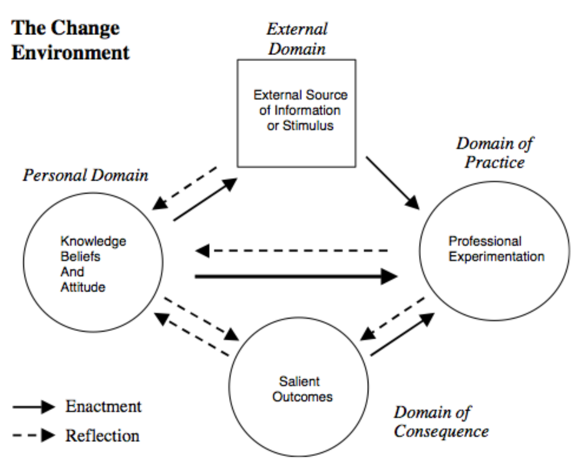
Although such traditional activities can encourage teachers' professional learning (Knight, Tait & Yorke, 2006), these sessions alone are not giving teachers the time, the range of activities, and the support needed for fostering meaningful change in their classroom practice (Birman, Desimone, Porter & Garet, 2000). Moreover, it often fails to distinguish between various school contexts, student populations, teaching styles, or the different needs required of novices compared to experienced teachers (Hofman & Dijkstra, 2010).

Reform, in contrast, takes into account the context of the teaching environment and needs of the students. Professional learning is often located at the school and includes ongoing support to assist implementation of new approaches and continued change within the school (Armour & Yelling, 2004). Reform approaches include a variety of learning activities such as mentoring, coaching conferences, and collaborative seminars where teachers can share their expertise and ideas around teaching practice (Borko, 2004; Hofman & Dijkstra, 2010; MacPhail, 2011). In addition, informal learning can support the reform process. While performing regular tasks at work, teachers can observe the performance of peers or engage in hallway conversations about practice. These informal activities can play a significance role in improving teachers' skills (Livingstone, 2001; Knight, Tait & Yorke, 2006; MacPhail, 2011). They can also lead to the development of teacher networks or action research projects where teachers methodically examine school process or teaching practice (Hofman & Dijkstra, 2010).

The ongoing nature of reform continues to influence teaching practice because there is more focus on pedagogy and active learning opportunities within the school context (Birman, Desimone, Porter & Garet, 2000). Despite the elements of reform being the feature of effective professional development, traditional professional learning still appears to be the dominant delivery method (Melville & Yaxley, 2009).

Clarke and Hollingsworth (2002) provide a different model of professional growth of teachers that extends the understanding presented by Borko (2004). It is a model with multiple entry points and growth pathways. Clarke and Hollingsworth argue that teacher change is motivated by more than just student outcomes: teacher change is personal and situated and must offer teachers every opportunity to learn professionally in a way that individuals find most useful. As summarized in Figure 2.3 the model takes into account both external and internal influences on teaching practice, seeing teaching and learning as a complex process.

Figure 2.3 Interconnected model of professional growth (Clarke & Hollingsworth, 2002, p. 951)



Source: Clarke & Hollingsworth, 2002, p. 951.

Continuing Professional Development (CPD)

There is growing interest around the world in teachers' CPD as an essential component for improving pedagogy and teaching practice (Kennedy, 2005). Increased attention should be directed towards ensuring: the sustainability of such efforts to support teachers to continue learning; and the evolution of their classroom practice across their careers in order to raise the quality of education in schools (Kennedy, 2005; Sabah, Fayez, Alshamrani & Mansour, 2014).

Day and Sachs (2004) defined 'continuing professional development' (CPD) as all the activities that teachers engage in through the course of their careers which are designed to enhance their work. Furthermore, opportunities for CPD vary across models and take place both inside and outside schools (Sabah, Fayez, Alshamrani & Mansour, 2014). Kennedy (2005) for example, proposed nine categories within his CPD model: training, award-bearing, deficit, cascade, standard-based, coaching/mentoring, community of practice, action research and transformative. In addition, these models were organized into three broad categories based on the professional autonomy they provide for teachers. The three broad categories: transmission where teachers have low control over their learning; transitional where teachers have professional autonomy; and transformative where teachers have more professional autonomy. According to Kennedy (2005), moving from transmission through transition to transformative would increase the capacity for professional autonomy of teachers as set out in Table 2.1.

Table 2.1 Nine categories organized into three broad categories (Kennedy, 2005, p. 248)

Model of CPD	Purpose of model
The training model The award-bearing model The deficit model The cascade model	Transmission
The standards-based model The coaching/mentoring model The community of practice model	Transitional
The action research model The transformative model	Transformative

Increasing capacity for professional autonomy

Source: Kennedy, 2005, p. 248.

The purpose of the transmission category of CPD is to fulfil the function of preparing teachers to implement reforms in education including categories such as training, award-bearing, deficit and cascade models. The transitional category of CPD has the capacity to support underlying agendas compatible with both transmission and transformative categories. This category includes the standards-based model, coaching/mentoring model and community of practice model.

Transformative Professional Development (TPD)

Johnson and Marx's (2009) model for teachers' development, which is known as transformative professional development (TPD), based upon the premise that practices of teachers can be positively transformed through effective, sustained, collaborative professional development. The TPD model has three main components: (a) intensive, sustained, whole-of-school effort focused on the development of student learning through effective teaching methods; (b) focus on building positive relationships between teachers and teachers, teachers and students, and teachers and university faculty members; and (c) creation of positive school and classroom climate through procedures for participating in science class.

TPD can be used as an effective model for professional development (PD) to transform teachers' practice and improve students' learning through three key characteristics:

1. PD takes into account the local cultural context of the school (McKeown & Hopkins, 2003).
2. PD is developed through co-construction of goals based on teachers' and students' needs (McKeown & Hopkins, 2003).
3. A whole-of-school approach is taken, growing a collective power for change within schools (Johnson & Fargo, 2010).

TPD achieves transformation of a school through all teachers being involved with professional development focused on changing an aspect of school culture or school wide classroom practice. For many schools this can be challenging to achieve, with professional development more often being targeted to specific areas such as the teaching of particular subjects (Johnson & Marx, 2009).

Professional development for science teachers

Student learning is influenced by many factors. As Hattie (2003) in his meta-analysis of over 500,000 studies found, teachers may account for 30% of variance in student learning outcomes. Teacher effects on student learning come next after the influence of student's personal, peer effects, school and home factor. It is important that teachers have the skills and knowledge to effectively support student learning. This is particularly important for the teaching of science, a subject which many students find challenging (Hattie, 2003).

Numerous science teachers are not adequately prepared to implement effective science teaching approaches. Tamir (1989) argued that many pre-service and in-service courses in science teaching and learning provide limited skills needed to facilitate meaningful learning for students in science classes. In Saudi Arabia and Hong Kong, studies by Al Ketheri, Sallam and Al Huthaifi, (1990) and Mac, Yip and Chung (1999) respectively reported that the main weakness of teachers was the lack of competencies to teach science at intermediate and secondary levels. Therefore, in order to improve the quality of preparation programs for science teachers; many specialist organizations outlined possible standards to guide the preparation of teachers to teach science effectively. In 2003, for example, the National Science Teachers Association (NSTA) in the USA explicitly stated that teachers must be able to articulate the knowledge and practice of contemporary science in their specialist area, including through active scientific investigation. The following extract from the NSTA statement of standards (2003) shows the degree of detail expressed for content knowledge and teaching skills required of science teachers:

> **NSTA Standards for Science Teacher Preparation:**
>
> **Standard 1:** Teachers of science understand and can articulate the knowledge and practices of contemporary science.
>
> **Standard 2:** Teachers of science engage students effectively in studies of the history, philosophy, and practice of science.
>
> **Standard 3:** Teachers of science engage students both in studies of various methods of scientific inquiry and in active learning through scientific inquiry.
>
> **Standard 4:** Teachers of science recognize that informed citizens must be prepared to make decisions and take action on contemporary science- and technology-related issues of interest to the general society.

> **Standard 5:** Teachers of science create a community of diverse learners who construct meaning from their science experiences and possess a disposition for further exploration and learning.
>
> **Standard 6:** Teachers of science plan and implement an active, coherent, and effective curriculum that is consistent with the goals and recommendations of the National Science Education Standards.
>
> **Standard 7:** Teachers of science relate their discipline to their local and regional communities, involving stakeholders and using the individual, institutional, and natural resources of the community in their teaching.
>
> **Standard 8:** Teachers of science construct and use effective assessment strategies to determine the backgrounds and achievements of learners and facilitate their intellectual, social, and personal development.
>
> **Standard 9:** Teachers of science organize safe and effective learning environments that promote the success of students and the welfare of all living things.
>
> **Standard 10:** Teachers of science strive continuously to grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession.

Source: National Science Teachers Association NSTA, 2003, p. 4.

However, such standards are not considered by many institutions in their preparation programs for science teachers and consequently, poor implementation of effective teaching approaches such as investigation processes are still dominant in science classes (Endorf & Koenig, 2007). Secondly, even with high levels pre-service qualifications, science teachers still encounter some technical obstacles to utilize contemporary science teaching approaches due to technology revolution, as well as the rapid progress of science education standards (Carla, 2006). These changes require ongoing professional development for all science teachers (Straker, 1988; Bullock & Scott 1989).

A large number of international studies on professional development practices of science teachers have been conducted. These studies addressed different issues regarding professional development of teachers. For example, in order to evaluate the effectiveness of training programs of science teachers, Asunta (1997) investigated different types of in-service science courses for primary teachers in Finland. The researchers reported that primary teachers felt they needed more continuous support in improving their knowledge and understanding of the subject, especially in chemistry and physics, and requested more hands-on activity planning. Moreover, Mac, Yip and Chung (1999) examined the alternative conceptions held by junior secondary science teachers enrolled in an in-service training program in Hong Kong. Findings indicated that science teachers, being graduates in specific areas in science, were not adequately prepared to teach a broad and balanced junior science curriculum.

Ahmed (2007) evaluated the quality of in-service training programs of science teachers from the perspectives of trainees in Iraq. Ahmed found that training activities from the perspectives of 16 physics teachers, 22 chemistry teachers and 27 biology teachers were generally satisfactory demonstrating that in-service teaching can be effective.

However, in exploring the quality of transferring learned skills from in-service professional development activities into teaching practice, Johnson (2006) investigated the barriers that science teachers' encounter when implementing standards based instruction while participating in effective professional development experiences in the central US. Findings indicated that even with effective professional development, science teachers still encounter technical, political, and cultural barriers to implementation. Therefore, more support is required for professional development efforts to be successful, such as resources and time, as well as administrative buy-ins and support. In addition, Boitshwarelo (2009) explored a case of science teachers' professional development in Botswana where a blended learning solution was attempted, which revealed deficiencies in policy, schools and training providers. It was recommended that schools should support teacher learning in the workplace and manage ICT resources for both teachers' and students' use. In addition, government should support participatory and localized learning and institutionalize ICT access and use. Training providers should also use blended methods to improve ICT practices.

Professional development of physics teachers

Teaching physics requires specialist knowledge and a range of pedagogical knowledge to support students' learning (Jauhiainen, 2013). This content knowledge and skills take time to develop; even within teacher education programs the level of knowledge and skill required to teach physics may not be achieved (Eryilmaz & İlaslan, 1999).

In many cases, teachers might be asked to teach outside their specialist areas and as a result, physics is taught by non-specialist teachers. For instance, in a study from Newcastle-upon-Tyne in the United Kingdom, 38% of all mathematics education and 22% of physics lessons for the 11-16 years age range were conducting by inappropriately qualified teachers (Straker, 1988). Such problems might occur due to the shortage of qualified teachers or as a result of curriculum reorganization (Millar, 1988; Alhaggass, 2009; Sakyi–Hagan, 2012). It is likely that learning physics could to be affected negatively when physics classes are run by non-science qualified teachers (Lubben, 1994). In-service professional learning activities are required to address these issues, and should be accessible for all teachers in general and for non-specialists involved in teaching physics.

A large number of international studies on professional development practices of physics teachers have been conducted. These studies addressed different issues regarding professional development. For example, in order to evaluate the effectiveness of training programs for physics teachers, Jauhiainen, Lavonen, Koponen, and Kurki-Suonio (2002) examined a long-term in-service training program in Finland, for physics teachers who taught grades 7-12, designed to enhance teachers' subject matter and pedagogical content knowledge. Results showed that the courses and activities that were most valuable for day-to-day teaching were those in which teachers could cooperate, reflect, and plan with each other in small groups. Morge, Toczek and Chakroun (2010) evaluated the impact of a training program on trainee physics and chemistry teachers in France, focusing on the way students' explanations are dealt with during teacher-student interaction. The qualitative analysis showed that teachers, after training, were better prepared to take students' productions into account, use a greater number of appropriate arguments, and are more aware of students' misconceptions. A quantitative analysis of the achievement of 172 students whose teachers had completed the program indicated that students' outcomes improved. Furthermore, Jauhiainen (2013) examined teachers' experience of the long-term physics teachers' training program organized by the national science and mathematics education development program to enhance teachers' pedagogical content knowledge in Finland. The results showed that teachers considered the training valuable for their daily teaching practice. The laboratory course was regarded as the most valuable, whereas the course dealing with theoretical principles of the perceptional approach was considered less advantageous. In addition, 18.4% of the teachers were influenced by the program and the way experiments could be used in supporting the creation of meaning of concepts. However, 9.2% of the teachers stated that experiments aimed at illustrating the meaning of concepts.

However, it has been found that some training programs do not provide trainees with sufficient knowledge and skills needed for effective teaching. For example, Eryilmaz and İlaslan (1999) evaluated 50 pre-service physics teachers' qualifications from 4 universities in Turkey. The results showed that 84 % of the pre-service physics teachers agreed that they were provided with ineffective teaching knowledge and skills during their course which represents an important factor that decrease their capacities to be qualified physics teachers. The pre-service physics teachers had medium attitudes towards becoming a physics teacher, knowledge of subject matter, knowledge of teaching methods, knowledge of measurements and evaluations, knowledge of classroom management, sociology and psychology, and knowledge of school administration.

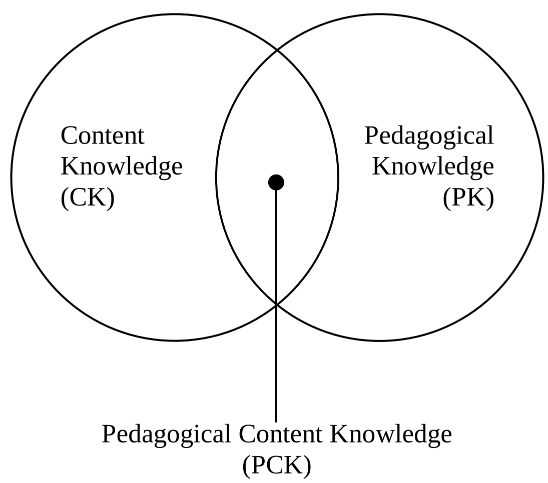
Several researchers have also explored the attitudes of physics teachers towards learning. Lavonen, Jauhiainen, Koponen, and Kurki-Suonio (2004) examined 98 teachers' beliefs about the role of experiments in physics education. Researchers found that the teachers' descriptions showed that approximately 20% had improved their use of experiments in conjunction with the goals of the in-service training program for physics teachers. In addition, Tecpan, Zavala and Benegas (2011) also investigated the attitudes toward active learning strategies of 39 in-service physics teachers attending a professional training workshop in Southern Cone, South America. Results showed that the format implemented in this workshop for active learning strategies clearly resulted in valuable participant reflections about the characteristics of each strategy and the possibilities for implementation in their own teaching contexts.

Skills and knowledge of non-specialist physics teachers have also been explored by many researchers. For example, Alhaggass (2009) identified the in-service training needs of non-specialist physics teachers in Saudi Arabia regarding experimental skills. The researcher reviewed data from a relevant sample (N=87) of non-specialist physics teachers at intermediate schools in the city of *Onaizah*, Saudi Arabia. The results have shown that dealing with liquid batteries, operating electrical devices, measuring the density of objects, correlating quantities mathematically and applying equations of both oscillatory motion and the use of heat quantity units represent training needs for those non-specialist physics teachers who participated in this study. Moreover, Thompson, Christensen and Wittmann (2011) described two courses designed at the University of Maine in the USA to assist future teachers to reflect on and discuss both physics content and student knowledge in the physics domain. Three kinds of activities were used: reviewing the literature, experiencing research-based curricular materials, and learning to use the basic methods of physics education research. It was found that the quality of teachers' responses, especially on questions dealing with knowledge of student ideas, can be successfully categorized and may be higher for those with a non-physics background than those with a physics background.

Skills needed for teaching physics

Similar to all professionals teaching in science, physics teachers need to have a deep comprehension of what to teach. This understanding of subject concept is collectively called content knowledge (CK) (Gil-Perez & Carvalho, 1998; NSTA, 2003) including a strong understanding of how to teach, known as pedagogical knowledge (PK). Furthermore, Shulman (1986) argued that a special kind of knowledge is required to teach particular content effectively as summarised in Figure 2.4 where understanding crosses the boundaries of CK and PK. This type of knowledge is known as pedagogical content knowledge (PCK). PCK, according to Shulman (1986), it is what makes possible the adaption of content knowledge into forms that are accessible by different students. This includes knowledge of how particular subject matter topics and issues can be organized and presented to cater to diverse interests and abilities of learners.

Figure 2.4 Three required areas for teaching physics



Physics content knowledge

Content in the curriculum domain of physics typically comprises two significant aspects (Rutherford & Ahlgren, 1990; American Association for the Advancement of Science (AAAS), 2010). The first aspect is scientific knowledge such as facts, concepts, laws and theories (Koponen, & Mäntylä, 2006; Etkina, 2010; Jauhiainen, 2013). The second aspect is particular methods for developing new knowledge which is known as science processes (Koponen, & Mäntylä, 2006; Munck, 2007; Etkina, 2010; Jauhiainen, 2013).

Teachers' capacities in the area of content knowledge are often developed as a result of their undergraduate studies and pre-service courses. According to Bartholomew, Moeed and Anderson (2011) student teachers obtain this body of knowledge through teaching resources distributed by lecturers, experiments and class activities, ideas presented in tutorials, websites, and sharing ideas with peers. However, many pre-service teaching courses do not provide student teachers with sufficient breadth of physics knowledge, which may decrease the effectiveness of their classroom practice (Eryilmaz & İlaslan 1999; McGee & Cooper, 2010).

This content knowledge is normally updated when physics teachers start working within their profession as they develop syllabus for their school. This is achieved through access to textbooks, engaging with colleagues, and utilizing available school resources (Bartholomew, Moeed & Anderson, 2011). It can become a more difficult task in cases where teachers are required to teach outside their specialist areas due to shortages of qualified teachers or because of curriculum reorganization (Millar, 1988; Straker, 1988; Alhaggass, 2009). As a result, physics may be taught by non-specialist teachers who require more professional development programs to build their content knowledge in physics.

More recently, approaches to learning in science classrooms is based on process learning where students construct knowledge through scientific inquiry that includes many skills such as observation, measurement, classification and experimenting (Padilla, 1990; Munck, 2007). Many recent professional development programs in science education have begun to emphasis this way of developing knowledge (Friedl & Koontz, 2005). This approach requires students to develop a wide range of physics and general science skills, as set out in Table 2.2.

Table 2.2 Science processes

Skills	***Definitions***	***Examples***
Observation	Using the senses to gather information about an object or event	Describing water as a liquid
Measurement	Using both standard and nonstandard measures to describe the dimensions of an object or event	Using a meter stick to measure the length of a table in centimetres
Classification	Grouping objects or events into categories based on properties or criteria	Placing all liquids having certain density into one group
Inferring	Making a guess about an object or event based on previously gathered data	Saying that a spoon transfers heat because it is made of metal
Predicting	Stating the outcome of a future event based on a pattern of evidence	Predicting the height of a balloon in two seconds based on a graph of its height during the previous four seconds
Communication	Using words or graphic symbols to describe an action, object or event	Describing the change in speed of a car over time in writing or through a graph
Interpreting data	Organizing data and drawing conclusions from it	Recording data from the experiment on reflection of light in a data table and forming a conclusion which relates trends in the data to variables
Controlling variables	Being able to identify variables that can affect an experimental outcome, keeping most constant while manipulating only the independent variable	Realizing through past experiences that heat and speed of airflow need to be controlled when testing speed of water evaporation
Operational definitions	Stating how to measure a variable in an experiment	Stating that the speed of a football player will be measured in metres per second
Hypothesizing	Stating the expected outcome of an experiment	The heavier objects reach the ground faster than lighter objects
Experimenting	Being able to conduct an experiment, including asking an appropriate question, stating a hypothesis, identifying and controlling variables, operationally defining those variables, designing a "fair" experiment, conducting the experiment, and interpreting the results of the experiment	The entire process of conducting the experiment on the effect of friction on the motion of objectives

Source: Adapted from the American Association for the Advancement of Science (AAAS), 2010.

Developing this range of skills requires that students engage in inquiry activities during science classes where teachers serve as facilitators of the discovery process. This approach is in contrast to the teacher 'as expert' lecturing to students about a particular science concept. Inquiry learning approaches enable learners to establish understanding and extend knowledge about science that parallels the procedures scientists use in their daily work (Bass, Contant & Carin, 2009).

Pedagogical knowledge (PK)

It is proposed that the main role of teachers is to assist students to reach their potential of educational achievement (Wong & Wong, 2001) by creating effective learning opportunities. The main role of learners is to participate positively in such opportunities in order to successfully benefit from this teaching goal. As a result, teachers need to build an understanding of how people learn, how to plan, implement and evaluate an effective learning program and how schools' structures support learning (Doering, Veletsianos, Scharber & Miller, 2009; Etkina, 2010; Victorian Institute of Teaching, 2013).

Teachers usually start developing their pedagogical knowledge as a part of a pre-service training program (Etkina, 2010) and continue updating this knowledge during their first year of teaching (Choy, Wong, Lim & Chong, 2013). However, there is a need to look at the development of teachers' pedagogical knowledge beyond the first year of teaching as an ongoing process of continual professional development.

PK includes an understanding of some areas that cut across subject disciplines and are relevant for all teaching. Kyriacou (2007, p. 11), for example, developed seven categories of essential teaching skills needed for successful classroom practice.

1. Planning and preparation: the skills involved in selecting the educational aims and learning outcomes intended for a lesson and how best to achieve these.

2. Lesson presentations: the skills involved in successfully engaging students in the learning experience, particularly in relation to the quality of instruction.

3. Lesson management: the skills involved in managing and organising the learning activities taking place during the lesson to maintain students' attention, interest and involvement.

4. Classroom climate: the skills involved in establishing and maintaining positive attitudes and motivation by students towards the lesson.

5. Discipline: the skills involved in maintaining good order and dealing with any student misbehaviour that occurs.

6. Assessing students' progress: the skills involved in assessing students' progress, covering both formative and summative purposes of assessment.

7. Reflection and evaluation: the skills involved in evaluating one's own current teaching practice in order to improve future practice.

These seven essential skills should continue to be enhanced and developed over a teacher's career as he or she encounters different groups of students, curricula and school cultures. Science teachers will also develop these skills over time, and apply them in different ways, depending on the setting, using a slightly different approach for classroom activities compared to laboratory work (Kyriacou, 2007).

Physics pedagogical content knowledge (PCK)

Every concept of physics has its own special features, which should be considered when planning for teaching (Jauhiainen, 2013). For example, teaching Kirchhoff's laws of electric current are different from Newton's laws of motion in terms of what kind of qualitative observations students would make and the type of practical work they would be engaged in. This means that teachers not only need to have knowledge about the concepts of electricity and motion, but also the best way to develop learning activities to help students understand these concepts. Different concepts require different teaching approaches (Jauhiainen, 2013). This creates the need to modify general pedagogy to suit a specific learning area and this is the essence of Pedagogical Content Knowledge (PCK), where teachers use specific pedagogical knowledge that will enhance students learning in a specific field (Shulman, 1986). The dynamic nature of PCK is manifested in how teachers deal with particular subject matter pedagogically. For physics teachers this includes how to choose, plan and apply the most effective instructional strategies to the teaching of different concepts of physics, asking questions, determining the students' role and spending an appropriate length of time on particular aspects of the content (Janík, Najvar, Slavík, & Trna, 2009; Etkina, 2010). Moreover, the selection of PCK elements should be based on the students' age, their characteristics, background, prior knowledge and learning difficulties in addition to context in which the teaching takes place such as the school environment, facilities and community (Janík, Najvar, Slavík, & Trna, 2009; Mushtaq & Khan, 2012; Jauhiainen, 2013).

Teachers start teaching new topics with general pedagogical knowledge, with PCK being built up over time through their own experiences and discussion with colleagues (Driel, Verloop & Vos, 1998; Rohann, Taconis & Jochems, 2010; Williams & Lockley, 2012). It takes time for teachers to acquire the skills needed to become experts in their fields. Support for teachers' PCK through in-service teachers' development programs can shorten this process (Halim & Meerah, 2002; Rohann, Taconis & Jochems, 2010).

Normally teacher training programs usually do not produce a major development in science teachers' PCK as the opportunities and amount of time pre-service teachers have to trial different approaches is limited (Driel, Verloop & Vos, 1998). PCK for science teachers requires in-service training programs to develop their awareness of their range of practices and understanding how to apply pedagogy to specific concept areas.

Relationship between content knowledge, pedagogical knowledge and pedagogical content knowledge

As can be seen from the above discussion, there is a strong relationship between the three areas of teacher knowledge. For example, a teacher's level of content knowledge (CK) can affect the application of pedagogical knowledge (PK) and the teachers ability to plan what content to teach, and how to evaluate physics students' learning (Sahin, 2011; Akman & Guven, 2015). Bulger, Mohr & Walls (2002) illustrated the complex nature of interactions between CK and PK through two scenarios:

1. A teacher may possess a substantial amount of CK but fail to enhance students' learning due to a lack of pedagogical ability.

2. A teacher may possess some generic pedagogical knowledge (PK) skills but fail to enhance students' learning due to limited content knowledge (CK).

These scenarios indicate the need to demonstrate teacher competencies in both subject matter and pedagogy. Consequently, professional development remains a necessary requirement for effective teaching. Teachers must be able to use different instructional strategies to fit different teaching contexts (Driel, Verloop & Vos, 1998). This does not mean all physics teachers will teach in the same way, but instructional strategies will be modified to best suit students' needs through applying CK and PK (Sahin, 2011; Akman & Guven, 2015). Table 2.3 summarizes the differences and connections between CK, PK and PCK for physics teachers.

Table 2.3 Connections between CK, PK and PCK

	Content knowledge (CK)	***Pedagogical knowledge (PK)***	***Pedagogical content knowledge (PCK)***
Nature of knowledge	Knowledge about physics subject matter	Knowledge about general teaching skills	Knowledge about how to teach concepts of physics within specific contexts
Examples	Newton's laws of motion	Using cooperative learning, Jigsaw reading activity to develop student knowledge of general physics laws	Students in small groups use practical physics activities to demonstrate the application of Newton's laws of motion
Type of training	Pre and in-service training programs	Pre and in-service training programs	In-service training programs
Provided by	Qualified instructor in physics	Qualified instructor in pedagogy	Experienced mentor in physics teaching
Location	Inside school (on-the-job training)	Outside school (off-the-job training)	Inside school (on-the-job training)

Modes of professional learning for physics teachers

Professional development for physics teachers can be carried out using a wide variety of learning activities designed to meet the needs of various situations. Using one or more of these activities depends on many factors such as the setting, program design and budget (Dessler, 2013). Professional development approaches can be categorized as on-the-job training and off-the-job training (Dessler, 2013), as will be discussed below.

On-the-job training

This type of professional learning aims to train an employee while working on the job (Nankervis, Compton & Baird, 2005; Dessler, 2013). It is commonly used in professional development because the cost of learning activities is reduced (Dessler, 2013). In addition, content of learning is relevant to the job with the trainees, receiving immediate feedback on their performance, which helps them to transfer new skills to their teaching (Fisher, Schoenfeldt & Shaw, 2006).

Various on-the-job training methods can be used to improve teacher's performance. For example, a familiar on-the-job training technique for teaching is coaching (Mathis & Jackson, 2011; Dessler, 2013) where training and feedback are given by an experienced supervisor. To be effective a good relationship between teachers and their supervisors is needed for honest critique of practice (Abduljawad, 1996). Moreover, Bullock and Scott (1989) and DeCenzo and Robbins (2005) suggested that qualified and seasoned veteran teachers could help with in-service training, as coaches or mentors, for less qualified colleagues. This includes assisting teachers in the teaching process and providing useful feedback on their performance in classrooms (Elmore & Burney, 1997; Newmann, King & Youngs, 2001; Gabriel, Pereira & Allington, 2011). Furthermore, according to the American Society for Training and Development (ASTD), approximately 80% of what employees learn on the job occurs informally including performing their jobs on a daily basis with their colleagues (Dessler, 2013). Organizations usually do not manage this type of learning. However, they can facilitate learning by providing meeting areas with some related materials, white boards with markers as well as using informal online learning tools (Dessler, 2013).

According to Dessler (2013), the step-by-step job instruction technique is useful in the on-the-job training context. A possible training sequence is as follows:

Step1: preparation of the trainee

Step 2: presentation of the operation

Step 3: performance tryout

Step 4: follow-up

A large number of studies on supervision procedures for teachers as an aspect of on-the-job training have been conducted internationally. These studies addressed different issues concerning supervision procedures and practices. For example, in order to evaluate the effect of supervision activities on improving teachers' performance, Almoqaid (2006) examined the supervisory practices of the UNRWA educational supervisors in Gaza in light of total quality principles, and using a questionnaire distributed to 245 educational supervisors and head teachers. The results showed that the level of supervisory practices of the UNRWA educational supervisors in Gaza was high. Furthermore, Al Qurashi (2007) examined the role of the educational supervisor in developing the performance of social studies teachers at intermediate schools for instructional media, from the perspective of 20 educational supervisors and 267 social studies teachers in the Holy city of Makkah. Results showed that the degree of emphasis placed by educational supervisors on instructional media used by teachers was satisfactory. In addition, the techniques used by educational supervisors to improve social studies teacher's performance in the field of instructional media utilization were also satisfactory. Abo Shamlah (2009) found that supervisory methods were effective in the improved performance of 275 UNRWA Arabic and Math teachers in Gaza, which included planning, lesson, evaluation and classroom management.

On the other hand, Kennedy (1991) investigated how teachers learn to teach in Michigan in the United States. She reported that even in cases where novice teachers have access to mentors, not enough modelling occurs to overcome the personal experience novices had with their childhood teachers. Advice and comfort can be helpful but mean nothing because teachers teach the way they were taught. Furthermore, if the mentoring process means fascinating dialogue and discourse, but little modelling of good teaching, its actual effect on practice will be less than desirable. Moreover, Aljerjawi and Alnekhala (2008) found (viewpoints of 300 teachers and 90 educational supervisors) that educational supervision practice did not attain the required level of developing teachers' performance at secondary schools in Gaza governorates. In addition, Ihmeideh, Jumia'an and Al-Khoulda (2011) investigated the role of educational supervisors in improving kindergarten teachers' performance in the development of children's language skills in Jordan. The results revealed that the role of educational supervisor was not satisfactory, from the viewpoint of 213 kindergarten teachers from educational private directorates in Amman, Mafraq and Irbid. Alzahrani (2013) investigated the contribution of educational supervisors in treating the problems that confront primary schools teachers in implementing the developed curricula in Saudi Arabia. He found that the educational supervisors' contribution was satisfactory in the area of planning and unsatisfactory in the areas of implementation and evaluation. It appears that mentoring and supervision has the potential to be effective but can be under mined resulting in less than satisfactory results.

Many researchers have investigated the obstacles that reduce the effectiveness of educational supervision. For example, Al-Sayegh (١٩٩٢) explored these obstacles from the viewpoint of educational supervisors in member states of the Arab Bureau of Education for the Gulf States. He found that supervision activities were negatively affected by the shortage of supervisors, the lack of training courses for supervisors and lack of professionalism. Al-Hammad (٢٠٠٠) investigated obstacles to effectiveness of educational supervision in Riyadh. He reported that 230 educational supervisors believed that obstacles have a negative effect. These included: the large number of schools supervisors need to visit; lack of transportation; extra administrative burdens; lack of training courses for improving supervisors' skills; shortage of funds needed to implement some supervisory activities; lack of fully equipped libraries within schools; lack of supportive staff at the department of educational supervision (e.g. writer, driver, reporter); and absence of the curriculum coordinator.

The practice of educational supervisors has been examined by several researchers. For example, a study conducted by Al-Qurashi (1994) examining the practice of the educational supervisors in Saudi Arabia in light of some new models. Results showed that from the viewpoint of 236 supervisors, 220 teachers in intermediate schools and 209 teachers in secondary schools, the educational supervisor visits were not arranged in advance and the supervision process focused on mistakes in teachers' performance. Al-khateeb (2001) evaluated the performance of supervisors of Islamic studies in light of their supervisory activities in intermediate schools in Riyadh. The results showed that in spite of the importance of some supervision activities, such as exchange visits among teachers, handouts, training courses, workshops, model lessons, supervisors were rarely used. In addition, sudden visits were frequent and supervisors did not explain the purpose of their visit or the nature of supervision activities. The researcher also reported a weakness in assisting teachers in setting learning objectives for their lessons and demonstrating new skills in front of the teachers.

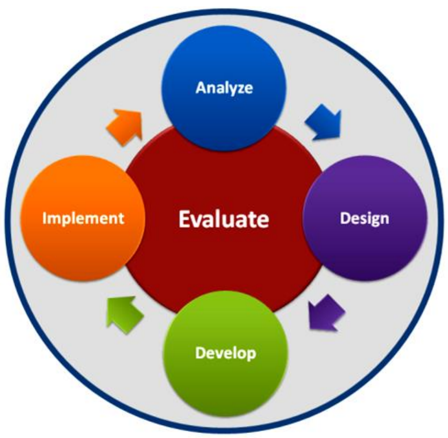
Off-the-job training

In addition to on-the-job training, it is important to provide teachers with some training away from their usual worksite as a supplement for workplace learning (Smith, 2002; Nankervis, Compton, & Baird, 2005). Such training can provide teachers with additional research-based skills and knowledge that colleagues usually do not possess. When designed well, such activities can allow trainees to focus on learning materials by minimizing distractions, and consequently desired outcomes can be achieved (Fisher, Schoenfeldt, & Shaw, 2006). A range of off-the-job training methods can be used to meet the shared learning needs of a group. For example, normal training courses, both short and long, have operated successfully for a number of years (Straker, 1988; Jauhiainen, 2013). Bullock and Scott (1989) suggested such courses should be run by academic experts or recently retired, experienced qualified teachers. Moreover, seminars and workshops can help teachers to improve their skills needed for teaching science

(Spickler, Hernandez-Azarraga & Komorowski, 1997; Morge, Toczek & Chakroun, 2010).

Although there is no universal agreement among researchers and practitioners about process, there is partial agreement on the key elements of off-the-job training. The ADDIE model is an example of the commonly used approach to developing off-the-job training programs (Danks, 2011).

Figure 2.5 The ADDIE model



Source: Adapted from Banta, 2008, p. 4.

ADDIE stands for the five steps contained in the model (Danks, 2011), as follows:

Step 1: Analysis, assessing the training needs

Step 2: Design, selecting the more appropriate training approach

Step 3: Development, creating the training materials

Step 4: Implementation, delivering the training materials

Step 5: Evaluation, making sure that the desired training goals has been achieved.

The ADDIE model is simple and clearly defines all steps with evaluation of each step at its core. It helps the trainer to create more effective instructional content (Danks, 2011). Trainers can also benefit from cost effectiveness, time saving, and effective learning that the model offers.

A large number of studies on teacher training programs, as an aspect of off-the-job training, have been conducted internationally. These studies addressed different issues concerning training activities. For example, in order to investigate the impact of training programs on the performance of trainees, a study was conducted by Al-Nemsha (1997). The researcher found that training programs were well designed and had a positive impact on the performance of trainees at the institute of Border Guards in Riyadh. In addition, he reported weaknesses in the implementation of training programs including the poor use of modern training methods and instructional aides due to the poor qualifications of trainers. Attiat and Attiat (2010) also evaluated the general diploma program in education at Al-Hussein Bin Talal University in Jordan from the learners' perspective. The results showed that 121 students were satisfied with the program in general including objectives, content and outcomes. Furthermore, Naoreen, Aslam, Arshad, and Nausheen (2011) compared the learning achievements of grade 4 students in mathematics taught by male/female trained/ untrained teachers in 48 rural/urban schools in the district of Faisalabad. The researchers concluded that the academic achievement of students who were taught by trained male/female teachers are significantly greater than those taught by untrained male/female teachers.

On the other hand, Uysal (2012) evaluated a one-week in-service training program for primary school language teachers offered by the Turkish Ministry of Education to explore its sustained impact on language teachers' attitudes, knowledge base, and classroom practices. Data was gathered through course materials analysis, interviews with trainers and teachers and through a questionnaire distributed to 72 teachers, 18 months after the course ended. Findings indicate that although teachers' attitudes are positive towards the course in general, the program has limitations, especially in terms of planning and evaluation phases, and its impact on teachers' practice. In addition, Kildan, Ibret, Pektas, Aydinozu, Incikabi, and Recepoglu (2013) carried out a study to evaluate the views of teacher trainees regarding teacher training in Turkey. The study group involved 58 newly appointed teacher trainees from different fields of teaching who had begun their teaching profession in Kastamonu in 2010. Researchers reported that these trainees indicated they felt inadequate, especially in relation to curriculum and content knowledge, and that teaching practice and school experience courses did not adequately contribute to their profession.

Several researchers evaluated the efficacy of professional development, for example, Mansour (2003) conducted a comparative study on in-service training of teachers within schools in England and the United States with a view to its applicability in Syria. Results showed that although in-service teacher training in Syria has some positive features, there are some weaknesses including not enough time allocated for training teachers, ambiguous training goals for many teachers and lack of trainers' ability. Moreover, to evaluate the quality of training from the perspective of workers at security training institutes in Riyadh, a study was carried out by Alnooijm (٢٠٠٥).

Results revealed weaknesses in training needs analysis, implementation and evaluation of training programs. Furthermore, Sarpong (2006) evaluated the in-service training organized from one to seven days for 120 males and female teachers from training colleges and training personnel from both Ashanti and Brong Ahafo regions in Ghana. Results showed that 65% of the teachers who attended the in-service training stated that the content of the program was beneficial. Furthermore, training was completed within a short timeframe and vacation was the best time to conduct the in-service training program. In addition, teachers were not well motivated to attend the in-service training and the most popular instructional method used was demonstration followed by discussion. Likewise, Hammad and Albahbahani (2011) investigated teachers' attitudes toward in-service training courses in public schools in Gaza. Results showed that government school teachers positively evaluated the training courses organized by the ministry of education and higher education in Gaza. The evaluation included the content of training programs, trainers, training environment and the time allocated for implementation of training programs.

Trainers' competency and instructional methods were also explored by many researchers. For example, Hamroon's (2007) proposal for developing an alternative model to the current Department of Educational training in all districts in Saudi Arabia. He suggested that providing financial support assisted in meeting most of the training centres requirements. In addition, workshops were the most dominant method used by trainer with weaknesses in problem solving techniques, case study, role play and field visits. Furthermore, using different approaches to determine training needs in addition to the use of evaluation tools were problematic. In addition, Harris and Sass (2008) investigated the effects of various types of education and training on the ability of teachers to promote student achievement in the state of Florida. These researchers suggested that only two forms of teacher training influence productivity. First, professional development focused on content is positively associated with productivity in middle and high school mathematics. Second, more experienced teachers appear more effective in teaching elementary math and reading and middle school math. Furthermore, there was no evidence that either pre-service training or the scholastic aptitude of teachers influences their ability to increase student achievement. Moreover, results of Aboul Gheit’s (2011) study showed that pre service teachers were satisfied with trainers' performance in math skills program at the department of math skills at King Saud University in Riyadh.

The effectiveness of training programs can be negatively affected by various factors. Al-Shehri (٢٠٠٦) investigated the quality of training programs from the perspective of officers of King Khalid Military College in Riyadh. Results showed that the training programs contributed to the development of the officers’ skills. In addition, the researcher reported five obstacles that limit the effectiveness of training programs including the poor content of some training programs, working the officers in a field that does not fit their specialization, lack of incentive, lack of trainer’s qualification and the long distance between the training location and the officer’s workplace. Furthermore, Abo Atwan (2008) found some barriers to in-service training programs from the viewpoint of 475 grades 7-10 teachers in Gaza. These barriers included the lack of incentives for trainees, analyzing training needs, training time, training methods, aids and evaluation. Similarly, Al-Zahrani (2009) reported that training courses play an important role in the development of teaching skills for teachers of art education in Mecca. The researcher also reported the existence of some obstacles that hinder the development process such as the absence of incentives, the short duration of courses and the focus on theoretical instead of practical content.

Advantages and disadvantages of the two formats of training

In on-the-job training, learning is relevant to teachers' daily practice and the supervisor directs teachers as to how to perform their tasks properly. Teachers receive immediate feedback and any errors are pointed out. Thus, they gain confidence in their teaching practice and transfer the new skills to their teaching (Fisher, Schoenfeldt & Shaw, 2006). Furthermore, from a financial perspective, on-the-job training is a cost effective method of imparting knowledge and skills (Dessler, 2013).

In contrast, due to the short time allocated for this type of training, the trainer may not be able to deliver the training well and provide teachers with the necessary feedback. The rate of error may also increase when on-the-job training is conducted informally (Werner & Desimone, 2006).

Off-the-job training, when well-organized, can impart a wide range of skills to large groups of teachers. Such activity can allow trainees to focus on learning materials and subsequently desired outcomes are more likely to be achieved (Fisher et al 2006). On the other hand, off-the-job training may provide limited opportunities to practice new skills and can be lacking in the provision of feedback (Malone & Smith, 2010). Thus, it does not provide many opportunities for transference of training to the actual job, when compared with on-the-job training (Fisher et al 2006).

Factors affecting the effectiveness of teachers' professional learning

Teachers' professional learning can be affected by many factors related to how, where and when to implement learning activities (Marsh, 2004; İnceçay & Bakioğlu, 2010). These include: class size, professional learning activities, competence of trainers/supervisors, timing of learning and venue.

Class size

Numerous studies have investigated the impact of class size on professional learning outcomes (*e.g.* Dalton, Hannafin, & Hooper, 1989; China, Ding & Lehrer, 2007; Gok, 2012; De Paola, Ponzo & Scoppa, 2013). It has been found that learning is affected by the number of learners in different ways: individually, as peers, and in small and large groups.

Individualisation format

This format is highly relevant to learners' needs (Print, 1993). It can take place when a physics teacher is involved in the professional learning process together with others such as a trainer or another expert in physics education. Coaching, counselling and considering the task with the educational supervisor are examples of this format of learning (Kumpikaitė, Ramírez & Ribeiro, 2012). Furthermore, individualisation takes a long time for preparation, organisation and implementation (Print, 1993).

Peer groups

It has been previously demonstrated that an association exists between peer groups and learning achievements (*e.g.* China, Ding & Lehrer, 2007; Hussain, Anwar & Majoka, 2011; Gok,_ 2012). For example, a study carried out by Gok (2012) investigated the effects of peer instruction on 123 college students' conceptual learning, motivation, and self-efficacy in an algebra-based introductory physics course for non-majors. The results indicated that those groups taught by peer instruction acquired significantly more conceptual knowledge, and were more self-efficacious than students in the control groups, who were taught by traditional, didactic methods of lecturing.

Small groups

It has been reported there is more individual attention in smaller classes, a more active role for learners, and beneficial effects on the quality of teaching (Blatchford, Russell, Bassett, Brown & Martin, 2007) and hence, learners are more likely to achieve positive academic outcomes in small groups rather than in large lectures (Wilkinson & Fung, 2002). In addition, research showed those learners in small groups work together cooperatively to achieve their academic task (Print, 1993; Whitton, Sinclair, Barker, Nanlohy & Nosworthy, 2004) as well as managing tasks using their own words, views and ideas (Harris-Barnett, 2007). Moreover, successful learning can involve lower achieving learners working together with higher achieving learners (Lin, 2006) in small, collaborative groups.

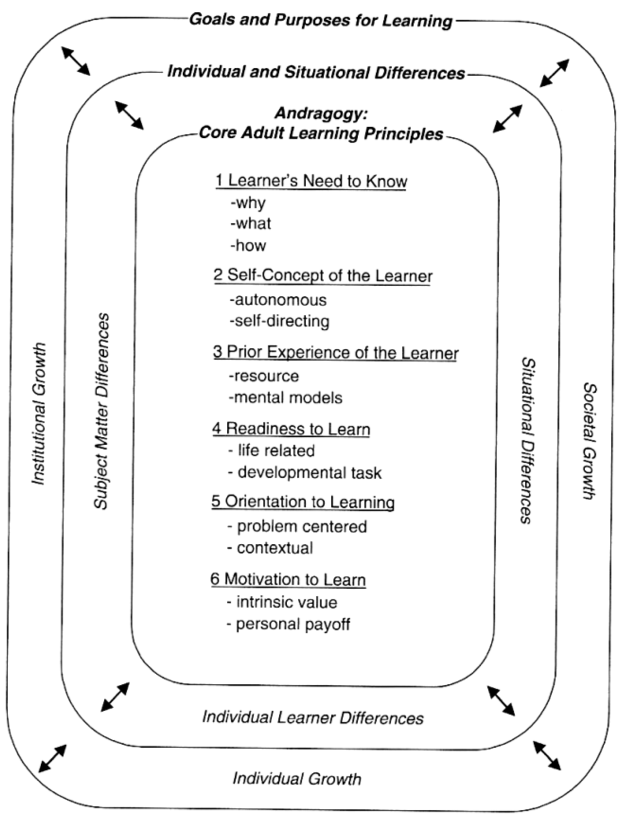
Large groups

Conversely, learners are less likely to achieve desired academic outcomes using whole class instruction (Wilkinson & Fung, 2002). For example, Monks and Schmidt (2010) examined the impact of class size on learners' outcomes in higher education and found that large groups appear to prompt faculty to alter their courses in ways that are deleterious to learners. In addition, De Paola, Ponzo and Scoppa (2013) analysed class size effects on college students by exploring data from a project offering special remedial courses in mathematics and language skills to freshmen enrolled at a medium-sized public university in Italy. Findings showed that after controlling for a number of individual characteristics, larger classes imparted a significant negative effect on students' performance in mathematics especially for low achievers.

Professional learning activities

The nature of teaching adults (andragogy) differs from that which refers to the teaching of younger learners (pedagogy) (Rogers, 1996). Thus, adult learning principles should be considered when choosing training methods. Knowles, Holton, and Swanson, (2005) described such principles and labelled these as the six assumptions of andragogy, as illustrated in Figure 2.6.

Figure 2.6 Six assumptions of andragogy



Source: Knowles, Holton, and Swanson, 2005, p. 4.

Based on these six assumptions, the following elements should be taken into account during planning, implementing, and evaluating of professional learning programs for physics teachers:

1. Teachers need to know the purpose of learning something when they are asked to attend training programs. They also need to know the nature of their learning activities.
2. Teachers need to be responsible for their decisions involving professional learning activities. Teachers also believe that they have the capacity to make decisions for themselves. As a result they prefer to be involved in the process of their learning activities. This includes planning, implementing, and evaluating learning activities (Minton, 1991; Rogers, 1996; Lawson, 2006).
3. Teachers have a range of professional in addition to life experiences that impact their learning. Such experiences should be considered as valuable learning resources during their training programs.
4. Readiness to learn can occur as a result from realization of the need to learn. Teachers therefore are more likely to learn better when they find out that the training program is relevant to their daily lives (Rogers, 1971).
5. Teachers' learning should be problem-centred rather than content-oriented. Subsequently, they are able to realize the importance of their learning in enhancing their ability to address issues and solve problems in their daily practice.
6. Teachers respond better to internal motivators versus external motivators. As a result, providing immediate feedback with some positive reinforcement is an important factor that can encourage teachers to learn well (Kroehnert, 2000).

In summary, teaching approaches for adult learners are most effective when there are clear learning intentions that connect with the learners' prior experience. The learner should be involved in the learning process by working in small groups on real problems or related issues.

Print (1993) differentiated between the most common models of learning as summarized in the following table.

Table 2.4 Models of learning

Model	***Definition***	***Examples***	***Advantages***	***Disadvantages***
Expository teaching	Transmission of information in a single direction from a source such as instructors, books and TV to learners	Lecture, demonstrations and audio-visual presentations	It caters for the large number of learners and learners can acquire a big amount of information in a short time	Learners receive minimal immediate feedback
Interactive teaching using small groups	Division of class into small groups which work relatively independently to achieve a goal	Group discussions, tutorials, seminars, brainstorming and buzz groups	Many skills are learnt and learners receive immediate feedback	Teachers may find some opposition from some learners because of lack of familiarity with the procedure
Inquiry teaching	Engaging in determining answers to questions or resolving problems	Problem solving	Learners develop a range of inquiry-based skills	It consumes a lot of time for both preparation and implementation, and the amount of content covered is minimal
Individualization	Accomplishment of tasks by learners at their own pace	Resolving problems using one of two ways: individualized	It is highly relevant to learners' needs	It consumes a very long time for preparation, organization and implementation and

		learning kit or independent learning		the amount of content acquired might be little
Models of reality	Involving learners in learning situations that are as real-life as possible	Simulations, physical models, games and role-playing	Provide learning situations that are often difficult to comprehend in other ways	It is expensive and takes a lot of time for preparation, and sometimes for implementation

The use of a range of instructional approaches during professional learning programs is necessary (Print, 1993). Various models of learning can be more effective for developing different areas of physics teachers' knowledge. For example, expository teaching can be used to meet the content knowledge needs of teachers (e.g. calculating kinetic energy). Moreover, developing pedagogy knowledge for physics teachers (e.g. classroom management) can be useful through interactive teaching in small groups. Furthermore, demonstrations can be used successfully to develop pedagogical content knowledge for physics teachers (e.g. teaching Law of Reflection of light).

Although such different teaching models and instructional techniques are used in educational institutions, no one method is universally accepted as a principal method of instruction. Kroehnert (2000) argued that using the same method of instruction all the time can create a barrier to learning so considered in the selection and implementation of the most effective training approaches is important. The nature of training content is dissimilar and thus the trainer should not rely on one method of instruction for all subjects (Kroehnert, 2000). Because training content is developed based on training programs outcomes, such outcomes should be considered when selecting instruction methods. For example, Townsend (2003) illustrated the appropriateness of instruction methods for instruction outcomes from 1 to 8, starting with (1) indicating high appropriateness and ending with (8) indicating low appropriateness. This perspective is presented in the following matrix in table 2.5.

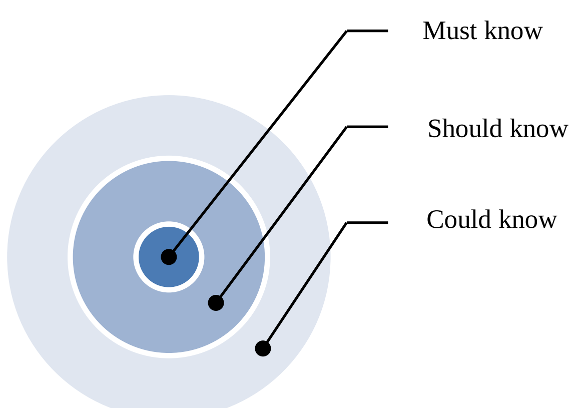
Table 2.5 Effectiveness of different training methods based on instruction goals

METHOD	*Knowledge acquisition*	*Attitude Change*	*Problem solving skills*	*Inter-personal skills*	*Participant acceptance*	*Knowledge retention*
Lecture	8	7	7	8	7	3
Case study	4	5	1	5	1	4
Workshop	1	3	4	4	5	2
Games	5	4	2	3	2	7
Films	6	6	8	6	4	5
Programmed instruction	3	8	6	7	8	1
Role-playing	2	2	3	1	3	6
'T' group	7	1	5	2	6	8

Source: Adapted from Townsend, 2003, p. 44.

In general, when considering the subject matter, training should aim at the ‘must know’ area as priority (Kroehnert, 2000).

Figure 2.7 Three priority learning areas



Source: Adapted from: Kroehnert, 2000, p. 67.

According to Jauhiainen (2013), dealing with theoretical principles as an approach is less advantageous. Consequently, during in-service professional development for physics teachers, the focus should be on practical learning rather than theoretical learning.

Finally, deciding what learning activities should be used is also affected by the duration of the training program and available facilities. For example, complex case studies and games consume more time for both preparation and implementation, and require more materials and facilities (Stanciu, 2007). Lectures maybe more effective for short training courses due minimal time and materials available.

Competence of supervisors/trainers

A qualified instructor plays an important role in increasing the effectiveness of learning (Kroehnert, 2000). Because teachers of adults have different tasks from those who teach children, many researchers plus some educational institutions have attempted to identify characteristics of successful adult instructors. For example, Lawson (2006) and Malley, Brown and Perez (2006) suggested that trainers need a broad range of skills including being knowledgeable in the subject area, being well organized, a good communicator, able to relate content to participants' situations, respectful of participants, and being supportive and able to use a variety of methods.

Timing of professional learning

Numerous studies have investigated the impact of time on learners' academic outcomes (e.g. Spickler, Hernandez-Azarraga & Komorowski, 1997; Logan & Geltner, 2000; Sjosten-Bell, 2005; Ray, 2009; Kucsera & Zimmaro, 2010). It has been found that learning is affected, both negatively and positively, by the period, duration and scheduling of learning activities.

Research shows that memory in addition to attention levels are affected by the instruction period throughout the day (Klein, 2001). According to Spickler, Hernandez-Azarraga and Komorowski (1997), science teachers achieved many desired outcomes by using a hands-on approach to the teaching of science and mathematics during the after-school hands-on science program. Ray (2009) also investigated the interactive effect of class time on students' academic performance in the Basic Statistics-I course at the Liberal Arts College. The results showed that the afternoon classes significantly impacted academic performance in a negative manner.

Based on previous research findings, it appears that short-term memory is better in the morning, while long-term memory is better in the afternoon (Jensen, 2000). As a result, learning activities involving short-term memory, such as mathematics and science, may be better run in the morning (Brewer & Campbell, 1991). However, learning activities involving long-term memory such as art, problem solving techniques and hands-on activities, may be better run in the afternoon (Brewer & Campbell, 1991; Stanciu, 2007).

Duration of the professional learning program appears to influence teaching and learning outcomes. For example, from a database consisting of 446,000 students at Santa

Monica College, those enrolled in the 6-week compressed sections had higher academic success rates than those enrolled in the same courses during a 16-week semester (Logan & Geltner, 2000). Furthermore, Austin, and Gustafson (2006) investigated the link between course length and student learning using a database of over 45,000 observations. They found that intensive courses do result in higher grades than traditional 16-week courses and this benefit peaks at about 4 weeks.

In contrast, Kucsera and Zimmaro (2010) investigated differences in the effectiveness of instructors who taught the same course in both intensive and traditional formats. Results indicated that for the same course taught in both formats within the same year, intensive courses did not significantly differ from traditional courses in overall "instructor" ratings on learner evaluations of teaching effectiveness at the University of Texas.

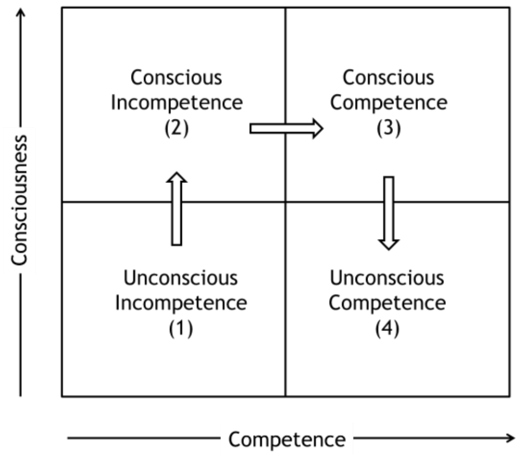
Finally, the date of professional learning should be considered. For example, in a study conducted by Karagiorgi and Symeou (2007), the results showed that the majority of Cypriot teachers prefer to be involved in their in-service training activity during working days, followed by holidays and weekends respectively.

Time required to accommodate new knowledge

In general, teachers learning a new skill need time. The duration is identified by different combinations of two factors: consciousness, which relates to the awareness of something for what it is and competence, which describes the possession of the required skills and knowledge to do something successfully. Based on these factors, Howell

(1982) developed a model of learning duration comprising four stages through which every learner should pass, as he/she builds competence in a new skill.

Figure 2.8 Four stages of learning a new skill



Source: Howell, 1982, p. 29.

These four stages are detailed below:

Stage 1: Unconscious incompetence

Learners during this stage are not aware they have a particular deficiency in how to do something within the area of training. For example, a physics teacher is not aware of his deficiency in how to use a Van de Graaff generator. Thus, the role of instructor is to move the learner into the next stage to become conscious of their incompetence before developing the new skill. This can take place by the instructor explaining the skill and the benefits it will bring to the learner's effectiveness.

Stage2: Conscious incompetence

The learner becomes aware of their deficiency in the use of a Van de Graaff generator even though they do not know how to address it. The learner also realizes how important it is to master this skill in order to increase their effectiveness in this area.

Stage3: Conscious competence

Learners during this stage are able to reliably use a Van de Graaff generator without assistance. However, the learner needs to concentrate and think in order to perform the skill.

Stage4: Unconscious competence

Because the skill has been practised, the learners can now use a Van de Graaff generator without concentrating and thinking about it. In this stage, the skill has become "second nature".

The duration needed for these four stages to be completed depends on the nature of the three areas of physics teachers' knowledge (i.e. CK, PK and PCK) as well as the learner's readiness to learn. Consequently providing teachers with new techniques, learning and the acquisition of knowledge should be given a suitable length of time to take place. For example, one training day can be suitable for a teacher to learn and master a simple skill in the area of PK such as using a SMART Board (Adey, 2006). However, multi-skilled training programs (e.g. planning for teaching physics) require more than a day for a sustained change in teaching practice to occur (Adey, 2006; Timperley, Wilson, Barrar & Fung, 2007). For example, Wanner, Martin-Diener, Frick, Kriemler, & Martin (2014) argued that a two-day training course can support classroom teachers to plan and conduct physical activity and sports for young primary school children in Switzerland. In addition, Birman, Desimone, Porter & Garet (2000) reported that a five-day summer science professional development institute (related to PCK), had effective features for teachers in the small, rural district of Washington.

Professional learning venue

Learning can be affected by the physical conditions of the learning venue (Marsh, 2004); however, this is not always given sufficient attention (Kroehnert, 2000). In addition, a good physical environment can improve comfort (Walker, 2007), the learner's rating of how they enjoyed the course (Hill & Epps, 2010) and well-being (Ruff, 2008). Research shows a correlation between the physical elements of the adult classroom and motivation to learn and hence influence learners' overall skill development and knowledge acquisition (Walker, 2007; Hill & Epps, 2010; McLaughlin, 2012), and the stimulation of creativity (Taiwo, 2010).

For example, a crowded place and a large venue for just a few learners can create a barrier to learning (Kroehnert, 2000; Earthman, 2004; Office of Classroom Management, 2010). Moreover, Callahan (2004) found that the learners seated in straight rows at the University of Florida campus were off-task, had fewer learner-to-instructor interactions and were distracted more often than learners seated in the pod arrangement. Furthermore, in order to examine the impact of temperature on learners' achievement, a study was carried out by Pilman (2001) on 52 undergraduate students from Loyola University. Results showed that the 80 ºF and the 64 ºF environment had negative effects on memory ability compared with standard 72ºF environment.

Professional learning venue standards

In considering the literature regarding the professional learning venue, several points can be identified as a guide when creating an ideal professional learning venue for physics teachers. These standards are presented in following table.

Table 2.6 Professional learning venue standards

Domains	***Standards***
Size of learning venue	• Space per person: 2.2-3.3 square meters • Minimum ceiling height: 3 meters around the room and 3.4 meters at the projection wall • Room shape: nearly square (not a rectangular)
Layout of learning venue	• Door location: at the back of the classroom • Spacing: 96.5cm apart with movable seats and minimum of 76cm space for rows of tables apart • Aisles: ٩١cm wide for primary and a minimum of 71cm wide for secondary paths
Furniture	• Furniture: easily to be rearranged • Chairs: good design, adjustable height, swivel with five point caster base • Tables: variety shapes (square, triangle, circle, semicircle and trapezoid) • Trapezoid tables: 82cm height, 50cm minimum depth of top, 60cm minimum width of top, wide angle=120° and narrow angle=60° • Carpet tile: over vinyl tile, resilient floor finish for the instructor area used to demonstrate the experiments • Supplementary accessories: coat racks, clocks, recycling and trash receptacles
Lighting	Natural lighting: • Light level: 30 foot-candles • Windows: proper size, level higher than the sight level of learners, opaque glass, controlling the amount of light (curtains, blinds and reflectors) Artificial light: • Light level: 75 foot-candles • Close to natural spectrum light (lamps with full-spectrum light bulbs), indirect lighting
Colour	• Ceiling: light colour, light reflectance coefficient= 90% or higher • Walls: light and natural green or blue, an eggshell finish • Wall behind white boards and projection screens: darker than other areas • The end wall: a medium color, light reflectance coefficient= 50-60% • Floor: medium to dark, a multi-coloured or patterned carpet

Table 2.6 (Continued)

Domains	*Standards*
Air quality	• Temperature: 68-77°F (20-25°C) • Humidity: 35-65% relative humidity • Air circulation: sufficient and gentle • Plants and flowers: sufficient and natural
Noise	• Learning venue: separated from noise sources (traffic, adjacent classes, mechanical rooms, elevators and restrooms) • Noise levels: not exceed NC 30 • Reverberation time: 0.6-1.2 seconds • Entrance doors: operated quietly, having a vision kit installed • Transfer grills: are not be used above doors
Learning aids	• Instructional aides: different audio visual equipment is available • Projection screen location: on right side of instructor area oriented towards the gravity Centre of the seating area • Dimensions of projection screen: ✓ Minimum height: 20% of distance to seat farthest away from screen ✓ Minimum width: 4:3 aspect ratio of projected images • Distances between projection screen and different seats: ✓ Minimum distance from the screen to the closest row: 1.5 of screen height ✓ Maximum distance from the screen to the farthest row: 6 of screen height • Viewing angles: ✓ Maximum 45º horizontal angle from the perpendicular to the centre of screen ✓ Maximum 35º vertical angle from the perpendicular to the top of each
Facilities	• Basic facilities: car park, access for the disabled, fire exits, building signs, room numbers, rest rooms, drinking fountains and tea & coffee making facilities • Corridors: providing furnished comfortable spaces (seats, tables, rugs, proper lighting and plants)

Summary of review of literature

This chapter explored the literature associated with the concepts, issues, research and practices of professional development for teachers. The review has highlighted the need to promote professional development as a key element in school improvement (Newmann, King, & Youngs, 2001; Borko, 2004; Melville & Yaxley, 2009). Professional development can support graduate teachers by addressing the gap between the knowledge and skills required within school based pedagogical practice and that acquired through pre-service programs (Birman, Desimone, Porter & Garet, 2000; MacPhail, 2011). The training should also provide teachers with relevant current instructional techniques, such as using multimedia technology, appropriate for 21st century learning (Al-Wreikat & Bin Abdullah, 2010; Behlol & Anwar, 2011).

Professional development activities can have a positive impact on teachers' performance (Powell, Terrell, Furey & Scott-Evans, 2003; Knight, Tait & Yorke, 2006; Gabriel, Pereira & Allington, 2011; Harris, Cale & Musson, 2011) However, many professional development programs have failed to improve teaching practice and ultimately students' achievement outcomes are not being attained (Birman, Desimone, Porter & Garet, 2000; Newmann, King & Youngs, 2001; Armour & Yelling, 2004; Hofman & Dijkstra, 2010).

Teachers' learning requirements needs to be the primary focus for improving teaching practice to maximize students' learning (Department of Education and Training, 2005; Cole, 2012). Researchers have highlighted the features of effective professional learning that can improve teaching including needs-based training, linking content to practice, varied learning activities, follow up and sustainability.

Physics teachers need to have a deep comprehension of content and pedagogy associated with teaching in this domain. This understanding of subject concepts is collectively called content knowledge (CK) (Gil-Perez & Carvalho, 1998; NSTA, 2003) and a strong understanding of how to teach is known as pedagogical knowledge (PK). Furthermore, Shulman (1986) argued that a special kind of knowledge is required to teach particular content to particular students effectively. This type of knowledge is known as pedagogical content knowledge (PCK).

Professional development for physics teachers should be carried out using a wide variety of learning activities that are designed to meet the needs of various situations. Using one or more of these activities depends on numerous factors such as professional learning objectives, situational characteristics, program design and available budget (Dessler, 2013). Professional development approaches can be categorized as on-the-job training and off-the-job training.

Teachers' professional learning can be affected by many aspects related to how, where and when learning activities are implemented (Marsh, 2004; İnceçay & Bakioğlu, 2010). Factors affecting the implementation of teachers' professional learning include class size, professional learning activities, competence of supervisors and trainers, timing of learning and physical condition of the learning venue.

The literature has broadly addressed many issues related to professional development for teachers. In spite of the importance of this body of work, some points should be further considered. Firstly, while the majority of these studies were conducted in order to examine professional learning practices worldwide, few studies have been conducted to investigate professional learning practices in Saudi Arabia. Secondly, most of the studies investigated professional learning practices for effective teaching in general. A small number of studies investigated training practices for teaching physics. Thirdly, many previous inquiries have focused on training practice in the areas of training needs analysis and training evaluation for educators in both pre-service and in-service programs. However, few investigations focused on training implementation and professional learning experience. Fourthly, while many studies explored general pedagogy for teaching, few explored pedagogical content knowledge for teaching physics. Lastly, some researchers have investigated the professional learning practice of teachers at different career stages, whereas few studies have investigated training practices at secondary and intermediate level.

Research focusing on professional learning practice for physics teachers in regard to training implementation for secondary and intermediate schools is relatively absent in the literature. More research is required in order to understand the work and requirements of physics teachers in this area, which is the purpose of conducting this study.

The following chapter provides an overview of the pedagogy of physics teaching and professional learning in Saudi Arabia. It presents in detail the Saudi education system, focusing on professional development of physics teachers using the two main modes of in-service training, supervision procedures and educational training programs.

CHAPTER 3: PHYSICS PEDAGOGY AND PROFESSIONAL LEARNING IN SAUDI ARABIA

This chapter presents an overview of the educational system in Saudi Arabia. It includes a profile of the country, the main characteristics of its education system and physics education. Furthermore, the discussion addresses the professional development process for physics teachers focusing on the two main formats of professional learning; educational supervision activities and educational training programs.

Profile of Saudi Arabia

The kingdom of Saudi Arabia, commonly referred to as Saudi Arabia, means different things to different people (Ministry of Foreign Affairs, 2014). For example, for millions of Muslims across the world it is the ultimate Holy Land and pilgrimage destination. In addition, for a large number of expatriates from Asia, Africa, Europe and the United States, it is a land of opportunities. Furthermore, for the rest of the world, Saudi Arabia means oil – the lifeline of present and future economies. Saudi Arabia has so far lived up to all these definitions, and is now entering a new phase of its development.

Saudi Arabia was first established in 1902 by King Abdulaziz Al-Saud. It is located in the southwest corner of Asia and has large border. As shown in Figure 3.1, it is surrounded by the Red Sea on the West, by Yemen and Oman on the South, the Arabian Gulf and the United Arab Emirates and Qatar on the East, and Jordan, Iraq and Kuwait on the North (Central Department of Statistics & information, 2014).

Figure 3.1 Map of Saudi Arabia

Source: Maps of world (2014)

Saudi Arabia is the second largest country in the Arab world and spread over 2,150,000 square kilometres occupying almost 80 % of the Arabian Peninsula. Its Red Sea coastline stretches about 1,760 kilometres while its Arabian Gulf coastline roughly 560 kilometres. Desert covers more than half the total area of Saudi Arabia and a narrow coastal plain runs through the Kingdom’s western coast while a range of mountains run parallel to the coastal plain along the Red Sea. The mountains in the west of the Kingdom are very rich in minerals with large deposits of limestone, gypsum and sand. The eastern region has the richest reservoirs of oil in the world.

The total Saudi population as of 2010 amounted 29,195,895 million (Central Department of Statistics & information, 2014) and the official language in Saudi Arabia is Arabic.

Saudi Arabia is divided into 13 administrative regions comprising over 6000 cities, towns and villages. The main cities are: Riyadh, the capital city of Saudi Arabia and located in the central region; Mecca and Medina, the Holy cities of Islam; Jeddah, the main port in the western region and Dammam, the main port in the eastern region.

Development of education in Saudi Arabia

According to Alromi and Alswaidani (2013) education in Saudi Arabia began in 1925 and has grown through three phases as following:

First phase: traditional learning. This type of education was delivered at a mosque.

Second phase: public education. This was a formal type of education introduced by the Turks. Mainly it was delivered in the cities of Al-Madinah and Makkah using the Turkish language.

Third phase: private education. This type of education was funded and delivered by parents.

Evolution of the education system

The first government school in Saudi Arabia was established in 1925 and the number of schools has grown through the three stages of education system to reached 34784 schools in 2013 (Ministry of Education, 2014). These stages are listed below:

In 1925, the first formal organization of education was established under the Ministry of the Interior in Makah. This organization was called Directorate of Knowledge and the aim of establishing the Directorate of Knowledge was to organize the educational process around Saudi Arabia by issuing regulations and strategies needed. These included the regulations of teaching program in the holy mosque in Makah. At that time, the total number of schools in Saudi Arabia was 4.

In 1927, the first board of the knowledge was established. The role of that board was initially the supervision of the education in the Hejaz region. However, the supervision included the rest of region in Saudi Arabia later on. The board also endeavoured to make the elementary education stage is compulsory and free for all male students of all social classes. At that time, the number of schools was 323 schools.

In 1951, the Ministry of Knowledge was established in Makah as a development of the Directorate of Knowledge. The goal of the Ministry of Knowledge was to develop the different types and stages of education institutions in Saudi Arabia both formal and informal. This development included public education for boys, institutes of teachers, and technical institutes, in addition to universities until 1975. In 1956, the Ministry of Knowledge moved to Riyadh.

In 1960, General Presidency for Girls' Education was established in order to develop the education process for girls around Saudi Arabia.

In 1975, the Ministry of Higher Education was established in order to develop the education process in university around Saudi Arabia.

In 1980, the General Organization for Technical Education and Vocational Training was established in order to develop technical education process around Saudi Arabia.

In 2003, the General Presidency for Girls' Education was merged with the Ministry of Knowledge.

In 2004, the Ministry of Knowledge was re-named the Ministry of Education.

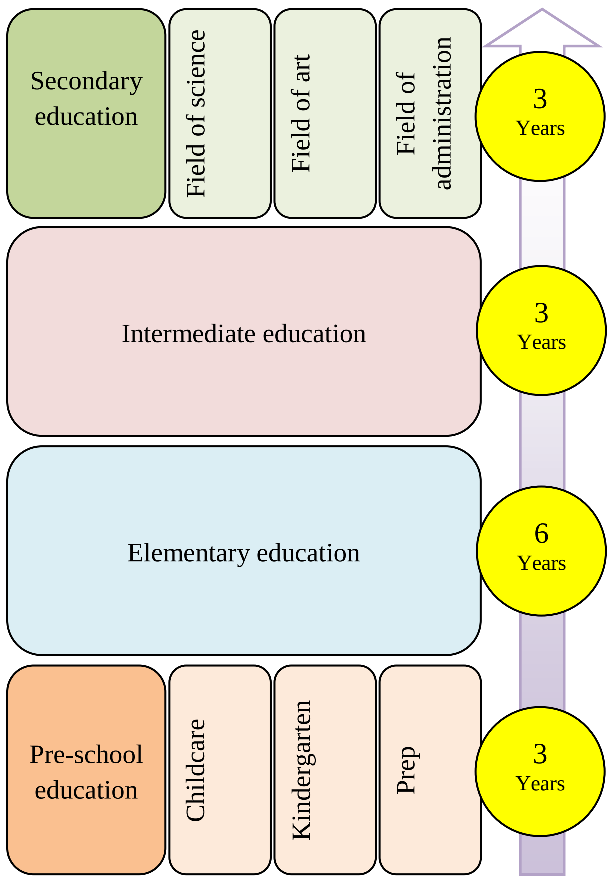
General goals of education in Saudi Arabia

The education system's goals in Saudi Arabia are fundamentally derived from Islamic principles. Therefore, the policy of education in Saudi Arabia (1970), declared the general goals of Education in Saudi Arabia are to assist students to understand Islam in correct and comprehensive manner, to plant and spread the Islamic creed, to provide the students with values, teachings and ideals of Islam, to provide the students with various of knowledge and skills, to develop behavioural constructive attitudes, to develop the community economically, socially and culturally, to prepare the individual to be a useful member in the building of his/her community.

The structure of the educational systems in Saudi Arabia

The structure of general education in Saudi Arabia is mainly organized to include three stages: elementary, intermediate and secondary education. Each stage is also divided into a certain number of grades. Furthermore, the structure implements the 6-3-3 system, which is six years elementary education, three years intermediate and three years for secondary education (Alromi and Alswaidani, ٢٠١٣). This style of organizing the educational ladder is a wide spread style of education in the Arab world. Additionally, the organizational structure in Saudi Arabia includes three years for pre-school education. This stage consists of three levels: childcare, kindergarten and prep. These levels are a mixed gender education. Therefore, male and female students go to the same school under the supervision of girls' schools. Figure 3.2 illustrates the general Saudi educational ladder.

Figure 3.2 The structure of the educational systems in Saudi Arabia



Source: adapted from Ministry of Education, 2014

Summary of statistical information on general education in Saudi Arabia

There has been a notable increase in the number of schools, students and teachers in Saudi Arabia from the academic year 1925 up to the recent academic year. Table 3.1 demonstrates a summary of statistics on both male and female education by stage and type of education for the academic year 2013.

Table 3.1 Summary of statistics on general education in Saudi Arabia

Stage	*Gender*	*Schools*	*Students*
Pre-school	Male	0	71,906
	Female	2,559	110,650
	Total	2,559	182,556
Elementary	Male	6,872	1,304,068
	Female	6,929	1,266,266
	Total	13,801	2,570,334
Intermediate	Male	4,373	639,933
	Female	3,952	590,644
	Total	8,325	1,230,577
Secondary	Male	2,954	670,198
	Female	2,771	543,886
	Total	5,725	1,214,084
Adult Ed.	Male	821	14,563
	Female	1,688	37,340
	Total	2,509	51,903
Special Ed.	Male	1,269	15,395
	Female	596	9,356
	Total	1,865	24,751
Total	Male	16,289	2,644,157
	Female	18,495	2,630,048
	Total	34,784	5,274,205

Source: adapted from Ministry of Education, 2014

Education funding in Saudi Arabia

The Saudi Arabian government is responsible for educational funding. This means education in all styles and stages is free for all citizens and residents, except the private education as declared in the policy of education in Saudi Arabia:

> Education is free in all its forms and stages. Government does not charge learners fees of education service.
> *Item (No. 233 of the policy of education in Saudi Arabia, 1390H / 1970)*

As a result, the government allocates enormous funding for this sector. This funding increases in line with the public budget implementing the education policy in Saudi Arabia as stated in article number 230 of the policy:

> Government considers the increase in the proportion of the education budget to face a growing need for education. This percentage is growing with the growth of the general budget of the country.
> *Item (No. 230 of the policy of education in Saudi Arabia, 1390H / 1970)*

For example, the education budget was SR 666 million representing 9.8% of the 1970 financial year total appropriations. This budget grew to reach SR 210 billion representing 25% of the 2014 financial year total appropriations (Ministry of Finance, 2014).

Furthermore, the 2014 education budget includes new projects for 465 new school buildings amounting to around SR 3 billion in addition to 1,544 school buildings currently under construction. In addition, the budget includes appropriations to increase the number of classrooms and the renovation of around 1500 existing school buildings.

The new budget also includes appropriations for completing renovation for girls' colleges in several universities, establishing 8 new colleges, and completing the construction of campuses for the new universities. In addition, the new budget includes several new projects that include the construction of new vocational and technical colleges and institutes costing around SR 5.2 million.

Science teaching in Saudi Arabia

Science is a very important subject to be taught in all different stages of schooling in Saudi Arabia schools. The Ministry of Education consequently, seriously tried to improve teaching of science and then to assist students to learn science properly by giving more attention to the discipline. The Ten-Year Plan of the ministry of education for example, included the area of science education development as following:

> **Goal No. 4:**
>
> To prepare students academically, and culturally at a local and international level to be able to achieve advanced posts internationally in the fields of maths and sciences for the various age categories, taking into account International tests' standards.
>
> **Objectives:**
>
> 1. To enhance co-operation and exchange in cultural and educational fields between the Ministry and its international counterparts and establish the proper communication and administrative channels for such endeavour.
> 2. To enrich the participation of the Ministry of Education in educational and cultural activities.
> 3. To enhance the benefits of programs and projects by international and local educational organizations.
> 4. To ensure the inclusion of international standard levels for students' academic (scientific) performance and for knowledge acquisition.
> 5. To promote and facilitate students' participation in international Math and science tests.
>
> *(General Directorate for Planning, 2005:13)*

General goals for science education in Saudi Arabia

Al-Ghanem (1999) reported that the general goals for science education in Saudi Arabia are to provide the student with the necessary scientific information, various skills and developing the student's scientific thinking, strength the student's feelings about the problems of his society and preparing him to participate in their solution, demonstrate the full harmony between science and religion in the Islamic law as Islam is a combination of religion and secularism, and the Islamic thought meets all the human needs in their highest forms and in all ages in addition to follow up world achievements in the fields of science.

Physics teaching in Saudi Arabia

Generally, teaching of physics topics in Saudi Arabia's schools can be classified into three categories. This is presented in Table 3.2:

Table 3.2 Physics teaching in Saudi Arabia

Stage	*Grade*	*Organizing of curriculum*	*Teachers*
Primary school	1-6	Basic of integral scientific topics (including physics) in one textbook	Specialists in general science
Intermediate school	7,8,9	Mixture of separated topics (physics, chemistry, biology, geology and astronomy) in one textbook	Specialists in one area of science
Secondary school	10,11,12	integral physics topics in one textbook	Specialists in physics

Source: Alhaggass, 2009, p. 3.

Table 3.2 indicates that teachers of science in intermediate schools are required to teach some physics topics which are outside of their specialist area. Because of the shortage of qualified teachers of this stage, every specialist in any field of science such as chemistry, physics and botany can acquire the opportunity to teach in this stage which has the potential to cause many instructional problems (Al-Huthaifi, 2000). These instructional problems include the poor operation and use of physical devices and the insufficient ability in applying mathematical process (Alhaggass, 2009). These instructional problems represent an obstacle for teaching physics topics in Intermediate school and consequently, the desired outcomes of learning physics are not achieved properly in this stage. This situation generates the need to identify professional development strategies for teachers and ultimately improve outcomes for students.

Teachers' development in Saudi Arabia

Teachers' professional development is a vital component of any educational system. Therefore, many regulations have been made in Saudi Arabia on this area. For example, the policy of education in Saudi Arabia for example, declared that:

> Training of teachers is a continuous process. A qualification plan should be built for unqualified teachers and a training plan should be built for qualified teachers.
> *Item (No. 170 of the policy of education in Saudi Arabia, 1390H / 1970)*

In addition, the legislation of civil service affirmed that:

> Training of employees is considered as a part of their jobs both during work hours and out of work hours.
> *Item (No.34 of legislation of civil service, 1397H/ 1977)*

Thus, teachers must participate in at least one training program every five years as the policy of educational training of the Ministry of Education 2002 stated.

As the professional development for teachers is unlikely to take place unless planned effectively (Duncombe and Armour, 2004), the Ten-Year Plan of the Ministry of Education (2005) aimed to improve the quality of both male and female teachers to achieve the full use of Saudi human resources. Therefore, the plane included some items on this notion such as development of the teaching methodologies, development of the educational supervision methodologies in accordance with the aimed development of the educational system, in addition to development of specific standards for male and female teachers' performance based on an accountability system.

Professional development of physics teachers in Saudi Arabia

Physics teachers in Saudi Arabia are developed professionally through two main formats; on-the-job training and off-the-job training. Table 3.3 demonstrates the difference between these two formats.

Table 3.3 The difference between the two formats of professional development of physics teachers in Saudi Arabia

	First format	*Second format*
Training format	On-the-job training	Off-the-job training
Started in	1377H - 1957	1374H - 1954
Designed and implemented by	Department of Educational Supervision	Department of Educational Training
Designed and implemented at	Schools	Educational Training Centre
Includes activities such as	Classroom visit Meeting: ✓ Individual ✓ Group Literature: ✓ Handout ✓ Proposed reading list Model lessons Workshop Microteaching	Lecture Group discussion Field trip Workshop Demonstration Brainstorming Role playing Case study Project
Duration	One schools day twice a year	4-20 hours
Period	Morning	Morning / evening
Cost	SR1150 per a teacher yearly	SR 650 per a teacher yearly

Educational supervision in Saudi Arabia

Educational supervision in Saudi Arabia has evolved from being an inspection process to being a supervision process. Each new stage of supervision was given a new title to reflect its purpose. According to the General Directorate of Educational Supervision (1998) educational supervision in Saudi Arabia has gone through four main phases; inspection phase, technical inspection phase, educational guidance phase and educational supervision phase. Table 3.4 demonstrates these four phases.

Table 3.4 The four main phases of the educational supervision in Saudi Arabia

Phase	***Duration***	***Process***
Inspection	1377-1384H 1957-1964	The inspector visits the school three times in each year in order to achieve three tasks as following: First visit: directing teachers Second visit: evaluating teacher performance Third visit: the evaluating the impact of the teachers on their students
Technical inspection	1384-1387H 1964-1967	The ministry of education established four specialized departments for subjects which are: 1. Department of Arabic Language 2. Department of foreign Languages 3. Department of Social studies 4. Department of Math and Science The inspector tasks included evaluating curricula, reviewing the shortage of teachers and the deficit of textbooks, teaching and learning aid within schools
Educational guidance	1387-1416H 1967-1996	The title of technical inspector was changed to educational guide in order to build a positive relationship between the educational guide and the teachers. The tasks of the educational guide included providing administrative and technical advice to the schools and evaluating curricula and textbooks in addition to the assist in the students assessment
Educational supervision	1416H -now 1996-now	The ministry of education increased the number of the specialized departments for subjects to become twelve departments. The educational supervisor tasks included transfer of expertise among teachers to assist them to develop. The supervisor also, supports schools to overcome any difficulty may hinder the implementation of the curriculum and assessing students' achievement effectively.

Source: adapted from General Directorate of Educational Supervision, 1998

The goals of the educational supervision

Educational Supervision in Saudi Arabia aims to develop the educational process in the light of the objectives of education policy in Saudi Arabia. This development considers all factors affecting the teaching and learning process such as students, teachers, textbooks, teaching methods, teaching and learning aids and evaluation tools.

Regarding teachers, the goals of educational supervision includes the development of teachers' performance both in the area of subject matter and pedagogy.

Educational supervision methods

In order to achieve the educational supervision goals, many supervisory methods are commonly used by supervisors. The General Directorate of Educational Supervision (1998) highlighted these methods as following:

Classroom visits

It is the most important supervision activity because it enable the educational supervisor to observe teaching activities and then evaluate teachers' performance within their classrooms. These visits take place either scheduled or unscheduled through three main steps as following:

Before the visit: the supervisor meets every teacher shortly and describes the purpose of the visit. This short meeting aims to create a positive atmosphere which helps both the supervisor and the teacher to achieve the visit purpose.

During the visit: the supervisor sits in a suitable location within the classroom so he can observe the teacher's performance. It is important to avoid interrupting the teacher and feedback should be deferred until the class is completed. In addition, if the supervisor notes that the teacher get nervous, the visit should be stopped and rescheduled for another time.

After the visit: the supervisor collaboratively with the teacher analyses the performance of the teacher within his classroom. Moreover, a treatment plan should be built to improve the teacher performance.

Handouts

It is a communication mean aims to provide teachers with useful teaching tips by the educational supervisor. These tips include some educational problems and proposed solutions, guidance related to instructional techniques and teaching aides.

Meetings

This sort of supervision activities provides teachers with an opportunity to address the educational problems may they face. Meetings are conducted using three forms: Individual meeting for a teacher with specific professional need, group meeting for some teachers with common professional need and public meeting for all teachers with widespread professional need.

Model lessons

It is a practical technique aims to demonstrate a new instruction method or the appropriate use of a modern teaching aid for teachers. Model lesson can be run by the educational supervisor himself or an experienced teacher under the supervision of the supervisor.

Exchange visits among teachers

Teachers are recommended to visit each other both within their schools and outside their schools. Such mutual visits among teachers are a desirable supervision activity because teachers share their teaching experiences with others. In addition, during mutual visits, teachers can evaluate their teaching skills by comparing their performance with the performance of others.

Workshops

The aim of workshops are to improve skills of a number of teachers by allowing them to work together collaboratively under the supervision of the educational supervisor in order to accomplish a specific task. Workshops include tasks such as textbook content analysis, building teaching plans, and production of some educational aids.

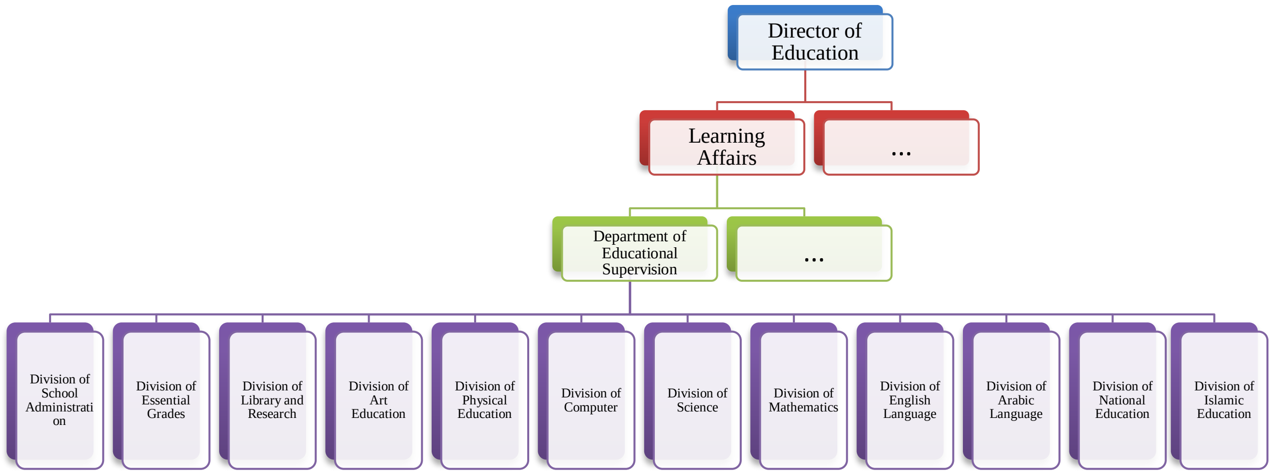
Microteaching

It is a supervision activity used to improve teacher's performance individually by focusing on one skill in one time. During this technique, a teacher is asked to run a small class (4-6 students) for short time (5-10 minutes) focusing on specific teaching skill. The teacher is asked to run the small class again after receiving some feedback by the supervisor on his performance. Once the teacher performs the specific skill well, he is asked to run a new small teaching class for new skill.

Organizational structure of educational supervision

Figure 3.3 illustrates the organizational structure of educational supervision department in each directorate of education in Saudi Arabia.

Figure 3.3 Organizational structure of educational supervision



Source: adapted from the General Directorate of Educational Supervision, 1998

Competency of the educational supervisor

In order to achieve the goal of the educational supervision, the supervisor should have a number of skills. These skills can be acquired through attending training programs in addition to the self-development. According to the General Directorate of Educational Supervision (1998), the following are examples of competencies needed for the educational supervisor regarding to the development of teachers' performance:

1. Competency of subject matter in his major
2. Competency of pedagogy
3. Competency of communication
4. Competency of using the educational supervision methods
5. Competency of training
6. Competency of human relationships

Educational supervisor recruiting

Educational supervisor is chosen among distinct teachers. According to the Department of educational supervision (2006), the minimum conditions that must be met for working as an educational supervisor are detailed as following:

The nominee should:

1. have at least a bachelor degree from an educational institute with overall “Good” grade (Alternatively, has a Diploma in Education after completing his bachelor degree)
2. worked at least six (6) years as a teacher and two (2) years as a secondary school teacher
3. obtained at least "Excellent" grade in the employee performance appraisal during the last two years
4. have the ability to:
    - perform a model lesson
    - exchange visits with his colleagues both within and outside his school
    - run a short meeting
    - do a research in educational practice
    - participate in the run of supervision activities
    - analyze and criticize curricula
5. have the following basic skills:
    - problems analysis
    - communication skills

- decision-making
- planning
- guidance
- evaluation
- writing reports
- observation and diagnosis of teaching practice

6. have the ability to use a computer
7. have the following personal attributes:
   - Islamic behavior
   - good physical abilities
   - good appearance

Educational training in Saudi Arabia

The Ministry of Education began to design and implement in-service training programs since 1374H, 1954 (General Directorate of Educational Training and Scholarship, 2002). These programs aimed to develop teaching skills of teachers both qualified and non-qualified as following:

In 1954, a summer holiday training course for the duration of one hundred days duration was conducted. This course aimed to develop teachers' skill in the area of psychology, subject matters and teaching methods.

In 1955, a three-years evening institute was established. The focus was on developing teachers' skills in psychology and teaching methods.

In 1965, short training programs in many locations around Saudi Arabia were conducted. These programs targeted those who successfully completed their summer training or have graduated from evening teachers' institute. In the same year, the Ministry of Education established two institutes for teachers in Riyadh and Taif.

In 1971, a training program for one year duration was conducted in order to develop skills of schools principals.

In 1973, a training program for one year duration was conducted to develop teachers' skills at intermediate and secondary schools.

In 1979, training programs in many locations around Saudi Arabia were conducted in cooperation with the educational guidance departments. These courses aimed to develop skills of teachers in different schooling levels in the area of Islamic education, teaching adults, special education and teaching aids.

The goal of the educational training

Educational training in Saudi Arabia aims to achieve a continuous professional growth of all educators, and to qualify national employees in different disciplines needed for the Ministry of Education (General Directorate of Educational Training and Scholarship, 2002).

Educational training types

The ministry of Education implement various training programs in different locations around Saudi Arabia. These locations include educational training centres, teachers' colleges, universities and Institute of Public Administration. Table 3.5 demonstrates these types of training programs.

Table 3.5 Types of training programs

Locations	***Types of training programs***	***Duration***	***Examples of training programs***
Educational training centres	Short courses	Up to two week	Teaching skills Classroom management Educational technology
Teachers' colleges	Qualification courses	1-2 Semesters	School principals course Custodians of laboratories course Schools activity
Universities	Qualification courses	1-2 Semesters	Educational supervisors course Diploma in guidance and counselling Measurement and Evaluation diploma
Institute of Public Administration	Short courses + Qualification courses	Different duration	Trainers skills development Training needs assessment Training management training

Source: adapted from the General Directorate of Educational Training and Scholarship, 2002

Educational training methods

In order to achieve the educational training goals, many training methods are commonly used by trainers. The General Directorate of Educational Training and Scholarship (2002) highlighted some of these methods as following:

- Lectures
- Structured discussion

- Unstructured discussion
- Field trips
- Workshops
- Programmed learning
- Brainstorming
- Role-playing
- Case studies

Educational training centres

Teacher training centres play a major role in providing training opportunities for all educators. Therefore, the Ministry of Education established more than 76 training centres around Saudi Arabia (General Directorate of Educational Training and Scholarship, 2002). Furthermore, in order to achieve the goal of the educational training, these centres are regularly supported through:

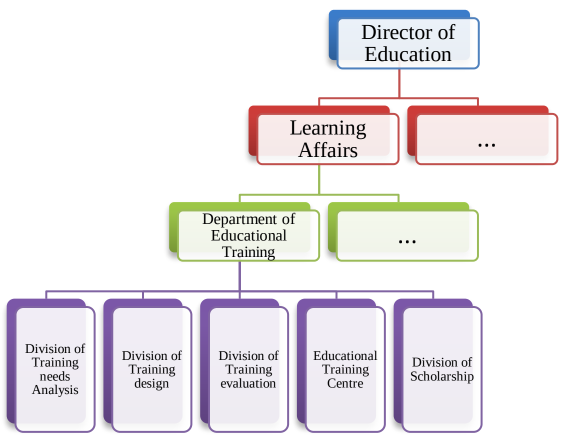
- establishing a major educational training centres in every educational district in Saudi Arabia, in addition to the expansion of establishing minor educational training centres in remote areas
- providing educational training centres with the necessary training programs and materials required for achieving the desired outcomes
- providing educational training centres with qualified human resources to implement educational training processes effectively

- providing educational training centres with the necessary funds to be spent for training requirements for each training centre according to financial rules and regulations
- creating a database to provide training centres with the required information

Organizational structure of educational training

Figure 3.4 illustrates the organizational structure of educational training department in each directorate of education in Saudi Arabia.

Figure 3.4 Organizational structure of educational training



Source: adapted from the General Directorate of Educational Training and Scholarship, 2002

Recruiting of educational trainers

An educational trainer is chosen from among distinct teachers. The General Directorate of Educational Training and Scholarship (2002) detailed the minimum conditions that must be met for working as an educational trainer as following:

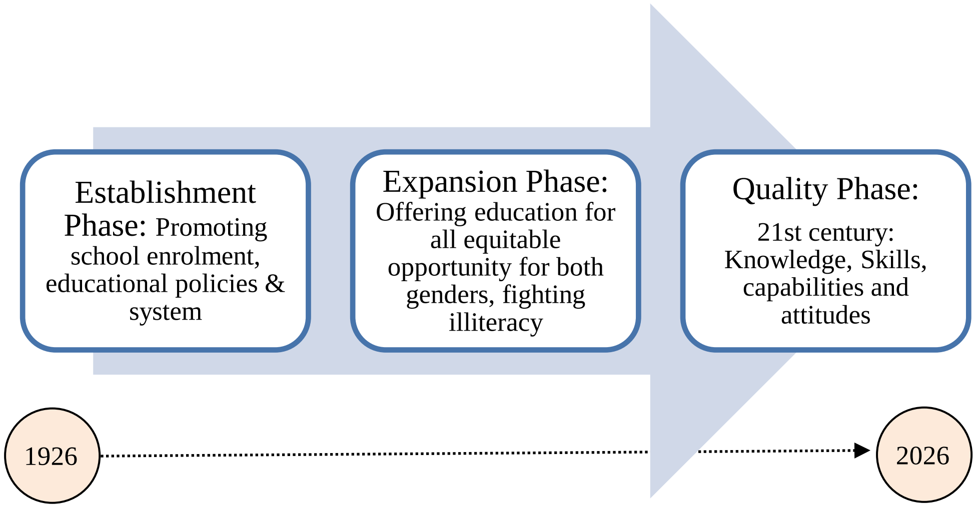
The nominee should:

1. have at least a bachelor degree from an educational institute with overall “Good” grade (Alternatively, has a Diploma in Education after completing his bachelor degree)
2. have worked at least five (5) years as a teacher
3. have attended a training program in the area of training process such as train the trainer, training needs analysis, training programs design etc.
4. have made some distinct contributions such as publication of articles, participation in seminars etc.
5. have obtained at least “Very Good” grade in the employee performance appraisal during the last two years
6. understand the role of the educational trainer and desire to do so. He also should write no more than three pages proposal for the development of educational training process
7. have the ability to use a computer

Public education development project

According to the Ministry of Education, a 100 years journey of K-12 education in Saudi Arabia comprise three main phases; establishment phase, expansion phase and quality phase. Figure 3.5 illustrates these phases.

Figure 3.5 The three phases of a 100 years journey of K-12 education in Saudi Arabia



Source: adapted from the Alsabti, 2012

Thus, the Ministry of Education endeavour to improve the quality in the third phase of public Education system holistically. Alsabti (2012) reported the major strategic directions of the reform as following:

1. Re-structuring the education system to make it an active, de-centralized, well-regulated and innovative system
2. Setting up King Abdullah bin Abdul-Aziz Public Education Development Project “Tatweer” with 2.4 billion $ to lead the reform
3. Establishing a government owned company, the "Tatweer Holding Company", and three subsidiaries to implement the reform and facilitate building an educational business cluster

4. Establishing an independent regulator to set world-class standards for both public and private schools in addition to evaluate the system as a whole and its main elements such as students, teachers, schools, and curriculum
5. Increasing the autonomy of schools and districts, and transforming them into learning organizations by putting every school in the driver's seat
6. Enhancing the teaching profession

Summary

This chapter presented an overview of the educational system in Saudi Arabia. It included a profile of the country and the main characteristics of its education system, including physics education. The professional development process for physics teachers was discussed focusing on the two main formats of professional learning; educational supervision activities and educational training programs.

The next chapter will discuss the research plan which has been applied in the quantitative study. This includes the processes associated with the collection and analysis of the quantitative data gathered in the first phase of the research.

CHAPTER 4: QUANTITATIVE STUDY

Introduction

This chapter provides an outline of the research design employed in this study. According to Creswell (2009), a research design is framed by the plans and the procedures for conducting research. These processes involve finalising research decisions from broad assumptions to detailed methods of data collection and analysis. The planning and procedural characteristics of the current research are considered in subsequent sections of the chapter.

The research design applied to this study is mixed methods, drawing from qualitative and quantitative studies. Mixed methods research includes procedures for collecting and analysing data using a blend of both methods to facilitate understanding of the research problem (Creswell, 2009). Mixed methods research represents a key tool in the improvement of social science and thus it is a commonly used technique in educational research (Gorard & Taylor, 2004; Ary, Jacobs, Razavieh, & Sorensen, 2006). Creswell (2009) argued that research approaches have become increasingly complex in design and significantly more adaptable in relation to their solicitation of methods. Mixed methods designs can provide pragmatic advantages when exploring complex research questions. For example, while quantitative statistical analysis can provide detailed assessment of patterns of responses, qualitative data may provide a deeper understanding of survey responses (Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007).

On the other hand, the analytic process of combining qualitative and qualitative data can be expensive and time consuming. Thus, researchers working to tight budgets or limited time may reduce sample sizes or thus decrease the amount of time needed for interviewing (Driscoll, et al., 2007).

Table 4.1 summarizes key differences between the two common methods of research based on the purpose, design, approach, tools, sample and analysis of each model.

Table 4.1 Differences between quantitative and qualitative research

	Quantitative	***Qualitative***
Purpose	To study relationship, cause and effect	To provide a deeper understanding of data phenomena
Design	Developed prior of study	Evolves prior to and during the study
Approach	Deductive	Inductive
Tools	Standardized instruments	Face-to-face interaction
Sample	Large	Small
Analysis	Statistical	Narrative and interpretation

Adapted from: Kervin, Vialle, Herrington & Okely (2006)

Using more than one research method within a research study can facilitate a more in-depth understanding of the research problem by accommodating information that is difficult to quantify such as reasons, opinions and comments. The complexity of questions relating to educational issues can be addressed more thoroughly through a combination of quantitative and qualitative methods (Creswell 2009; Johnson & Christensen, 2010). Consequently a mixed methods research approach has been selected as an appropriate design for this study in relation to effective professional learning characteristics for physics teachers.

Quantitative study

This chapter outlines the processes associated with the collection and analysis of the quantitative data gathered in the first phase of the research. These procedures typically involve the use of objective measurement and statistical techniques to evaluate numeric data to explore different types of phenomena (Cohen, Manion, & Morrison, 2008). In addition, according to Driscoll, et al., (2007), the statistical analysis of qualitative data provides researchers with a deep understanding of survey responses and detailed assessment of patterns of responses.

First the data collection and analysis procedures will be discussed. This discussion will be followed with a report of the results, and a contextualisation of the findings in relation to existing theory and research.

Method

In this section, the quantitative research method is discussed. The section comprises information on participants, measurement instruments, data collection and analysis procedures.

Participants

The target population of this study, defined as the entire group of people that are the focus of an investigation (Drew, Hardman & Hops 2008), was represented by the following cohort:

Male teachers of physics at secondary and intermediate schools in the city of Onaizah in Saudi Arabia. Importantly, there is no single rule for sample size that can be used under all conditions (Drew, et al., 2008). In this study only a small sample was available, but it does represent the population of the study, as it is a relatively homogeneous population

(Ary, et al., 2006). The final sample (see Table 4.2) comprised a total of 62 male teachers of physics at intermediate and secondary schools in *Onaizah*, Saudi Arabia. The cohort included 41 teachers from 24 intermediate schools and 21 teachers from 12 secondary schools.

Table 4.2 Demographic characteristics of participants

		Frequency (n)	***Percentage (%)***
Gender	Male	62	100
Age	20-29	27	43.55
	30-39	26	41.94
	40-49	8	12.9
	50-60	1	1.61
Level of qualification	Diploma	1	1.61
	Bachelor	60	96.77
	Masters	1	1.61
	Other	-	-
Type of qualification	Educational degree	37	59.68
	Science degree	25	40.32
Institution of qualification	University	39	62.90
	Teachers college	22	35.48
	S&M centre	1	1.61
	Other	-	
Major area of study	Physics	35	56.45
	Other fields of science	27	43.55
Involved in professional learning activities before	Yes	23	37.1
	No	39	62.90
Type of school building	Specialist physics / science facilities	39	62.90
	General facilities	23	37.1
Number of classes	< 5	3	4.84
	6-10	44	70.97
	11-15	11	17.74
	>16	4	6.45

Measures

Instruments

The study incorporated two questionnaires addressing the issue of professional development of physics teachers in the city of *Onaizah*, Saudi Arabia: Expectation Professional Learning Activities Questionnaire (EPLAQ 1) and Experience Professional Learning Activities Questionnaire (EPLAQ 2). These questionnaires were adapted from "Teachers' in-service training needs in Cyprus" (Karagiorgi & Symeou, 2007). The Cyprus questionnaire was chosen for this study because its items relate to the research question. For example, the questionnaire included items concerning teachers' views on the quality of their in-service training and desired format, such as the degree to which teachers' needs were met through current training activities, preferable forms and time of in-service training, in addition to expectations concerning the effects of training. Therefore, this questionnaire was appropriate for examining the most effective formats for physics teachers to learn professionally.

In addition, the Cyprus questionnaire was modified to suit the Saudi Arabia context and one question was removed altogether, as it did not relate to the areas being investigated in this study. This question investigated the reasons make teachers decide to involve in the in-service training such as chance for better payment or change the job.

Both the EPLAQ1 and EPLAQ2 consist of two main parts. The first part requests participants to provide demographic information collected both pre and post training programs to check the accuracy of demographic information. The second part investigated professional learning effectiveness associated with different formats of training, and preferred time and location. The EPLAQ1 and ELPAQ2 contain the same items with only a change in tense, for expectation of professional learning or reporting of completed professional experience (see Appendix A).

Expectation Professional Learning Activities Questionnaire (EPLAQ) 1:

Part 1: Demographic characteristics. This includes basic information in two sections A and B:

Section A: teacher related characteristics including age, total number of years in teaching, qualification, academic major, and previous professional learning activities.

Section B: school related characteristics including type of school building and number of classes.

Part 2: Teachers' expectations of the effectiveness of their professional learning activities. This includes three sections:

Section A: Expected professional learning outcomes

Section B: Preferred formats of professional learning

Section C: Preferred time and location of professional learning.

Experience Professional Learning Activities Questionnaire (EPLAQ) 2:

Part 1: Demographic characteristics (as for EPLAQ 1)

Part 2: Teachers' experiences of the effectiveness of their professional learning activities. This includes three sections:

Section A: Professional learning experiences and outcomes

Section B: Preferred formats and ideal mode of professional learning

Section C: Preferred time and location of professional learning.

Closed questions sought teachers' responses indicating the extent to which they agreed, with specific statements on a Likert scale from 1 to 5, from (1) indicating strongly agree to (5) strongly disagree. In addition, a further modification to the questionnaire was made, providing an opportunity for participants to add further comments.

Translation of instruments

In order to address possible language concerns for participation in the study, all instruments (initially prepared in English) were translated to Arabic (see Appendix B). The researcher translated the instruments from English into Arabic and a professional Arabic editor at the Directorate of Education in the city of *Onaizah* checked the Arabic translation and offered comments for consideration in the final Arabic versions.

A pilot study

An important strategy in assessing the appropriateness of the data collection tools (e.g. pilot study) should typically be considered (Ary et al., 2006). Therefore, both questionnaires were piloted with four educators. These educators were asked to comment on the clarity of items included in the EPLAQ 1 and EPLAQ 2. Their feedback (summarised in Table 4.3), was taken into consideration and questionnaires were modified accordingly.

Table 4.3 Examples of participants' comments

Participant	***Experience***	***Comment***
Director of the educational training centre	This person is a coordinator of professional development programs for all employees at the Directorate of Education in the city of *Onaizah*. He deals with different training activities under different titles inside and outside the educational training centre	The term 'professional learning' should be translated carefully so as to be understood by physics teachers
Supervisor of physics	This person is an expert in science education and regularly visits science teachers (including physics teachers) in their schools in different stages of the Saudi educational system (elementary, intermediate and secondary schools)	The term 'physics teachers' should be explained in the information sheet in order to include science teachers at intermediate schools as non-specialist physics teachers
Trainer at the educational training centre	This person is an expert in pedagogy and familiar with instructional terms used within Saudi schools	Regarding item 13, it is important to give an example of electronic resources of knowledge
Supervisor of Arabic	This person is a specialist in Arabic language and one of the official editors at the directorate of education in the city of *Onaizah*	Check the Arabic version of the two questionnaires grammatically

Data collection

After receiving Victoria University Human Ethics Committee approval to undertake this study (see Appendix C), the researcher commenced data collection. Permission for data collection from the Directorate of Education in *Onaizah* was also required by the university as a part of the ethics application (see Appendix D). The procedures for collecting data comprised eight steps.

Step 1: Devising training programs

Two training programs were designed specifically to be used for this research to examine three different approaches to in-service training: on-the-job, off-the-job and combined training programs. The programs were developed by qualified designers of in-service training programs at the Directorate of Education and the educational training centre in *Onaizah* based on the training needs of physics teachers in 2010. The training needs had already been assessed by the Department of Comprehensive Evaluation in *Onaizah* (Department of Comprehensive Evaluation, 2010).

The training programs focused on developing the teaching skills of physics teachers in areas of inquiry and collaborative activities. The three training approaches covered the same content and concepts but presented the information using different approaches.

Components of on-the-job training

The on-the-job training program in the current study consists of one-to-one training sessions in schools. This program is designed and delivered by the educational supervisor of physics at the Directorate of Education. It starts with observing the teacher's performance in the classroom and finishes with discussion on a set topic of inquiry for learning activities.

Key procedures implemented within this training program were: (a) observing teachers working in the classroom; (b) compiling observation notes of teachers' practice; (c) meeting with teachers and demonstration of skills *based* on *teachers' training needs;* and (d) providing teachers with training materials.

Components of off-the-job training

The off-the-job training program in the current study consists of a formal training program. This program is designed by the researcher with consultation with qualified designers of in-service training programs at the Directorate of Education and delivered to teachers in group 2 by a trainer at the educational training centre (see Appendix E). It starts with assessing the training needs of teachers and finishes with evaluation of training activities.

Key procedures implemented within this training program were: (a) assessing the training needs of teachers; (b) selecting the more appropriate training approach; (c) creating the training materials; (d) delivering the training materials; and (e) making sure the desired training goals have been achieved.

Components of combined training programs

Teachers in group 3 received both on-the-job and off-the-job programs. This combination consists of one-to-one training sessions in schools by the educational supervisor of physics and a formal training program by a trainer at the educational training centre.

Step 2: Grouping the physics teachers

An existing database of the cohort of physics teachers working in the city of *Onaizah* was reviewed at the beginning of the study. Therefore, based on the teachers' demographic characteristics, 62 male physics teachers have been divided into three heterogeneous subgroups of a similar size (see Table 4.3). The reason for taking this approach is to support the generalizability of the study findings to other similar cohorts of physics teachers working in the Saudi education system (see Appendix F).

Table 4.4 Grouping physics teachers

	No. of teachers	***Features of teachers***
Group 1	21	Every group has heterogeneous teachers in terms of age (equivalent mean age)
Group 2	21	Their 'major' science specialisation (equal proportions in each group)
Group 3	20	Work in different size schools (equal proportion of teachers in small, medium and large schools)
		Equivalent number of secondary & intermediate teachers in each group

Step 3: Training the trainer

One trainer was identified and recruited from the Directorate of Education as a contribution to conduct the research. The trainer received intensive instruction at the educational training centre in order to assist in the effective delivery of the training program. This instruction included specific training skills needed for training science teachers as well as using professional learning activities in physics classes (see Appendix G).

Step 4: Consultation with the supervisor and collaboration between the trainer and the supervisor

In order to implement professional learning activities efficiently, the supervisor consulted with physics teachers. In addition, the collaboration between the trainer and the supervisor took place before training (see Appendix G).

Step 5: Collection of pre-test data

For the purpose of examining teachers' expectations concerning the effectiveness of their professional learning, the first questionnaire was completed before training was implemented. The procedure incorporated the following stages:

- All principals of boys' secondary and intermediate schools were contacted via an initial email sent from the Directorate of Education in *Onaizah* using schools' email addresses. The email contained details of the study and accessibility of an online version of the information sheet, questionnaire, and teacher consent form for phase three of the study (see Appendix H).
- The information to participants sheet, questionnaire and consent form was printed out and distributed to physics teachers at their school.
- Physics teachers placed the consent form with the completed questionnaire in sealed envelopes and submitted them to school principals.
- Sealed envelopes were officially returned to the student researcher at the educational training centre in *Onaizah*.
- Questionnaires were completed by 64 of 65 participants included in the sample (98.46%).

Step 6: Implementing professional learning activities

Physics teachers who consented to further involvement participated in one of the three types of training activities as follows:

Table 4.5 Implementing professional learning activities

Professional learning group	***Type of training***	***Nature of training***
Group 1	On-the-job training	Normal supervision activities (by the supervisor of physics)
Group 2	Off-the-job training	Formal training program (by the chosen trainer at the educational training centre)
Group 3	Combined training	Both normal supervision activities and formal training program

Step 7: Collection of post-test data

At the end of semester 1 of the Saudi Arabia academic year 2011, accessibility of an online version of the second questionnaire on physics teachers' experience was emailed to all principals, who were asked to forward the instrument to all physics teachers in their schools and invite them to complete the EPLAQ2.

As occurred for EPLAQ1, the questionnaire was printed out and distributed to physics teachers in schools, who placed completed questionnaires and consent forms in sealed envelopes and submitted to schools principals to be returned to the student researcher. Questionnaires were completed by 62 out of 64 participants included in the sample (96.88%).

Step 8: Reviewing of plans, reports and instructional materials on supervision and training activities

Documents used in professional learning activities were collected and considered. These documents included:

- Supervisors' schedule of supervision activities (on-the-job training), reports and instructional materials given to physics teachers during the supervision activities (see Appendix I); and
- Trainer's schedule of training activities (off-the-job training), reports and instructional materials given to physics teachers during the training programs (see Appendix E).

The following table summarises elements of these training programs.

Table 4.6 Elements of training programs

Type of professional learning	*Location of professional learning*		*Professional learning activities*		*Duration of professional learning activities*
On-the-job training (supervision activities)	Advisor's office	4.76%	Oral presentation	100%	15-45 minutes
	Physics laboratory	9.52%	Demonstration	33.3%	
	Principal's office	61.90%	Providing teachers with training materials	95.24%	
	Secretary's office	4.76%			
	Vice Principal's office	19.05%			
Off-the-job training (training program)	Educational training centre	100%	Short lecture	20%	4 hours (for each program)
			Individual exercise	10%	
			Group discussion	30%	
			Video	10%	
			Workshop	10%	
			Group presentation	10%	
			Role playing	10%	

Data analysis

Data has been analysed as follows:

1. **Descriptive analysis:** This procedure was used to formulate the mean (M) and standard deviation (SD) for each variable in EPLAQ of the three different modes of in-service training. Items from planning, implementing and evaluating physics classes in EPLAQ were categorised based on similarity into set of subtotal. The following table presents descriptions of items subtotals.

Table 4.7 Definitions of items subtotals

EPLAQ variables	*Definition*	*Items*
Planning	Skills needed for planning physics classes (e.g. setting learning objectives, designing observation activities for inquiry lessons)	1, 2, 3, 4 and 5
Knowledge	Knowledge about inquiry learning (e.g. scientific inquiry process)	6 and 7
Teaching style	Using different instruction methods (e.g. interactive teaching)	8, 9 and 10
Resources	Using different kinds of resources (e.g. audio visual aids and electronic resources)	11, 12, 13 and 14
Students' practice management	Managing students' practice (e.g. organizing students' behaviour and using different formats of assessment)	Items 15, 16, 17 and 18
Activities	Method of training used by supervisor and trainer (e.g. lecture, demonstration and group discussion)	
Competence	Skills needed for supervisor and trainer to run professional learning activities (e.g. effective communicator and supportive)	
Venue	Physical features of professional learning location (e.g. size, lighting, air conditioning and *facilities*)	

2. **Two-Way Mixed Design (ANOVA):** This repeated measures analysis used a two way mixed design to examine the effects of the three different modes of in-service training (i.e., on-the-job training, off-the-job training and combined training programs), on specific aspects of physics teachers' professional learning. This study had one independent variable (group) with two phases (pre and post) and eight dependent variables (planning, knowledge, teaching style, resources, students practice management, activities, competence and venue). Separate ANOVA's were conducted for each dependent variable. Post hoc tests were conducted using LSD procedures to control for type 1 error. A present alpha level of $\alpha = .05$ was used for all statistical procedures.
3. **Chi-square analysis:** This technique was used to examine the distribution of participants' training preferences prior to undertaking the three different modes of professional learning according to age, type of qualification, type of institution, major study area and involvement in professional learning activities before this study was conducted was conducted. The preference variables assessed were training group size, duration, period, scheduling, and location of professional learning. Because there was only one participant over 50 years, age was regrouped into three categories: 20-29, 30-39 and 40 and over. Moreover, 60 participants out of 62 had a bachelor's degree. Hence, the variable of level of qualification was suspended. In addition, the majority of participants were graduates from the university and teachers college while only one participant had graduated from the Science and Mathematics Centre (S&M). Consequently, type of institution issuing qualification was regrouped into two categories: university and non-university.

Results

The research questions for the quantitative study investigate similarities and differences between expectations and experiences of physics teachers. These concern the effectiveness of the different modes of professional learning; on-the-job training, off-the-job training and combined training programs.

Descriptive analysis

Table 4.8 Descriptive results

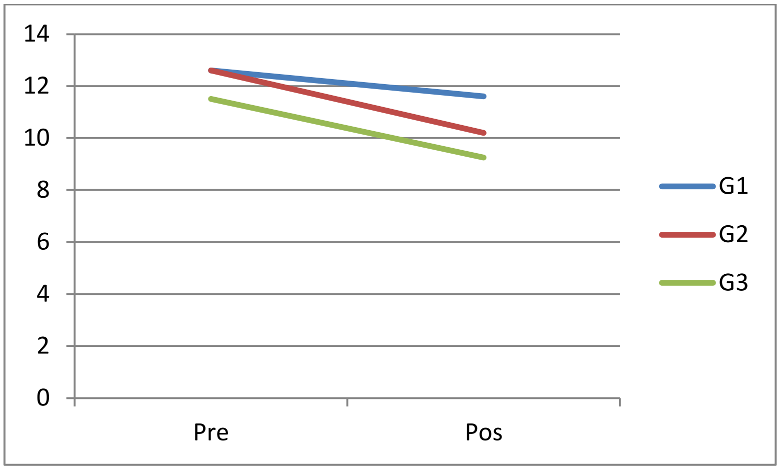
	Pre								Post							
	G1		G2		G3		T		G1		G2		G3		T	
EPLAQ variables	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Planning	12.7	4.27	12.6	4.7	11.5	3.57	12.27	4.25	11.6	4.4	10.2	3.3	9.25	3.2	10.4	3.8
Knowledge	4.4	1.6	5.1	1.8	5.2	1.98	4.9	1.8	4.5	1.7	4.6	1.6	4.4	2.2	4.5	1.8
Teaching style	6.7	2.5	7.6	2.6	7.3	2.1	7.2	2.4	6.3	1.7	6.3	1.8	6.4	2.1	6.3	1.9
Resources	9.3	3.9	10.8	3.7	10.5	3.4	10.2	3.7	9.6	3.93	10.8	4.1	10.2	4.1	10.2	4.1
Students' practice management	8.8	3.5	11.2	4.2	10.9	3.4	10.3	3.9	4.7	2.0	5.1	2.1	5.7	1.95	5.2	2.1
Activities	12.3	2.2	14.1	2.9	11.1	1.8	12.5	2.6	11.9	3.3	13.0	3.6	11.7	1.9	12.2	3.1
Competence	7.4	3.8	8.6	3.4	8.1	3.3	8.0	3.5	6.0	1.8	6.3	3.0	7.4	3.2	6.6	2.8
Venue	17.4	5.4	15.6	5.7	16.0	4.3	16.4	5.2	19.0	4.7	16.4	5.1	15.4	4.6	16.95	5.0

Note: G1 = on the job training; G2 = off the job training; G3 = on+off the job training; M = median; SD = standard deviation

Two-Way Mixed Design (ANOVA) results for planning physics classes

Results of the ANOVA indicated that significant differences in the area of planning physics classes existed between pre- and post-test EPLAQ scores of physics teachers, $F(1, 59)= 19.353$, $p < .000$, $\eta p^2 = .247$. The interaction effect for planning physics classes and professional learning groups was not significant, $F(2, 59) = 1.343$, $p = .269$, $\eta p^2 = .044$. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59) = 1.130$, $p = .330$, $\eta p^2= .037$.

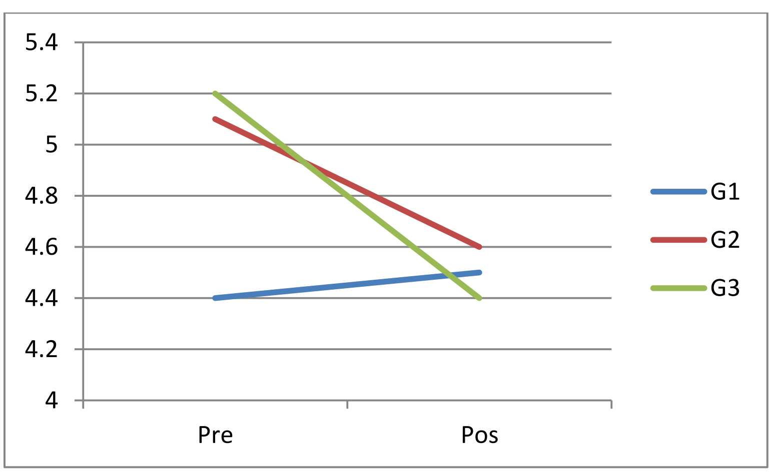
Figure 4.1 ANOVA results for planning physics classes



Two-Way Mixed Design (ANOVA) results for knowledge

Results of the ANOVA indicated that significant differences existed between pre- and post-test EPLAQ knowledge scores of physics teachers, $F(1, 59) = 8.042$, $p = .006$, $\eta p^2 = .120$. The interaction effect for knowledge and group was also significant, $F(2, 59) = 3.355$, $p = .042$, $\eta p^2 = .102$. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59) = .233$, $p = .793$, $\eta p^2 = .008$.

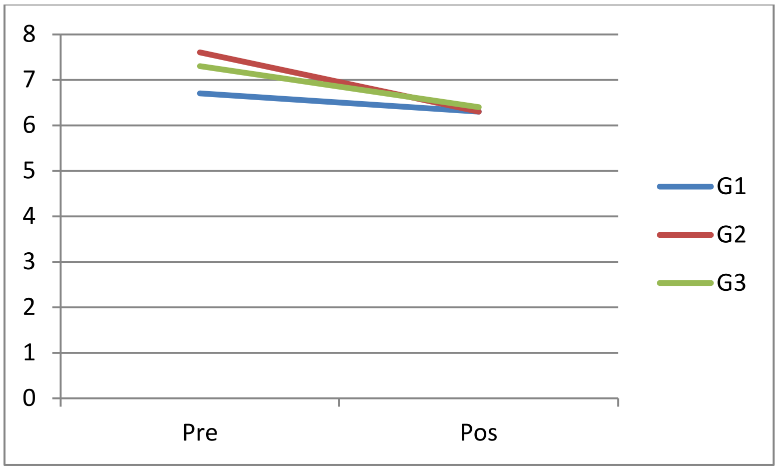
Figure 4.2 ANOVA results for knowledge



Two-Way Mixed Design (ANOVA) results for teaching style

Results of the ANOVA indicate that significant differences existed between pre- and post-test EPLAQ teaching style scores of physics teachers, $F(1, 59) = 9.970$, $p = .003$, $\eta p^2 = .145$. The interaction effect for teaching style and group was also not significant, $F(2, 59) = .893$, $p = .415$, $\eta p^2 = .029$. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59) = .330$, $p = .720$, $\eta p^2 = .011$.

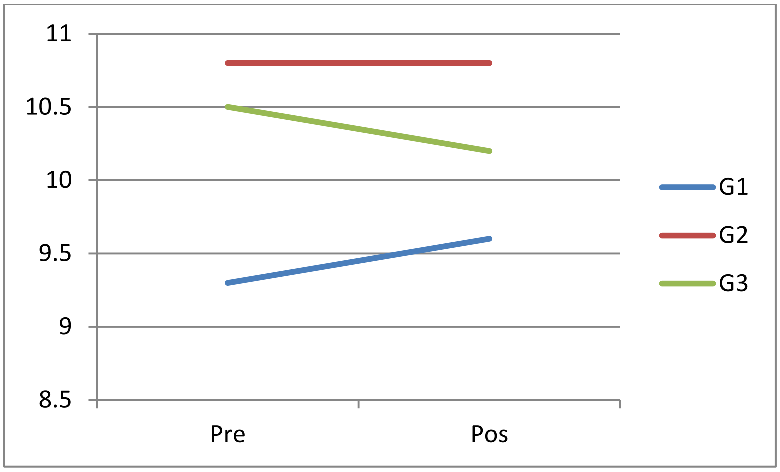
Figure 4.3 ANOVA results for teaching style



Two-Way Mixed Design (ANOVA) results for resources

Results of the ANOVA indicated that no significant differences existed between pre- and post-test EPLAQ resources scores of physics teachers, $F(1, 59) = .004$, $p = .949$, $\eta p^2 = .000$. The interaction effect for resources and group was also not significant, $F(2, 59) = .233$, $p = .793$, $\eta p^2 = .008$. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59) = .659$, $p = .521$, $\eta p^2 = .022$.

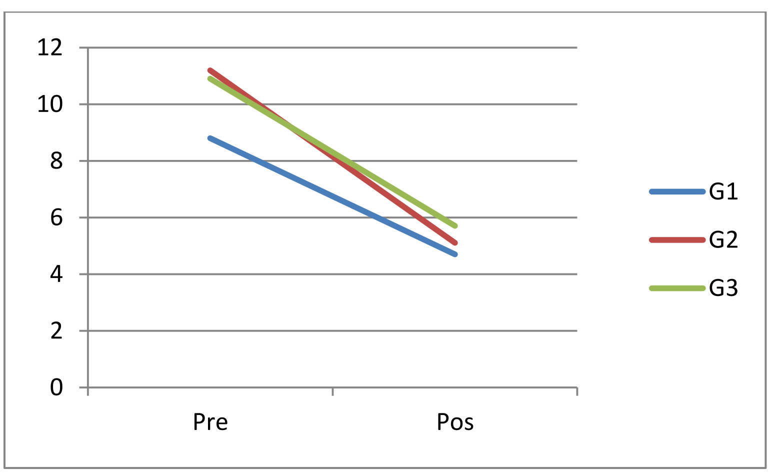
Figure 4.4 ANOVA results for resources



Two-Way Mixed Design (ANOVA) results for students' practice management

Results of the ANOVA indicate that significant differences existed between pre- and post-test EPLAQ students' practice management scores of physics teachers, $F(1, 59) = 211.584$, $p < .000$, $\eta p^2 = .782$. The interaction effect for students' practice management and group was not significant, $F(2, 59) = 2.888$, $p = .064$, $\eta p^2 = .089$. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59) = 2.085$, $p = .133$, $\eta p^2 = .066$.

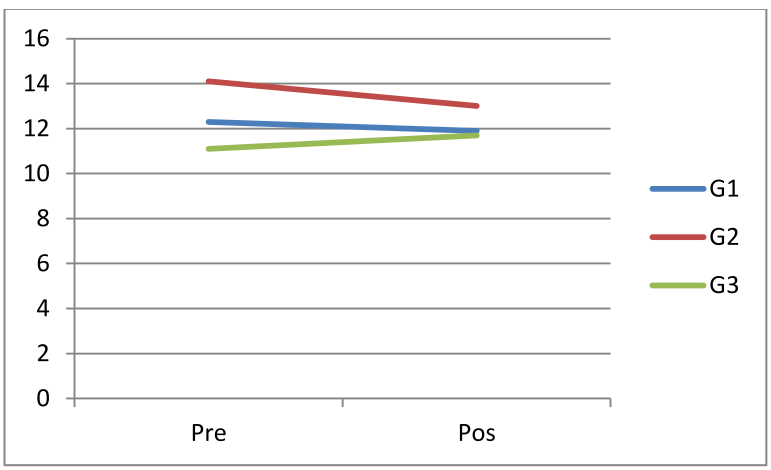
Figure 4.5 ANOVA results for students' practice management



Two-Way Mixed Design (ANOVA) results for activities

Results of the ANOVA indicate that no significant differences existed between pre- and post-test EPLAQ professional learning activities subscale scores of physics teachers $F(1, 59) = .994$, $p = .323$, $\eta p^2 = .017$. The interaction effect for professional learning activities and group was also not significant, $F(2, 59) = 2.950$, $p = .060$, $\eta p^2 = .091$. Contrasts between subjects for the three professional learning groups revealed significant differences in EPLAQ scores, $F(2, 59)= 3.853$, $p = .027$, $\eta p^2 = .116$. Post hoc analysis showed a significant difference between the off-the-job training group (M = 13.57, SD = 0.56) and the combined training group (M = 11.40, SD = 0.57), $p = .009$. No other post hoc group comparisons were significant.

Figure 4.6 ANOVA results for activities

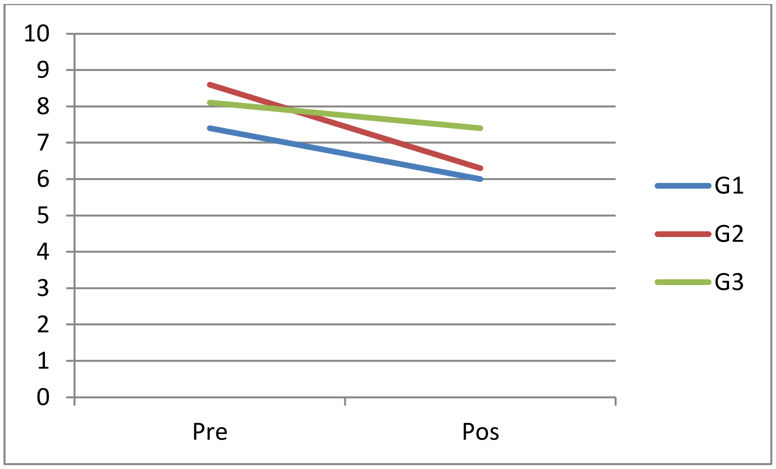


Two-Way Mixed Design (ANOVA) results for competence

Results of the ANOVA indicate that significant differences existed between pre- and post-test EPLAQ competence of trainers/supervisor scores of physics teachers, *F*(1,

59) = 13.295, p = .001, ηp^2 = .184. The interaction effect for competence and group was also not significant, $F(2, 59) = 1.392$, p = .257, ηp^2 = .045. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59)$= .728, p = .487, ηp^2 = .024.

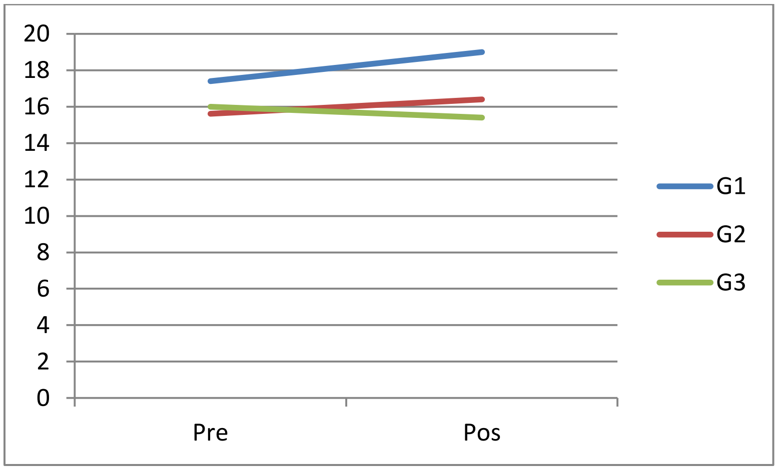
Figure 4.7 ANOVA results for competence



Two-Way Mixed Design (ANOVA) results for professional learning venue

Results of the ANOVA indicate that no significant differences existed between pre- and post-test EPLAQ professional learning venue scores of physics teachers, F(1, 59) = 1.269, p = .264, ηp^2 = .021. The interaction effect for venue and group was also not significant, $F(2, 59) = 1.599$, p = .211, ηp^2 = .051. Contrasts between subjects for the three professional learning groups revealed no significant differences in EPLAQ scores, $F(2, 59)$= 1.777, p = .178, ηp^2 = .057.

Figure 4.8 ANOVA results for professional learning venue



Chi-square analyses of training preferences for professional learning

Table 4.9 presents chi-square analyses comparative results of training preferences of participants prior to undertaking the three different modes of professional learning according to age, type of qualification, institution, major area of study and involvement in professional learning activities before this study was conducted. The preference variables assessed were training group size, duration, period, scheduling, and location of professional learning.

Table 4.9 Chi-square analyses comparative results of training preferences

	Group size	***Duration***	***Period***	***Scheduling***	***Within school***	***Outside school***
Age (chi)	2.714a	4.801a	6.911a	10.624a	7.971a	5.127a
df	6	6	6	6	8	8
Asymp. Sig.	.844	.570	.329	.101	.436	.744
Type of qualification (chi)	2.200a	.461a	7.032a	5.124a	2.655a	4.943a
df	3	3	3	3	4	4
Asymp. Sig.	.532	.927	.071	.163	.617	.293
Type of institution (chi)	.869a	3.719a	4.225a	.331a	.457a	4.138a
df	3	3	3	3	4	4
Asymp. Sig.	.833	.293	.238	.954	.978	.388
Major (chi)	1.610a	2.942a	4.497a	1.810a	5.786a	11.265a
df	3	3	3	3	4	4
Asymp. Sig.	.657	.401	.213	.613	.216	.024
Have you involved (chi)	3.863a	.210a	2.082a	8.314a	5.092a	3.312a
df	3	3	3	3	4	4
Asymp. Sig.	.277	.976	.555	.040	.278	.507

(See Appendix K for the descriptive percentage of Chi-square analyses)

Frequency analysis of pre-test EPLAQ scores for preferred training group sizes for physics teachers to be involved with professional learning activities indicated that overall the participants preferred small group (32.3%), followed by large group (30.6%), individual (24.2%), and two participants the least preferred (12.9%). The chi-square result indicated that there was no significant difference between the group sizes and demographic characteristics of participants. However, the descriptive patterns highlighted that the 30-40 year old age group, educational qualification, non-university qualification and specialist physics teachers groups had a lower preference for working in groups of two people.

For the duration of physics teachers' professional learning activities, descriptive analysis of pre-test EPLAQ scores indicated that more than half (51.6%) of participants preferred 1-4 days' duration, followed by 1-4 hours (24.2%), 1-4 weeks (16.1%), while five teachers preferred other duration (8.1%). The chi-square result indicated that there was no significant difference between the duration and demographic characteristics of participants. However, the descriptive patterns highlighted that the 30-40 year old age group and university qualification group had a lower preference to be trained in other duration.

Furthermore, frequency analysis of pre-test EPLAQ scores for the period of professional learning activities for physics teachers indicated that the majority (88.7%) of participants preferred morning courses, followed by afternoon courses (6.5%), evening courses (3.2%), while only one teacher preferred other period courses (1.6%). The chi-square result indicated that there was no significant difference between the period and demographic characteristics of participants.

Regarding the scheduling of physics teachers' professional learning activities, descriptive analysis of pre-test EPLAQ scores indicated that approximately half of teachers (46.8%) preferred their activities to be conducted at the beginning of semester, followed by the end of semester (22.6%), summer holiday (21%), while a small number of teachers preferred to be trained mid semester (9.7%). The chi-square result indicated that there was significant difference (*p* = 05) between the scheduling and demographic characteristics of participants. The descriptive patterns highlighted that all those over 40 years' old and the non-educational qualification group had a lower preference to be trained mid semester.

Finally, frequency analysis of pre-test EPLAQ scores for the location of physics teachers' professional learning activities indicated that the majority (62.3%) of participants preferred to be trained outside schools compared with (24.2%) who stated their preference to be trained within schools. The chi-square result indicated that there was significant difference (*p* = 05) between the implementation of professional learning outside schools and demographic characteristics of participants. The descriptive patterns highlighted that the group of specialist physics teachers had a lower uncertainty in preference the location of implementing professional learning. Moreover, among teachers who preferred to be trained outside schools, analysis of pre-test EPLAQ scores showed that the educational training centre was the preferred location for the majority (85.5%) of participants, followed by other location (9.1%), another school (3.6%), while only one teacher (1.8%) preferred the Directorate of Education. Among those teachers who preferred to be trained within schools, frequency analysis of pre-test EPLAQ scores indicated that teachers preferred other site to school (38.5%), followed by physics laboratory (28.2%), school library (23.1%), while (10.3%) preferred staff room.

Discussion

The research questions in this quantitative study concern the effectiveness of different modes of professional learning for physics teachers *Onaizah*, Saudi Arabia; on-the-job training, off-the- job training and combined training programs. The data obtained from pre- and post-test EPLAQ scores of physics teachers was quantitatively analyzed to examine similarities and differences between expectations and experiences of physics teachers concerning the effectiveness of different modes of training. Resultant data was considered in relation to a set of characteristics that included professional learning outcomes, professional learning activities, supervision and training competencies, professional learning location and professional learning time. These are discussed in the following section.

Professional learning outcomes

Physics teachers who participated in this study were asked to identify their expectations and experiences regarding the outcomes of professional learning outcomes. Results of the ANOVA indicated that significant differences existed between pre- and post-test EPLAQ scores of physics teachers in the areas of planning physics classes, knowledge, teaching style and students' practice management. In addition, between subjects results of on-the-job training, off-the-job training and combined training programs revealed no significant differences in EPLAQ scores.

These findings indicated there were differences between the expectations of physics teachers and their experiences in the area of planning physics classes, knowledge, teaching style and students' practice management. From the EPLAQ1 data physics teachers did not expect to increase their understanding of inquiry learning through the training. Data from the EPLAQ2 found that physics teachers reported increased understanding of inquiry learning and classroom approaches. This positive professional learning occurred for all three delivery methods. Participants therefore reported a positive result. There was a perceived improvement in planning, knowledge, teaching style and class management and evaluation. These findings are an expected result, and could refer to quality of design and implementation of professional learning activities in which physics teachers participated.

Firstly, because the purpose of in-service training was to assist in resolving organizational problems through equipping teachers with knowledge and skills to deliver physics curriculum (Lawson, 2006; Behlol & Anwar, 2011), organizations may face difficulties in professional development when training needs are not accurately identified before creating any new training program (Kroehnert, 2000; Moskowitz, 2008). Therefore, a clear understanding of organizational problems is required as a first step for designing an effective training program (Lawson, 2006). This step was considered when professional learning activities were designed and implemented for physics teachers. For example, during supervisor's visits as an aspect of on-the-job training, 100% of supervision activities addressed the topic of inquiry-based approaches to teaching and learning scientific concepts (see Appendix I) as an important strategy needed for physics education (General Directorate of Curriculum, 2009).

Similarly, during the training program, as an aspect of off-the-job training, the focus was on scientific inquiry. Thus, teachers were provided with basic knowledge and skills needed to apply this technique in physics teaching more effectively. An inquiry-based approach is more productive in physics education compared with traditional models of instruction such as expository teaching (General Directorate of Curriculum, 2009).

The assessment of training needs (completed as part of the training programs) contradicts previous findings by Alnooijm (2005) and Abo Atwan (2008) that weakness in assessing training needs represented barriers of in-service training programs at security training institutes in Riyadh and Gaza governorates respectively. Such a contradiction might refer to the technique used in analyzing training needs in different studies. For example, in Alnooijm's (2005) study, training needs were assessed based on the previous experience of training programs designers, due to the lack of a good database to be used as a source for determining training needs. In Abo Atwan's (2008) study, the point of view of teachers was rarely considered when analysing training needs. However, in this training program, training needs of physics teachers have been assessed by experts at the Department of Comprehensive Evaluation, Directorate of Education in *Onaizah*. Consequently, by designing and implementing professional learning activities based on accurate identification of training needs, physics teachers can improve their learning and performance. This can be measured using a variety of methods such as direct observation by the supervisor about what teachers actually do in the classroom, after attending the training program, in addition to evaluating students' achievement (Darling-Hammond, 2010).

Secondly, several benefits for training designers can result from precise analysis of training needs. For example, specifying learning objectives (Salas & Cannon-Bowers, 2001) which represents a key step in the design process of professional learning activities (Lawson, 2006). Therefore, informing learners before instruction can help them understand learning objectives and what will be expected of them during the course (e.g. describing the required performance and explaining performance criteria) (Gagné et al, 2004). This procedure was applied in the three forms of professional learning activities for physics teachers. For example, the supervisor begins by explaining the nature of supervision activities for physics teachers including what the teachers should be able to do at the completion of the supervisor's visit (see Appendix I). Thus, by informing physics teachers, as adult learners, early and clearly about learning objectives, they are more likely to positively engage in these activities and therefore achieve desired training outcomes (Townsend, 2003; Knowles, Holton & Swanson, 2005; Lawson, 2006). This finding is supported by Bassoppo-Moyo's (1996) study investigating the effects of pre-instructional activities in enhancing learner recall and conceptual learning of prose materials for pre-service teachers at the Gweru and Bulawayo-Hillside Teacher's Training Colleges in Zimbabwe. The researcher reported that performance objectives have the most beneficial effect on learning compared with other techniques such as advance organizers and structured overviews.

In contrast, the finding contradicts Al khateeb (2001) who reported that teachers of Islamic sciences were not informed about the objectives of their supervision activities by supervisors. Such a contradiction might refer to the nature of supervision activities in the two studies. For example, the supervisor's visits in the Al khateeb (2001) study took place without prior notification, an adoption of the old trend of supervision activities as inspection processes rather than professional learning activities (General Directorate of Educational Supervision, 2009). However, supervisor's visits in the current study were put into practice as professional learning processes for physics teachers as a new trend of supervision activities.

Similarly, before implementing the off-the-job training program, participants were provided with an information sheet about the training program including program outcomes (see Appendix E). In addition, at the first session of each training program, trainers presented and explained learning objectives to trainees.

Learning objectives are real power in the dynamic interaction of adult learning (Rogers, 1996; Lawson, 2006). Consequently, physics teachers are more likely to participate positively in professional learning activities when they are informed early and clearly about the outcomes of their learning.

Thirdly, because physics teachers, as adult learners, are goal focussed, they want to take responsibility for their professional development. This includes planning, implementing, and evaluating their learning activities (Minton, 1991; Rogers, 1996; Lawson, 2006). Thus, it is important to adapt objectives by integrating trainer's planned outcomes with trainees' desired outcomes. This approach can assist physics teachers to achieve these outcomes and was therefore adopted in the three modes of professional learning activities. For example, during the individual meeting as a part of each supervisor’s visit, the supervisor asked the physics teacher about his desired outcomes after explaining what the teacher should be able to do, as planned by the supervisor in advance, at the completion of the supervisor’s visits.

In a similar approach to the supervisor’s visit, during the off-the-job training program, program outcomes have been articulated in two stages. During the first stage of the first session, the trainer asks each physics teacher to write down his expectations about the training program on a piece of paper and stick it on a specific board, followed by presenting training outcomes as planned by the trainer in advance. The trainer then works collaboratively with teachers to adapt planned training objectives based on their expectations. During the second stage of the final session, the trainer asks each physics teacher about the extent to which his expectations about the training program have been fulfilled. Therefore, by considering physics teachers' desired outcomes, they are more likely to participate positively in professional learning activities (Rogers, 1996).

Finally, training content knowledge can be developed based on learning outcomes (Lawson, 2006; DeSilets, 2007). However, the prior practice of physics teachers should be considered by linking the new subject matter to their previous experience, which can support their learning (Townsend, 2003; Knowles, Holton, & Swanson, 2005). Furthermore, focus should be on practical learning versus theoretical learning due to practical benefits for physics teachers (Jauhiainen, 2013). This was considered when learning activities were designed and implemented. For example, during supervisor's visits, teachers have been provided with some practical ideas relevant to their daily practice plus a CD containing useful learning and teaching materials (see Appendix I).

Similarly, during the off-the-job training program, participants have been provided with practical content knowledge, so physics teachers can apply scientific inquiry as a productive approach more effectively in their physics classes. For example, the training course contained knowledge related to the design and implementation of inquiry learning activities including: observation, developing the hypothesis, testing the hypothesis (by designing an experiment), drawing conclusions and communicating them (see Appendix E). Furthermore, in order to assist physics teachers to transfer what they have learnt into their daily practice successfully, they were asked to explain any expected obstacles for using inquiry activities in physics classes within their schools. They also *offered* some suggestions to overcome the challenges of implementing inquiry activities.

The improvement of teachers' knowledge about inquiry learning is supported by previous studies (Attiat &Attiat, 2010; Hammad &Albahbahani, 2011). These researchers reported that learners positively evaluated content knowledge they have been provided with during the general diploma program in education at Al-Hussein Bin Talal University and in-service training courses for teachers in public schools at Directorates of Education in Gaza. The positive evaluation by learners for training content included effectively addressing some contemporary educational issues related to practice. In addition, learners acknowledged the balance of theoretical and practical content knowledge during the courses.

On the other hand, the finding related to practical content knowledge of the training program contradicts the previous findings of Al-Shehri (٢٠٠٦), Al-Zahrani (2009) and Kildan, Ibret, Pektas, Aydinozu, Incikabi, and Recepoglu (2013). Researchers reported that officers of King Khalid Military College, art teachers in Saudi Arabia and teacher trainees from different branches in Kastamonu weren't provided with appropriate content knowledge during training courses. Such contradiction might refer to the nature of the outcomes of each training program, which affect the development of content knowledge in different studies. For example, in the three previous studies, the focus was on theoretical learning rather than practical content knowledge (Al-Shehri, ٢٠٠٦). However, because physics is an experimental subject, participants in this training program have been provided with practical content knowledge related to the physics curriculum (see Appendix E). Thus, by providing physics teachers with practical training relevant to their daily practices, they may generate a more relevant knowledge base, and transfer what they have learnt into their physics teaching and this took place in the current study (Jauhiainen, 2013).

Professional learning activities

Physics teachers in this study were asked to discuss their expectations and experiences regarding the effectiveness of their professional learning activities. Results of the ANOVA indicate that no significant differences existed between pre- and post-test EPLAQ scores of physics teachers for professional learning activities. These findings indicated there was no change between expectations of physics teachers and their experiences. These findings may refer to using the same professional learning activities before and during this study. For example, meetings with each physics teacher are still the dominant approach adopted during supervisor's visits (General Directorate of Educational Supervision, 2009). This meeting mainly comprises a short oral overview given by the supervisor as feedback about the teacher's performance in the classroom. However, other productive supervision activities, such as workshop and model lessons, are not commonly used (Al khateeb, 2001). In the current study, 100% of supervision activities included an oral presentation by the supervisor through to an individual meeting with the teacher, whereas other methods, such as demonstration, represented no more than 33.3% of supervision activities (see Appendix I).

Similar to the supervisor's visit, during the training program, as an aspect of off-the-job training, many contemporary training methods were used before carrying out this study. Also, during the implementation of different training, the same contemporary training methods are used. For example, individual exercise, group discussion, demonstration, brainstorming, role playing, case study and project are regularly used during training programs for educators at the educational training centre (Department of Educational Training, 2013). Likewise, in this study almost the same training methods were used during the three types of training program. Thus, physics teachers have been trained using the professional learning activities themselves before and during the implementation of this study.

Supervision and training competencies

Physics teachers in this study were asked to discuss their expectations and experiences regarding supervision and training competencies. Results of the ANOVA indicated that positive significant differences in supervisor and trainer competencies existed between pre- and post-test EPLAQ scores of physics teachers for professional learning activities. In addition, the contrast between on-the-job, off-the-job and combined training programs revealed no significant differences in EPLAQ scores.

These results may be due to the fact that both supervisor and trainer have been trained before implementing the three types of professional learning activities for physics teachers. For example, in order to assist supervisors to efficiently implement supervision activities for physics teachers in group 1 (on-the-job training) and group 3 (combined training), they were invited to be involved in a consultation program, which is designed especially for this purpose. This program comprised training activities (e.g. a short presentation on supervisor competence), a short video of an inquiry class in action, and discussion about the competence needed by supervisors to improve science teachers in general and physics teacher in particular (see Appendix G). Thus, the supervisor was prepared in advance to supervise and support physics teachers. This result is dissimilar to Al-Sayegh (١٩٩٢), Al-Qurashi (1994) and Al khateeb's (2001) findings, who reported the need to improve supervisors' competence in general including the ability to support teachers to achieve. Furthermore, this finding is not supported by Al-Hammad's (٢٠٠٠) study, which affirmed that supervisors had some difficulties in communicating with teachers regarding required teaching skills and methods. Such a contradiction could be due to two main reasons. Firstly, supervisors may have visited teachers as inspectors, and thus focusing on mistakes in teaching practice (Al-Qurashi, 1994) rather than improving teaching performance. However, the supervisor in this study has been asked to visit physics teachers and focus on improving their performance rather than identifying mistakes in their practice. Thus the supervisor is an effective communicator and supportive of physics teachers to learn more successfully. Secondly, supervisors may not possess skills required for implementing supervision activities effectively due to their lack of experience (Al-Sayegh, ١٩٩٢; Al-Hammad, ٢٠٠٠; Al khateeb, 2001). However, the supervisor in this study was involved in a special training program and has been provided with essential supervision skills (see Appendix G).

Similar to supervisor competency, in order to assist the trainer to implement training activities for physics teachers efficiently in group 2 (off-the-job training) and group 3 (combined training), he was invited to be involved in a training program which is designed especially for this purpose (see Appendix G). This program comprised a short presentation on the trainer's competence in general, a short video of an inquiry class in action, and discussion about the competence needed by supervisors for training science teachers. Thus, the trainer was prepared in advance to conduct the training activities for physics teachers.

This finding is supported by Aboul Gheit (2011), Hammad and Albahbahani (2011) and Uysal’s (2012) studies. These researchers reported that learners positively evaluated the performance of trainers in the mathematics skills department at King Saud University, in public schools in the Gaza governorate, and in a one-week in-service training program for primary school language teachers offered by the Turkish Ministry of Education respectively. On the other hand, this finding regarding trainer competency contradicts previous findings by Al-Nemsha (1997), Mansour (2003), Alnooijm (٢٠٠٥) and Al-Shehri (٢٠٠٦). These researchers found that weaknesses in the trainers’ performance represented barriers to communication that hindered the effective delivery of training content during training courses at the institute of border guards in Riyadh, in-service training programs of teachers in Syria, security training institutes and King Khalid Military College respectively. Such contradiction could refer to trainers’ abilities. For example, trainers may not have had the skills required for implementing training activities effectively due to their lack of experience (Al-Nemsha, 1997; Alnooijm, ٢٠٠٥). The trainer in the current study, however, was involved in a special training program to equip him with essential skills for training science teachers plus inquiry-based learning advocated by the American Association for the Advancement of Science (AAAS) (2010) (see Appendix G).

The results for trainer competence in this study have generated evidence that a competent instructor is an important element in professional learning for teachers.

Consequently, physics teachers are more likely to learn successfully, and transfer new knowledge and skills into their classroom practice.

Professional learning location

Physics teachers who participated in this study were asked to discuss their expectations and experiences regarding the location of their professional learning activities. Results of the ANOVA indicate that no significant differences in the area of professional learning location and venue existed between pre- and post-test EPLAQ scores of physics teachers. In addition, the contrast between on-the-job, off-the-job and combined training programs revealed no significant differences in EPLAQ scores.

These results may be due to the fact that professional learning activities were implemented before and during this study at the same location. Adult learning can be affected by the physical condition of the learning location (Walker, 2007; Hill & Epps, 2010; McLaughlin, 2012). Consequently, supervision activities, such as individual meetings with each physics teacher as an introductory procedure of training, usually take place in a quiet and comfortable location within schools such as the staff room, school library and physics laboratory (General Directorate of Educational Supervision, 2009). Supervision activities in this study also took place in comfortable locations to enhance teachers' learning. For example, more than 61.9% of supervision activities took place in principals' offices, 19.05% took place in vice principals' offices while the physics laboratory was only used twice.

Similar to supervision activities, off-the-job training programs for teachers usually took place at the educational training centre in *Onaizah*. In this study, the training program for physics teachers was also implemented at the same training centre (see Appendix E).

Professional learning time

Physics teachers who participated in this study were asked to discuss their preference for an appropriate time sequence for their professional learning activities. Descriptive results of preferred time included three elements: duration, period and scheduling of professional learning.

Duration of professional learning activities

Descriptive analysis of pre-test EPLAQ scores indicated the majority of physics teachers preferred 1 to 4 days' duration for professional learning activities. Such a result is not surprising due to the nature of professional learning activities for physics teachers. For example, supervision activities, as an aspect of on-the-job training, comprise four main steps: preparation based on performance, presentation, performance and follow-up (Dessler, 2008). These steps need sufficient time for training outcomes to be achieved. Thus determining the duration of training depends on the nature of learning activities based on teachers' training needs. For example, demonstration of a simple skill by the supervisor (e.g. using graduated cylinder) expends less time. However, multiskilled training programs (e.g. using small groups for learning Ohm's Law in electricity) require more time to employ the four main steps (Stanciu, 2007). It can be argued that, in general, the duration for a training session should be no less than one school day (Adey, 2006; General Directorate of Educational Supervision, 2009). Less time may compromise supervision activities and the professional learning of physics teachers.

Similar to the duration of supervision visits, the appropriate length of the off-the-job training programs implemented at the educational training centre represents an important element in the area of teachers' development. Thus, the teachers' higher preference regarding 1-4 days duration is an acceptable result due to the advantages of such length of training courses. Many factors impact the duration needed for implementing off-the-job training programs. These factors include the nature of training content, learning activities and prior teaching experience.

The complexity of training content should be considered when determining the duration of training programs. For example, learning a single instructional skill (e.g. using a data show projector) may take less time. However, multiskilled training programs (e.g. classroom management) usually take longer for design and delivery. It can be argued that, in general, training programs should be given no less than one school day to take place. This argument is supported by Adey (2006), who affirms that one training day is needed for teachers to learn how to use a SMART Board.

Making decisions about the appropriate duration for training programs is affected by what learning activities will be used. For example, while lectures demand a short time, role playing and games, on the other hand, can consume a longer time for both preparation and implementation (Stanciu, 2007). Training programs for physics teachers focus on practical activities (e.g. using games for teaching scientific concepts). Consequently, no less than one school day is needed for these activities. This finding is similar to Wanner, Martin-Diener, Frick, Kriemler, & Martin's (2014) finding that a two-day training course supported classroom teachers to plan and conduct physical activity and sports games for young primary school children in Switzerland.

In addition, prior teaching experience should be considered as an important knowledge resource (Knowles, Holton, & Swanson, 2005). By creating efficient learning opportunities, both inside and outside the classroom, teachers can learn from each other through sharing their prior experience about teaching particular subjects (Print, 1993; Whitton, Sinclair, Barker, Nanlohy, & Nosworthy, 2004; Westheimer, 2008). For example, inside the classroom, teachers can learn formally from each other through working collaboratively in learning activities in small groups (Wilkinson & Fung, 2002). Outside the classroom, they have the opportunity to informally exchange experiences with colleagues about physics teaching. These informal activities play a significant role in improving their skills (Livingstone, 2001; Knight, Tait & Yorke, 2006; MacPhail, 2011). Such learning opportunities need to be planned and be given adequate time, depending on the nature of professional learning activities. For example, Birman, Desimone, Porter and Garet (2000) reported that science teachers who were involved in a five-day summer professional development institute, in the small, rural district, Washington, had high quality effective features for their professional learning. The program comprised many training activities included sharing the prior experience about teaching among participant.

Appropriate duration of programs may better enable trainers to implement training activities more effectively and enable physics teachers to improve their skills.

This finding is similar to the results of earlier studies concerning the effectiveness of educational training in relation to professional learning duration. For example, Mansour (2003) and Al-Zahrani (2009) reported that the short duration of training programs was considered a critical professional development obstacle for teachers participating in in-service training programs in Syria and art teachers in Saudi Arabia respectively.

Period of professional learning activities

Descriptive analysis of pre-test EPLAQ scores for the period of professional learning activities for physics teachers indicated that the majority preferred morning programs. This is an anticipated result and consistent with previous studies by Sjosten-Bell (2005) and Ray (2009) indicating that morning training programs positively impacted academic performance in computing mathematical algorithms and basic statistics of elementary students in Columbus State and those students enrolled in twelve units of Basic Statistics I at the Liberal Arts College respectively. However, the preference for morning training programs contradicts Barron, et al. (1994) and Spickler, Hernandez-Azarraga and Komorowski's (1997) findings, whereby reported results supported the positive impact of afternoon instruction on learners' achievement in the mastery of reading skills and hands-on science programs respectively. This might refer to the nature of content knowledge that has been taught in the two different periods. Research shows that short-term memory is better in the morning, while long-term memory is better in the afternoon (Jensen, 2000). Therefore, learning activities involving short-term memory, such as mathematics and science, may be better implemented in the morning (Brewer & Campbell, 1991) while learning activities involving long-term memory, such as art and hands-on activities, may be better implemented in the afternoon (Brewer & Campbell, 1991; Stanciu, 2007). As a result, training programs that include large amounts of physics content knowledge (e.g. laws, equations and complex experiments), may be better implemented in the morning. This may assist physics teachers to engage in professional learning more effectively.

Scheduling of professional learning activities

Descriptive analysis of pre-test EPLAQ scores indicated that the majority of participants preferred involvement in professional learning activities during semester rather than summer holidays. Such a preference is not surprising due to the fact that teachers need out-of-school time for family and other commitments (Australian Education Union, 2007). Therefore, out-of-school time to implement professional learning may hinder the effectiveness of teachers' professional development. This finding is supported by Karagiorgi and Symeou (2007) and the Australian Education Union (2007). The results indicated that implementing professional learning activities during semester is preferred for Cypriot and Victorian teachers respectively.

Furthermore, for this cohort, descriptive analysis of pre-test EPLAQ scores indicated that approximately half preferred their professional learning activities to be implemented at the beginning of semester. This finding might be representative of the different training needs of physics teachers. Generally, in order to achieve the desired results, training should take place closer to when learners need new skills to put into practice (Lawson, 2006). Thus, teachers who preferred the beginning of semester may need to improve their skills early based on curriculum requirements while teachers who preferred the end of semester may need to evaluate their performance during semester. These different preferences are supported by Abo Atwan (2008), who reported that professional development programs should be scheduled to meet the different training needs of high school teachers in Gaza.

The general pattern of results reinforces that time plays a vital role in teachers' professional development. Therefore, if professional learning activities are implemented according to the appropriate duration, and preferred period and scheduling of time, physics teachers are more likely to engage in professional learning more effectively.

Summary

This chapter has presented and discussed the research plan applied in the quantitative study. Information was presented in relation to sampling, measurement instruments, and procedures of data collection and data analysis.

This quantitative study addressed the issue of professional development of physics teachers in the city of *Onaizah*, Saudi Arabia. The research questions investigated similarities and differences between expectations and experiences of physics teachers concerning the effectiveness of three different modes of learning: on-the-job, off-the-job and combined training programs. The results were first outlined and then discussed. Pre- and post-test EPLAQ scores of physics teachers can be summarized as follows.

Firstly, results of the ANOVA indicated that significant differences in the area of planning physics classes, knowledge, teaching style, students' practice management, and competence of supervisor and trainers existed between pre- and post-test EPLAQ scores of physics teachers. In addition, no significant differences were found in EPLAQ scores between on-the-job, off-the-job and combined training programs.

Secondly, results of the ANOVA indicated that no significant differences in the area of professional learning activities, location and venue existed between pre- and post-test EPLAQ scores of physics teachers. In addition, no significant differences were found in all variables of EPLAQ scores between on-the-job, off-the-job and combined training programs.

Finally, chi-square analyses results of pre-test EPLAQ scores indicated that the majority of physics teachers preferred to be involved in professional learning activities in the mornings for a period of 1 to 4 days. It was also found that the majority of participants preferred working days with a preference for beginning of semester.

The findings and discussion in this chapter has led to the primary conclusion that positive changes existed between the expectations of physics teachers and their experiences in planning physics classes, knowledge, teaching style, and students' practice management. Positive changes also existed between the expectations of physics teachers and their experiences regarding the competence of supervisors and trainers due to the successful implementation of professional learning activities. Participants therefore perceived improved skills as a result of their involvement. In addition, no change was found between the expectations of physics teachers and their experiences with regard to location and venue.

The next chapter will present and discuss the research plan applied in the qualitative study. Interview responses will be explored in greater detail, providing further insights into professional learning experiences.

CHAPTER 5: QUALITATIVE STUDY

Introduction

As detailed in chapter 4, the research design employed in this study is a mixed methodology approach commonly used in educational research (Ary, Jacobs, Razavieh, & Sorensen, 2006). While quantitative method depends on the collection of numerical data, qualitative method, depends on the collection of non-numerical data such as interviews and observations (Kervin, Vialle, Herrington & Okely, 2006). Combining quantitative and qualitative analyses enables the researcher to obtain rich data for analysis, and supports the methodological integrity of the study (Muijs, 2004). In addition, using a mixed methods, respondents' opinions and comments bring a deeper understanding of the qualitative data (Johnson & Christensen, 2010). Thus, this approach is deemed the most appropriate research design for this thesis, because both qualitative and quantitative data can be collected and analysed to identify the effectiveness of professional learning for physics teachers.

Qualitative researchers aim to investigate social phenomena through an in-depth understanding of human behaviour (Kervin, Vialle, Herrington & Okely, 2006). In addition, because qualitative research utilises face-to-face interaction, smaller samples are more appropriate for evaluating the effectiveness of professional learning activities for physics teachers. This chapter will present and discuss the research plan applied in the qualitative study.

Method

In this section, the qualitative research methods and procedures are discussed including selection of participants, measurement instruments used, and data collection and data analysis.

Participants

In order to evaluate the effectiveness of physics teachers' professional learning, the perspectives of 14 participants were obtained. These professionals were 14 educators recruited from the larger sample of participants involved in study 1.

All participants indicated their availability to be contacted for interview in the consent form. However, to achieve a balance across participants, 6 teachers were selected randomly as were 6 principals, 1 supervisor, and 1 trainer. The cohort was distributed as detailed in Table 5.1. Table 5.2 summarises the role, subject knowledge background and school level teaching of the 14 participants.

Table 5.1 Distribution of interviewees

	Group 1 *On-the-job training*	**Group 2** *Off-the-job training*	***Group 3*** *Combined training*
Intermediate schools	One teacher	One teacher	One teacher
	One principal	One principal	One principal
Secondary schools	One teacher	One teacher	One teacher
	One principal	One principal	One principal
Department of supervision	Physics supervisor		
Educational training centre	Trainer of the training program		

Table 5.2 Characteristics of participants

Participants	Major	Workplace
Teacher 1	Physics	Intermediate school
Teacher 2	Biology	Intermediate school
Teacher 3	Physics	Intermediate school
Teacher 4	Physics	Secondary school
Teacher 5	Physics	Secondary school
Teacher 6	Physics	Secondary school
Principal 1	Social studies	Intermediate school
Principal 2	Arabic	Intermediate school
Principal 3	Social studies	Intermediate school
Principal 4	Mathematics	Secondary school
Principal 5	Social studies	Secondary school
Principal 6	Arabic	Secondary school
Trainer	Mathematics	Educational training centre
Supervisor	Physics	Department of supervision

Interview guide

Semi-structured interview items were developed after the three modes of professional learning activities were delivered and the two questionnaires (EPLAQ1 and EPLAQ2) completed. Analysis of quantitative results identified that physics teachers found that all forms of training benefitted their learning. The data did not identify if one approach was more effective than another. This prompted the need to obtain additional data to explore more subtle differences between training programs.

Developing the interview questions

The interview questions were prepared based on teachers' responses to the questionnaires. For example, although results of the ANOVA indicate that overall a significant difference in the area of professional learning outcomes existed between pre- and post-test EPLAQ scores, the contrast between on-the-job, off-the-job and combined training programs revealed no significant differences in EPLAQ scores.

From the insights gained through the data analysis into expectations of the training, three issues regarding professional learning were identified, which guided the development of the interview guide:

1. From the ANOVA analysis physic teachers involved in the research expected the training to be useful when applied to their teaching practice. This led to the development of a series of interview questions exploring delivery practices of both supervisor and trainer.
2. From the ANOVA analysis participants expected the skills of the supervisor and trainer to be poor. This led to the competence of both the supervisor and trainer being explored through interview questions.
3. The Chi-square analysis indicated participants' preference to be involved in morning programs for one to four days' duration both inside and outside schools. This led to the development of interview questions that explored the location and timing of professional learning.

Interview questions

As an outcome of the quantitative data analysis it was clear that the guiding research question (*How do physics teachers, principals, trainer and supervisor evaluate the different modes of in-service training as a tool of professional learning of physics teachers?)* would require the collection of qualitative data to gain insights into the educators' experiences of the training programs. As suggested by Borko (2004), professional learning is a complex activity influenced by many aspects of training and delivery including context, participants' readiness to learn, and ease of transfer of learning to their class environment. With this in mind, five interview questions were developed (see Appendix J for the Arabic version of the interview guide):

1. *What similarities and differences exist between on- and off-the-job training for physics teachers?*
2. *What are the advantages and disadvantages of using one or both types of training for physics teachers?*
3. *To what extent do physics teachers usually respond to professional learning activities?*
4. *Are there any difficulties physics teachers may face while involved in on- or off-the-job training in regards to location or timing?*
5. *What role should the decision makers in the city of Onaizah play in order to increase the effectiveness of professional learning for physics teachers?*

Procedures of data collection

After receiving Victoria University Human Ethics Committee approval to undertake this study (see Appendix C), the researcher commenced data collection. Permission for data collection from the Directorate of Education in *Onaizah* was also required by the university as a part of the ethics application (see Appendix D). Fourteen semi-structured interviews were conducted after both questionnaires and the three modes of professional learning activities had been completed. The procedures of interview data collection comprised four steps.

Step 1: Scheduling the interviews

To encourage interviewees to speak freely about their training experiences a convenient date, time period and location were organised. To ensure confidentiality and privacy the venue was located away from other members of staff. Table 5.3 demonstrates the schedule of the interviews.

Table 5.3 Interview schedule

	School stages	*Participants*
Group 1	Intermediate	Teacher 1
		Principal 1
	Secondary	Teacher 2
		Principal 2
Group 2	Intermediate	Teacher 3
		Principal 3
	Secondary	Teacher 4
		Principal 4
Group 3	Intermediate	Teacher 5
		Principal 5
	Secondary	Teacher 6
		Principal 6
Department of supervision	Intermediate and secondary	Physics supervisor
Educational training centre	Intermediate and secondary	Trainer of the program

Step 2: Conducting the interviews

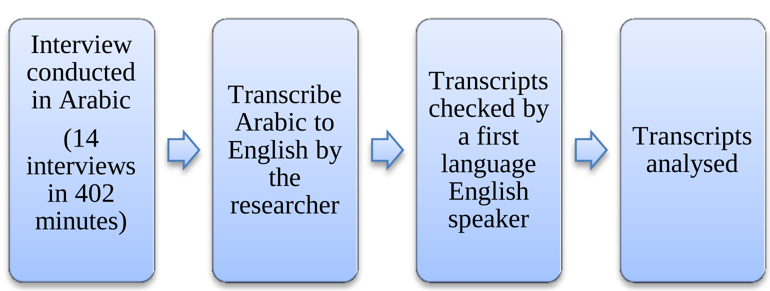
Participants were interviewed individually and the process consisted of the following activities:

1. Welcoming interviewees and expressing clearly the purpose of interviews, in addition to potential benefits for them and the impact on their students' learning.
2. Advising that interviews will be recorded and information provided will remain confidential and be used for research purposes only, as well as reminding participants that they can withdraw from the study at any time if they do not want to continue.
3. Recording interviews using a digital audio recorder.
4. At the end of the interviews, interviewees were thanked for their participation and given the opportunity to ask questions regarding the research.

Step 3: Transcribing and translating audio-recorded interviews

In order to overcome the barriers of local language and slang, the researcher transcribed and translated all the audio-recorded interviews from Arabic into English and the translation was checked for language consistency by a first language English speaker as summarised in the Diagram 5.1. This was important to ensure the accuracy of translation.

Figure 5.1 Process of transcribing and translating audio-recorded interviews



Step 4: Data analysis

Thematic analysis techniques were used to analyse the qualitative interview data plus responses to open-ended items in the questionnaires (EPLAQ1 and EPLAQ2). Thematic analysis is defined as a method for identifying, analysing, and reporting patterns (themes) within data (Braun & Clarke, 2006) and is widely used in qualitative research. According to Braun and Clarke there are six phases for conducting thematic analysis as follows:

1. Familiarisation with the data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Producing the report.

Table 5.4 summarises these six phases and procedures. This commenced with words and phrases from interview transcripts that were analysed and coded in relation to the main research question and sub questions. As detailed in Table 5.4 these coded data were categorised as themes in terms of evaluation of the different modes of in-service training as a tool of professional learning of physics teachers.

Table 5.4 Six phases for conducting thematic analysis

Phases	***Procedures***
Familiarisation with the data	The researcher transcribed and translated all audio-recorded interviews from Arabic into English. This process was the first step in familiarisation with the data. Once completed the researcher read each interview carefully to increase familiarity with the content.
Generating initial codes	The codes developed related to characteristics of different training programs and teaching practices. In particular, the participant's experience and opinion of the training style, perceived effectiveness and usefulness were identified for coding. This resulted in an initial coding set of several codes.
Searching for themes	After the initial coding process the researcher searched for themes by examining possible similarities or links between codes. These were collated to identify broader patterns of meaning. This process resulted in several themes.
Reviewing themes	The themes that emerged were reviewed by the researcher, examining each participant's response against the guiding research questions. Some themes were refined and split into subthemes, some themes were combined and others discarded.
Defining and naming themes	When the final themes were selected, the researcher gave a final name for each theme.
Producing the report	Once the themes were ready, the researcher started to contextualize the analysis in relation to the existing literature and previous studies.

The entire data for this study was limited due to the low number of interviews conducted (e.g. 14 interviews were conducted during 402 minutes and the transcripts comprised 19 pages with 7102 words). Thus, in order to become familiarised with the data, interviews were transcribed into Word documents. In addition, coding was achieved by cutting and pasting relevant quotations into identified themes.

Furthermore, a summary of findings from interviewees' responses to each sub question was derived from the total transcript. Table 5.5 displays examples of interviewees' responses and the summary of findings.

Results

This section presents the results from qualitative data in this study. The research questions concern the differences between on- and off-the-job training for physics teachers in *Onaizah*. Educators who agreed to participate in this phase were asked to give their personal opinions about on- and off-the-job training by evaluating the different modes of in-service training as a tool for professional learning. The physics teachers interviewed have typically experienced specific training types (see the quantitative study in chapter 4) while principals, trainer and supervisor are knowledgeable across all training formats. The guiding interview question was divided into five sub questions (as outlined previously), and interview responses will be presented for teachers (T), principals (P), trainer (TR) and supervisors (SU) respectively.

Sub question 1: What similarities and differences exist between on- and off-the-job training for physics teachers?

Sub question 1 Response

Teachers (T)

Three out of six teachers responded to sub question 1 and identified clear differences between the two training formats: on the-job-training (feeling like an inspection process) and off the-job-training (more relaxed and collegial). For example:

T1: "The physics supervisor's visit seems to be an inspection process while training programs provide the teacher with more experience because the teacher attends such training programs by his own will"

T3: "There is a big difference between the physics supervisor's visit and training programs conducted outside school. The physics teacher attends training programs with less stress (more relaxed) because he is away from his workplace"

T5: "No, I think training programs and supervision procedures are dissimilar. Training improves the teacher in many different areas while the supervisor should evaluate the teacher's performance before and after attending training programs"

Conversely, two out of six teachers affirmed that similarities exist between on- and off-the-job training for physics teachers. For example:

T4: "They play the same role. I think they are very similar"

T6: "I think there is no difference. Both of them have positive impacts on the teacher's performance"

In addition, uncertainty about similarities and differences exist between on- and off-the-job training for physics teachers was mentioned by one teacher:

T2: "That depends on the nature of [the] relationship between the supervision department and the training centre"

Principals (P)

All principals acknowledged differences between on- and off-the-job training by way of improving teachers' performance. For example:

P1: "Well, I think that a well-planned and implemented physics supervisor's visit can play a different role than training programs"

P2: "The physics supervisor's visit and training programs try to improve teachers' performance in different ways"

P3: "No, I think they are different. In contrast to training, the supervisor's visit focuses on a limited number of issues to discuss in a short time (not sufficient to cover many teachers in school)"

Trainer (TR) and supervisor (SU)

Both the trainer and the supervisor stated they considered differences between on- and off-the-job training regarding their respective roles. For example:

TR: "I think they are different. Training programs improve teacher's performance while supervision evaluates teacher's performance"

SU: "According to my experience, I think they are different. The physics supervisor evaluates the teacher's performance before and after training programs. So, these roles complement each other"

***Sub question 2*:** What are the advantages and disadvantages of using one or both types of training for physics teachers?

Sub question 2 Responses

Teachers (T)

Five out of six teachers identified advantages in using both types of training for physics teachers because they complement each other. For example:

T4: "I think both type of professional learning should be applied. The physics supervisor's visit is an integration of the training programs"

T5: "For me, both physics supervisor's visits and training programs are acceptable"

T6: "No, I think both supervision activities and training programs are needed as only supervision activity is insufficient"

In addition, the acceptable use of training programs only, due to their effectiveness in improving physics teachers' performance, was mentioned by only one teacher.

T3: "I think that training programs are much more effective for the teacher's development than physics supervisor's visits"

Principals (P)

Four out of six principals declared the need for both types of training for physics teachers because they complement each other. For example:

P1: "I think both training programs and supervisor's visits are needed. However, I believe that training programs and supervisor's visits represent only 20% of professional learning for teachers"

P3: "Both types of training are needed. Yes, training programs first, followed by supervisor's visits as feedback"

P4: "No, I think both types of professional learning are seriously needed"

P6: "Both of them. I think training programs are better to be first, followed by the physics supervisor's visits"

Additionally, two out of six principals stated the need for training programs only for physics teachers:

P2: "No, it is better for the teacher to leave school for professional learning"

P5: "Curriculum has been changed; therefore, more training is needed nowadays. Yes, I think training programs are sufficient"

Trainer (TR) and supervisor (SU)

While the trainer stated the need for only one type of training for physics teachers, the supervisor declared the need for both because each complements the other. For example:

TR: "Well, I think training programs are sufficient provided that the principals of the schools are trained"

SU: "Each one complements [the] other. Supervisor's visits represent 50% and training programs represent 50% of professional learning activities"

Both the trainer and supervisor indicate that follow-up visits are beneficial to teachers. The trainer suggested the principal could take on or support this activity.

Sub question 3: To what extent do physics teachers usually respond to professional learning activities?

Sub question 3 Responses

Teachers (T)

Three out of six teachers stated that they positively respond to both modes of professional learning activities. For example:

T3: "Well, physics teachers positively engage in professional learning activities"

T5: "I seriously respond to both of them. I even prepare myself very well"

T6: "The teachers usually welcome participation in both of them"

In addition, two out of six teachers stated a positive response to on-the-job training activities. For example:

T1: "For me, the physics supervisor's visits helps me in the area of dealing with physics curriculum within my school's context and my students' abilities"

T5: "Physics supervisor's visits are most welcome. I really wait for him to get some improvement"

Conversely, two out of six teachers stated a positive response to off-the-job training activities. For example:

T2: "There is no doubt that training is the most helpful way for professional learning because the teacher attends such training programs of his own will"

T3: "Personally, I think that training programs improve teacher's performance better than physics supervisor's visits. In fact, these visits at my school do not provide me with significant experience, except when I was a new teacher"

Lastly, uncertainty about the response to professional learning activities for physics teachers has been mentioned by one teacher:

T4: "Well, for training programs, [the] physics teacher's response, positive or negative, depends on the reputation of [the] trainer"

Principals (P)

Four out of six principals stated that physics teachers positively respond to off-the-job training activities. For example:

P1: "Teachers usually respond to training programs outside school, more than supervisor's visits"

P3: "Training programs are welcomed by many new teachers"

P5: "I think teachers, especially new teachers, respond to training programs outside school more than supervisor's visits"

P6: "Some teachers welcome participation in training programs outside school"

In addition, three out of six principals stated a negative response to on-the-job training activities. For example:

P3: "In general, supervisor's visits are not welcomed by teachers. Some visits resemble inspection"

P4: "Some supervisors do not realize the real role of [the] visit. They think they are inspectors. Teachers need to be encouraged"

P6: "For the careless teacher, it [supervisor's visit] is not welcome. I hope that [the] physics supervisor comes to school as an expert, not an inspector"

Lastly, uncertainty about the response to professional learning activities for physics teachers was mentioned by only one principal:

P4: "Again, it depends on the trainer's reputation"

Trainer (TR) and supervisor (SU)

While the trainer stated that physics teachers positively respond to off-the-job training activities, the supervisor compared the differences in physics teachers' responses to on-the-job supervision activities. For example:

TR: "I think teachers respond to training programs outside schools more than supervisor's visits"

SU: "Well, I try to be friendly and supportive. So, I try to provide teachers, as needed, with some new learning materials like software. Physics teachers respond to supervisor's visits in different ways (positive and negative)"

Sub question 4: Are there any difficulties physics teachers may face while involved in on- or off-the-job training?

Sub question 4 Responses

Teachers (T)

Five out of six teachers stated there were no difficulties that physics teachers encounter in professional learning activities. For example:

T2: "For training programs, I do not think so"

T3: "There are no difficulties facing physics teachers involved in supervision activities"

T4: "No, I do not think so"

T5: "No, my school is fully equipped and ready for supervision activities"

T6: "Well, for training programs, I do not think so"

In addition, two out of six teachers identified some difficulties physics teachers encounter in on-the-job training activities. For example:

T2: "For supervision activities, [it] could be due to the poor correlation between supervision activities and the actual practice of physics teaching"

T6: "Well, for the supervision activities, [it] could be when the supervisor comes to school as an inspector, looking for mistakes in [the] teacher's performance"

On the other hand, three out of six teachers identified some difficulties physics teachers face while involved in off-the-job training activities. For example:

T1: "Yes, some principals do not give permission for teachers to attend training programs outside their schools during the school day"

T3: "I think there is no weakness in training programs, except the long introduction of some programs"

T5: "Regarding training programs, [the] timetable is negatively affected due to teachers [taking] leave during the school day"

Principals (P)

Four out of six of principals stated there are no difficulties face physics teachers face while involved in professional learning activities. For example:

P1: "For supervisor's visits, there is no difficulty when the supervisor informs [the] school about the date of [the] visit in advance"

P2: "No, and training programs are scheduled"

P4: "For one teacher leave there is no difficulties cam face my school"

P6: "No, my school is fully equipped and ready for supervision activities"

In addition, only one principal identified some difficulties physics teachers face while involved in on-the-job training activities:

P3: "It is important to establish a special room for supervisors. Such [a] room should be large enough and contain [a] white board as well as other professional learning resources. Supervisor's visits should be long enough and the supervisor should be an expert"

On the other hand, four out of six principals stated that the school timetable could negatively be affected due to teachers leaving to complete training during the school day. This can be difficult for physics teachers while involved in off-the-job training activities. For example:

P1: "Regarding training programs, when the [educational] training centre does not notify [the] school about the date of [the] training program in advance, [the] timetable could [be] negatively affected due to teachers [taking] leave during the school day"

P4: "There are some problems [if] two teachers [take] leave"

P5: "Regarding training programs, the only difficulty is that [the] timetable is negatively affected, due to teachers [taking] leave during the school day. Therefore, it is better to run training programs in the evening"

P6: "Regarding training programs, [the] timetable is negatively affected due to teachers [taking] leave during the school day"

Trainer (TR) and supervisor (SU)

While the trainer stated there are no difficulties physics teachers face while involved in off-the-job training activities; the supervisor declared that involving the supervisor in some administrative affairs rather than focusing on improving teachers' performance represents a difficulty that may be encountered by physics teachers while participating in on-the-job supervision activities. For example:

TR: "Well, there are fake difficulties. Some schools principals think the timetable is negatively affected due to teachers leaving during the school day"

SU: "Some teachers have a negative image of the supervisor. In addition, the supervisor is asked to become involved in some administrative affairs rather than focusing on improving teachers' performance"

Sub question 5: What role should the decision makers in the city of *Onaizah* play in order to increase the effectiveness of professional learning for physics teachers?

Sub question 5 Responses

Teachers (T)

Four out of six teachers offered suggestions to increase the effectiveness of professional learning for physics teachers. These suggestions included the improvement of professional learning activities, professional learning materials, school principals' skills in the area of professional learning for teachers as well as increasing the positive correlation between the supervision department, learning technology department and the training centre. For example:

T1: "Obviously, running physics teachers' meetings to exchange experiences. Personally, I think such frequent meetings are effective. So, I hope they are run twice a semester"

T2: "I think the most important role is to make an effective correlation between the supervision department, learning technology department and the training centre"

T5: "Well, by inviting experts and providing teachers with well-designed learning materials such as DVDs"

T6: "[The] school principal should also understand the teacher's role and his needs and meet them".

In addition, one teacher made the following suggestion for increasing the effectiveness of on-the-job training activities:

T6: "By providing the teacher with new practical ideas followed by instant demonstration by the supervisor in [the] physics class"

On the other hand, two teachers offered the following suggestions for increasing the effectiveness of off-the-job training activities:

T5: "Well, by training the trainers"

T6: "By avoiding boring lectures in the training programs"

T6: "I think a well-equipped building is needed for running professional learning activities for physics teachers"

Principals (P)

In order to increase the effectiveness of professional learning for physics teachers, five out of six principals offered some suggestions, which included improving professional learning activities, teachers' motivation, professional learning resources, school principals' competence as well as correlation between the supervision department and the training centre. For example:

P1: "Exchange visits among teachers should be planned and scheduled"

P1: "Motivating teachers to do research is useful"

P3: "Schools principals should be trained in order to help improve teachers"

P3: "Also, motivating teachers to become involved in professional learning activates"

P3: "A specialist educational library should be established in school"

P4: "Well, utilising technology in this area is important as well as motivating teachers to become involved in development"

P4: "Principals should also be trained in order to motivate teachers to become involved in professional learning activities"

P5: "[the] department of supervision and the training centre should be combined"

P6: "Well, it is possible to use some incentives to encourage teachers to become involved in professional learning activities"

In addition, four out of six principals offered the following suggestions for increasing the effectiveness of supervision activities (on-the-job training) for physics teachers:

P1: "I think [the] supervisor should focus on developing teachers rather than being involved in some administrative affairs"

P4: "Firstly, training supervisors"

P5: "Well, supervisors should be developed, the number of supervisors should be increased and the number of supervision visits, especially for new teachers, should be increased"

P6: "What is [the] problem in using the best teacher to supervise other teachers in the same area within [the] school? I think it is a good idea"

On the other hand, five out of six principals offered the following suggestions for increasing the effectiveness of off-the-job training activities:

P1: "Training should be based on training needs at the beginning of semester"

P2: "Regarding training programs, I hope they are compulsory for once a semester based on training needs. Instead of leaving school in the morning, the teacher can participate in evening programs, if available"

P3: "Run some training programs (by a trainer from the educational training centre) within school in order to improve a large number of teachers"

P4: "Analysing training needs of teachers at the beginning of semester"

P5: "It is better to run [a] training program on a specified day for five weeks than offer the whole program in one week"

Trainer (TR) and supervisor (SU)

Both trainer and supervisor declared the need to improve their skills in order to increase the effectiveness of professional learning for physics teachers. For example:

TR: "In fact, trainers and [the] department of training should be developed. Supervisors should be chosen by teachers"

SU: "Well, supervisors' skills in the area of technology and [in] other areas should be developed"

Summary of interviewees' responses

Table 5.5 summarises interviewees' replies to sub questions 1, 2, 3, 4 and 5 and presents examples.

Table 5.5 Summary of interviewees' responses

Sub question	***Interviewees***	***Examples of participants' replies***	***Summary of findings***
Sub question 1 *What similarities and differences exist between on- and off-the-job training for physics teachers?*	Teachers	The physics supervisor's visit seems to be an inspection process while training programs provide the teacher with more experiences, because the teacher attends such training programs at his own will They play the same role. I think they are very similar That depends on the nature of the relationship between the supervision department and the training centre	Teachers found on-the-job training to be more stressful than off-the-job training. However, several participants identified the value in both approaches, if off-the-job training is supported by school visits from supervisors
	Principals	The physics supervisor's visit and training programs try to improve teachers' performance in different ways	
	Trainer	They are different. Training programs improve teachers' performance while supervision evaluates teachers' performance	
	Supervisor	According to my experience, I think they are different	

Table 5.5 (Continued)

Sub question	***Interviewees***	***Examples of participants' replies***	***Summary of findings***
Sub question 2 *What are the advantages and disadvantages of using one or both types of training for physics teachers?*	Teachers	I think both types of professional learning should be applied. Physics supervisor's visits integrate training programs I think that training programs are more effective for teacher development than physics supervisor's visits	Several participants found off-the-job training to be more effective for teachers' development than school visits by supervisors. A smaller number of participants reported that both types of professional learning complement each other
	Principals	I think both types of professional learning are seriously needed Yes, I think training programs are enough	
	Trainer	Well, I think training programs are sufficient	
	Supervisor	Each one complements the other	
Sub question 3 *To what extent do physics teachers usually respond to professional learning activities?*	Teachers	The teacher usually welcomes both of them Physics supervisor's visit is most welcome There is no doubt that training is the most helpful way for professional learning Physics teachers respond positively or negatively, which depends on the reputation of the trainer	Physics teachers respond more positively to off-the-job training (outside their schools) than school visits by the supervisor. It was also identified that the reputation of trainers was a factor in responses to training programs implemented at the educational training centre
	Principals	Teachers usually respond to training programs outside school more than the supervisor's visit In general, supervisor's visit are not welcomed by teachers Again, it depends on the trainer	
	Trainer	I think teachers respond to training programs outside schools more than the supervisor's visit	
	Supervisor	Physics teachers respond to supervisor's visit in a different way	

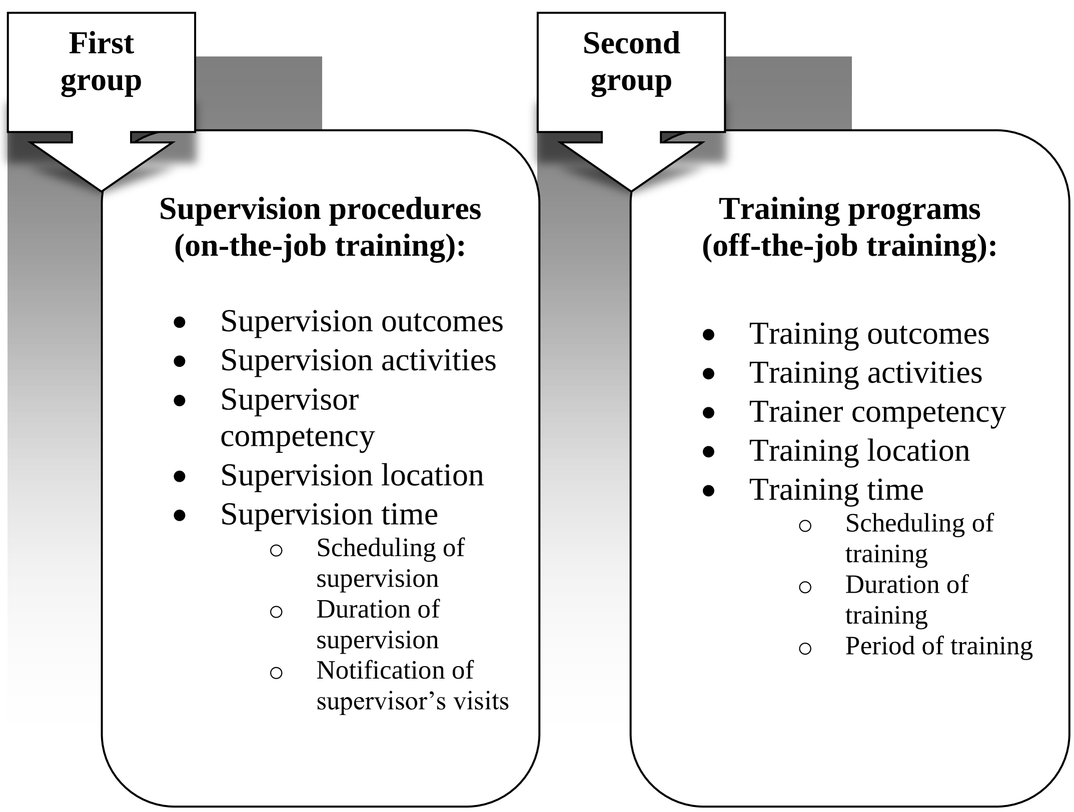
Table 5.5 (Continued)

Sub question	***Interviewees***	***Examples of participants' replies***	***Summary of findings***
Sub question 4 *Are there any difficulties physics teachers may face while involved in on- or off-the-job training?*	Teachers	No, I do not think so. The timetable is negatively affected due to teachers leave during the school day	There are no difficulties physics teachers may face while involved in both on- and off-the-job training. However, some participants claimed that the school timetable could negatively be affected due to teachers leave during the school day
	Principals	No, and training programs are scheduled Timetable could negatively be affected due to teachers leave during the school day	
	Trainer	Well, there are fake difficulties	
	Supervisor	Some teachers have a negative image of the supervisor as well as the supervisor is asked to be involved in some administrative affairs	
Sub question 5 *What role should the decision makers in the city of Onaizah play in order to increase the effectiveness of professional learning for physics teachers?*	Teachers	Well, by inviting experts and providing teachers with well-designed learning materials such as DVDs By providing the teacher with new practical ideas followed by instant demonstration by the supervisor in the physics class Well, by training the trainers	The effectiveness of professional learning for physics teachers can be increased by improving learning activities such as providing teachers with new practical teaching methods based on their training needs and exchange visits among teachers. Furthermore, several participants affirmed the importance to develop both supervisors and trainers
	Principals	Exchange visits among teachers should be planned and scheduled What is the problem with using the best teacher to supervise other teachers in the same area within the school? I think it is a good idea Training should be based on training needs at the beginning of semester	
	Trainer	In fact, trainers and the department of training should be developed	
	Supervisor	Well, supervisors' skills in technology and other areas should be developed	

Results of thematic analysis

As an outcome of conducting six phases of thematic analysis (Braun & Clarke, 2006), two main groups of themes emerged from the data, as all participants identified two different approaches to professional learning delivery. These overarching themes were not unexpected, as the interview guide explored both approaches to training. Sub-themes fell under these two broad areas and five sub-themes emerged, as summarised in Figure 5.2.

Figure 5.2 Two thematic groups



The following discussion will detail each group's sub-themes.

First group: Supervision procedures (on-the-job training)

Supervision outcomes

As an aspect of on-the-job training, only three teachers made clear statements about the positive impact on their performance as a result of the supervisor's visit, as follows:

T1: "For me, the physics supervisor's visit helps me in the area of dealing with physics curriculum within my school context and my students' abilities"

T5: "[The] physics supervisor's visit is most welcomed. I really wait for him to get some improvement"

T6: "A number of physics teachers welcome the supervisor's visit. [The] physics supervisor usually has a positive impact on teachers' knowledge about [the] curriculum, especially the latest physics textbook. [In this version] there are several new concepts and equations"

However, limitations regarding the positive impact of supervision activities on teacher's performance have been mentioned by some participants. For example:

T6: "The impact of supervision activities on teacher's performance only had a small effect"

P3: "I note there is a small change in teachers' performance as a result of [the] physics supervisor's visit"

P5: "The supervisor's visit has a short-term effect"

In addition, one teacher as well as the supervisor indicated that some positive outcomes took place with new teachers. For example:

T3: "The physics supervisor who visited me at my school did not provide me with significant experience, except when I was a new teacher"

SU: "For [the] supervisor's visit, I note there is a positive change (about 30%) on new physics teachers' performance"

On the other hand, the downside of the physics supervisor's visit has been reported by one teacher and one principal, as follows:

P1: "In reality, unfortunately the physics supervisor's visit is just routine and useless"

T2: "Professional learning activities can be improved by implementing supervision activities based on the physics curriculum"

Supervision activities

Instead of improving teachers' performance, the supervision process seemed to be an inspection process according to two teachers and four principals. For example:

T1: "Some supervisors visit teachers in order to find out teachers' mistakes instead of improving them"

T6: "For supervision activities, a difficulty could be when the supervisor comes to school as an inspector, looking for mistakes in teacher's performance"

P2: "Supervision activities should be improved. Teachers do not improve when the supervisor comes to school as an inspector"

P3: "In general, [the] supervisor's visit is not welcomed by teachers. Some visits look like an inspection"

P4: "Some supervisors do not realize the real role of [the] visit; they think they are inspectors"

P5: "The supervisor comes to school as an inspector"

Moreover, two teachers indicated that the supervision process is not conducted in short, logical steps:

T4: "I receive some brief notes during the visit of physics supervisor"

T6: "Professional learning activities can be improved by providing the teacher with new practical ideas followed by instant demonstration by the supervisor in [the] physics class"

In addition, the need for more supervisors and supervisor's visits was repeated in many comments. For example:

P3: "For [the] supervisor's visit, I prefer [them] to be at least twice a semester"

P5: "The number of supervision visits, especially for new teachers, should be increased. I prefer [them] to be at least four times a year. The number of supervisors should [also] be increased"

P6: "The number of supervisors and visits should be increased"

Supervisor competency

When discussing the supervisor's visits, participants reported that unless the physics supervisor is qualified in the area of supervision activities (on-the-job training), physics teachers may not able to learn professionally. These supervision skills related to delivering training (e.g. communication skills). This was clearly stated by many respondents from all three groups. For example:

T2: "The benefits gained from visiting supervisors depends on the supervisor's skills"

P2: "A physics teacher gain usually depends on the physics supervisor's personality"

P4: "In order to increase the effectiveness of professional learning for physics teachers, supervisors should be trained"

P5: "In order to increase the effectiveness of professional learning for physics teachers, supervisors should be developed"

SU: "Supervisors' skills in technology and other areas should be developed"

Supervisors' skills, as mentioned by respondents, can be classified into three groups as follows:

Firstly, the physics supervisor should be sufficiently knowledgeable. Supervision activities, therefore, should be run by experts in science education. Two teachers and four principals gave the following examples:

T2: "Professional experts in science education also are needed"

T5: "Inviting experts can increase the effectiveness of professional learning for physics teachers"

P2: "Supervisors should be capable and experienced"

P3: "The supervisor should be an expert"

P5: "The supervisor should come to school as an expert, not an inspector"

P6: "I hope that the physics supervisor comes to school as an expert, not an inspector"

Secondly, the physics supervisor should be an effective communicator during supervision activities. One teacher and one principal commented:

T5: "If the supervisor is a good communicator, the teacher reacts to him well and vice versa"

P4: "[The] response of [the] physics teacher to supervision activities depends on the supervisor's skills in the area of communication"

Lastly, three principals and the physics supervisor mentioned the need for more support by physics supervisors in order to increase the efficiency of supervision activities. For example:

P3: "It is important to motivate teachers to become involved in professional learning activities"

P4: "Teachers need to be encouraged. It is important to motivate teachers toward development"

P6: "It is possible to use some incentives to encourage teachers to become involved in professional learning activities"

SU: "I try to make my supervision visit friendly and supportive"

Supervision location

The majority of respondents across the three groups agreed that school facilities support the implementation of on-the-job supervision activities. For example:

T2: "School facilities support the implementation of professional learning activities"

T4: "I think school facilities support the implementation of professional learning activities reasonably"

T5: "My school is fully equipped and ready for supervision activities"

P4: "Facilities are available at school"

P5: "School facilities support the implementation of professional learning activities"

P6: "My school is fully equipped and ready for supervision activities"

SU: "There is no problem with school facilities. Supervision activities often can be run at any place"

On the other hand, school facilities did not adequately support the implementation of supervision activities, according to three teachers and one principal:

T1: "At school, the facilities are incomplete"

T3: "I think, at school the facilities are incomplete compared with the educational training centre. The facilities at school should be complete"

T6: "In my opinion, the facilities at school somewhat support the implementation of professional learning activities"

P3: "It is important to establish a special room for supervisors. This room should be large enough and contain a white board as well as other professional learning resources"

Supervision time

This element has three aspects: scheduling of supervision, duration of supervision and notification of supervisor's visits.

Scheduling of supervision

Many respondents from all three groups affirmed the importance of the supervisor's visit being early in the semester. For example:

P2: "For supervisor's visit, it is important to be at the beginning of semester"

P4: "For supervisor's visit, it is better to be at the beginning of semester"

P5: "For supervisor's visit, I prefer [it] to be at the beginning of semester"

SU: "Nowadays we prepare (using technology) to provide teachers with some materials at the beginning of semester"

In contrast, others preferred mid semester. For example:

T5: "Date of the supervisor's visit is suitable in mid semester"

P1: "For supervisor's visit, I prefer mid semester. ...As a result the supervisor can assess the teachers' performance properly"

P3: "For supervisor's visit, I prefer mid semester"

In addition, some supervision activities can take place based on need, regardless of date. For example:

T4: "Date of physics supervisor's visit is suitable at the beginning [of semester] or mid semester"

P4: "Date of the supervisor's visit depends on the quality of teacher's performance and his needs"

SU: "It is difficult to visit all teachers at the beginning of semester. The date of visit is according to priority"

Duration of supervision

Many respondents mentioned the school day or a part of the school day to run supervision activities. For example:

T4: "If everything is clear there is no need to extend the physics supervisor's visit"

P1: "If the supervisor's visits the teacher every semester, a part of the school day is ok"

P4: "In general, a day's visit each semester could be okay"

Many respondents, on the other hand, affirmed that the duration of supervision activities needed to be longer:

T5: "I am not satisfied about the short duration of the supervisor's visit"

P3: "The duration of the supervisor's visit is often not sufficient to cover many teachers in school"

P3: "[The] supervisor's visit should be long enough"

P5: "It is rare that the supervisor provides teachers with new skills and methods due to the short visit by the supervisor"

Moreover, the duration of supervision visits can take place based on the training needs of physics teachers. For example:

P4: "[The] duration of the supervisor's visit depends on the quality of [the] teacher's performance and his needs"

Notification of supervisor's visits

Respondents from all three groups believed that in order to obtain good results, supervision visits needed to be arranged in advance. For example:

T6: "I think the supervisor's visit should be arranged in advance (not suddenly) so the teacher can be ready"

P1: "There is no difficulty when the supervisor informs [the] school about the date of his visit in advance"

P2: "I prefer to notify teachers [in advance] about the date of supervisor's visit"

P3: "Some supervisor's visits are sudden. I prefer [them] to be arranged in advance"

P6: "I hope that [the] physics supervisor's visit is not sudden"

TR: "[The] supervisor can visit schools if [and when] needed"

Second group: Training programs (off-the-job training)

Training outcomes

The majority of respondents made clear statements about the positive impact on physics teachers' performance as a result of their involvement in training programs. For example:

T1: "Training programs provide the teacher with many teaching skills. I believe that these programs represent a strong support for physics teachers due to exchanging experience with other teachers"

T2: "Training programs are the most helpful way to improve physics teachers' performance using contemporary teaching techniques. We still need more training programs"

T3: "Physics teachers positively respond to professional learning activities, especially training programs. I think training programs are [a] much [more] effective way to develop teachers than [the] physics supervisor's visit"

T4: "I gain some improvements as a result of participating in training programs"

T5: "I seriously respond to training programs. I even prepare myself very well"

T6: "The impact of training programs on teacher's performance is excellent. The physics teacher gains new skills as a result of being involving in training programs outside his school"

P1: "I note some positive changes in teachers' performance as a result of involvement in training programs. I think training programs are more effective than the supervisor's visit"

P3: "Training programs are welcomed by many new teachers"

P5: "Training programs provide teachers with new skills and methods. I note that teachers are positively changed by training activities more than supervision activities. Thus, I am pleased with this outcome. [The] curriculum has also changed; therefore, more training is needed nowadays"

P6: "I note that new teachers are impacted by training activities more than old[er, more experienced] teachers"

TR: "Training programs improve teachers' performance"

However, the limitations of training programs have been mentioned by many participants. For example:

T5: "Some training programs are wasting time"

P2: "Some training programs outside school are sort of wasting time"

P3: "I note there is no big change in teachers' performance as a result of participating in training programs"

TR: "Training outcomes are not satisfactory"

Moreover, the poor assessment of teachers' training needs could limit the desired effect of training programs. This was indicated by some respondents:

T2: "Professional learning activities can be improved by implementing training activities based on the needs of physics teaching methods"

P1: "Training should be based on training needs"

P2: "I hope to run training programs based on training needs"

P4: "It is important to analyse training needs of teachers at the beginning of semester"

Teachers, in addition, may become involved in undesirable training activities unless they are provided with necessary details about the training programs, which could limit the positive effects of such programs. For example:

T4: "For training programs, there is just a title. It is better to provide the teacher with some important details about the training activities"

P1: "Even though one program contains some details, unfortunately, lots of programs contain just titles of training programs. It is better for training programs to be detailed"

P2: "Usually we are provided with titles of training programs and although some programs contain some details, the rest needs to be more detailed"

Training activities

Many respondents remarked on the productive implementation of training programs. For example:

T4: "Cooperative training activities are good enough"

T5: "Using small groups in training programs is excellent"

P3: "Training activities are excellent"

P4: "Training activities are suitable"

Two respondents stated their satisfaction in developing topics for training, as follows:

T4: "During the training program, I get detailed, practical advice about the applied topic"

P3: "Training topics are excellent"

Some respondents identified a weakness in developing relevant content during training programs. For example:

T4: "In some training programs, the content does not exactly match the title.

T5: "Sometimes, I found the content of the training program did not match its modern title. The program contains not up-to-date knowledge about teaching and learning.

P6: "Teachers sometimes fail to apply what they learn during training programs due to the school environment and lack of school facilities"

TR: "Training programs contain some normal knowledge about teaching and learning"

Moreover the poor delivery of content is sometimes evident during training activities. Two teachers, for example, made the following comments:

T3: "I think there is no weakness in training programs, except long theoretical introductions in some programs"

T6: "Boring lectures in the training programs should be avoided"

Trainer competency

The trainer plays a big role in teachers' professional development. Therefore, physics teachers may not learn well unless the trainer is qualified. For example:

T4: "For training programs, [the] physics teacher's response, positively or negatively, depends on the reputation of [the] trainer"

P1: "The effectiveness of training activities depends on the trainer"

P2: "A physics teacher's gain usually depends on the trainer's competency"

P3: "The trainer plays a big role in teachers' improvement"

P4: "Response of physics teachers to training programs depends on the trainer"

SU: "Obviously, it depends (90%) on the trainer's competency"

However, only two teachers expressed their satisfaction with their trainer's performance:

P4: "According to my experience, trainers, in general, are qualified"

P5: "Trainers are nice and qualified"

Other respondents declared the need for more qualified trainers to increase the efficiency of training activities. For example:

T5: "Some trainers are not knowledgeable enough and download free pre-designed training programs from the internet instead of designing them. I think *the effectiveness of professional learning for physics teachers can be increased by training the trainers"*

P2: "Trainers should be capable and experienced. Frankly, some trainers are not qualified"

P3: "As a difficulty may face the improvement of physics teachers is the poor competence of some trainers. Some trainers need to be developed"

TR: "I think it is wrong to ask trainers to design training curriculum because they do not have enough experience to do so. In fact, trainers and [the] department of training should be developed"

SU: "I think it is very important to train the trainers"

Training location

The implementation of professional learning activities outside school is better for the teacher to learn professionally according to many comments. For example:

T3: "[The] physics teacher attends training programs outside school with less stress (more relaxed) because he is away from his workplace"

P1: "Teachers usually respond to training programs outside school more than those within [the] school"

P2: "It is better for the teacher to leave school for professional learning"

P6: "Some teachers welcome participation in training programs outside school in order to relax"

TR: "I think teachers respond to training programs outside schools more than the supervisor's visit"

However, the opportunity for teachers to leave during the school day may decrease due to the negative effect on [the] school timetable according to some teachers and principals. For example:

T1: "Some principals do not give permission for teachers to attend training programs outside schools during the school day"

T5: "Regarding training programs, [the] school timetable is negatively affected due to teachers' absence during the school day"

P5: "The only difficulty is that [the] timetable is negatively affected due to teachers leaving during the school day"

P6: "[The] school timetable is negatively affected due to teachers leave during the school day"

Moreover, the majority of respondents from all three groups agreed that the location and facilities of the educational training centre support the implementation of training activities. For example:

T2: "The educational training centre facilities support the implementation of professional learning activities which is established for this purpose"

T4: "[The] training location is good enough and I think educational training centre facilities support the implementation of professional learning activities reasonably"

T5: "[The] training location and facilities are excellent"

T6: "In my opinion, the facilities at the educational training centre somewhat support the implementation of professional learning activities"

P1: "[The] location of training programs is good"

P3: "[The] training location and facilities are good"

P4: "Facilities are available at [the] educational training centre and [the] training location is suitable"

P5: "The educational training centre facilities are very good"

P6: "[The] educational training centre facilities are ok"

TR: "[The] learning environment at the educational training centre is almost prepared"

Conversely, educational training centre facilities did not adequately support the implementation of supervision activities according to two participants:

T6: "I think a well-equipped building is needed for running professional learning activities for physics teachers"

TR: "Educational training centre facilities do not meet our hopes"

Training time

This element has three aspects: scheduling of training, duration of training and period of training.

Scheduling of training

Some respondents affirmed the importance of early training programs for physics teachers. For example:

T4: "Training program's date is suitable at the beginning of semester"

P1: "Training programs should be at the beginning of semester"

P4: "For training programs, it is better to be at the beginning of semester"

In addition, two respondents spoke about the positive impact of training programs run during the summer holidays. For example:

T5: "I prefer to run training programmes during the summer holidays based on training needs"

P6: "It is better to run training programs during summer holidays"

One participant, on the other hand, stated that summer holidays are not suitable for running such training programs:

P2: "I disagree with running training activities during summer holidays"

Duration of training

Long training programs seem to be more effective. For example:

T4: "The teacher needs longer training programs to learn new teaching techniques well, one or two weeks"

P3: "Long training programs are more effective than short programs"

P6: "I think long training programs are more effect than short programs. Teachers need more practice and that takes longer"

TR: "The one-day training program is acceptable for a simple skill. However, training programs need to be longer for complex or multi-skilled teaching methods"

However, the duration of training programs depends on the nature of training programs. This was clearly affirmed by two teachers:

T4: "The duration of training programs depends on the nature of training programs"

T5: "Duration depends on the nature of training programs"

In addition, separate training days could work better for physics teachers, according to two participants:

P4: "For training programs, it is better [they run] for one-day or separate days"

P5: "It is better to run [the] training program on a specified day for five weeks than one week"

Period of training

Two principals preferred to run training programs in the evening. For example:

P2: "Instead of leaving school in the morning, the teacher can participate in evening programs, if available"

P5: "It is better to run training programs in the evening"

Practically, morning programs seemed to be favoured by teachers as the trainer affirmed:

TR: "Teachers participate in morning programs more than evening programs"

Summary of the two main groups of themes

Table 5.6 summarises sub-themes that emerged from the qualitative data with examples.

Table 5.6 Two main groups of themes

First group			***Second group***		
Supervision procedures (On-the-job training)			**Training programs (Off-the-job training)**		
Sub-themes	**Summary of sub-themes**	**Examples of sub-themes**	**Sub-themes**	**Summary of sub-themes**	**Examples of sub-themes**
Supervision outcomes	**Two perspectives:**		**Training outcomes**	**Two perspectives:**	
	There is a positive impact on teacher's performance as a result of physics supervisor's visit	*"For me, the physics supervisor's visit helps me in dealing with physics physics curriculum within my school context and my students abilities"*		There is a positive impact on physics teachers' performance as a result of involvement in training programs	*"Training programs are the most helpful way to improve physics teachers' performance. We still need more training programs"*
	There is limited positive impact of supervision activities on teacher's performance	*"I note there is a small change in teachers' performance as a result of [the]physics supervisor's visit"*		There is a limited positive effect of training programs on teachers' performance	*"I note there is no big change in teachers' performance as a result of participating in training programs"*

Table 5.6 (Continued)

Supervision procedures (On-the-job training)			Training programs (Off-the-job training)		
Sub-themes	**Summary of sub-themes**	**Examples of sub-themes**	**Sub-themes**	**Summary of sub-themes**	**Examples of sub-themes**
Supervision activities	Supervision process seems to be an inspection process	*"Some supervisor's visit teachers in order to find out teachers' mistakes instead of improving them"*	**Training activities**	The implementation of training programs is good enough	*"Training activities are excellent"*
Supervisor competency	Physics supervisor is not qualified in the area of training delivery	*"In order to increase the effectiveness of professional learning for physics teachers; supervisors should be trained to be a good trainer"*	**Trainer competency**	**Two perspectives:** The trainer is qualified	*"According to my experience, trainers, in general, are qualified"*
				There is a need for more qualified trainers	*"Trainers should be capable and experienced. Frankly, some trainers are not qualified*

Table 5.6 (Continued)

Supervision procedures (On-the-job training)			Training programs (Off-the-job training)		
Sub-themes	**Summary of sub-themes**	**Examples of sub-themes**	**Sub-themes**	**Summary of sub-themes**	**Examples of sub-themes**
Supervision location	School facilities support the implementation of supervision activities	*"I think school facilities support the implementation of professional learning activities reasonably"*	**Training location**	The implementation of professional learning activities outside school is better for the teacher to learn professionally	*"Physics teacher attends training programs outside school with less stress (more relaxed) because he is away from his workplace*
				Location and facilities of educational training centre support the implementation of training activities	*"Training location is good enough and I think the facilities of [the] educational training centre support the implementation of professional learning activities reasonably"*

Table 5.6 (Continued)

Supervision procedures (On-the-job training)			Training programs (Off-the-job training)		
Sub-themes	**Summary of sub-themes**	**Examples of sub-themes**	**Sub-themes**	**Summary of sub-themes**	**Examples of sub-themes**
Supervision time Scheduling of supervision	Physics supervisor's visit should take place at the beginning of semester	*"For supervisor's visit, it is important to be at the beginning of semester"*	**Training time** Scheduling of training	Training programs should be at the beginning of semester	*"For training programs, it is better to be at the beginning of semester"*
Duration of supervision	Duration of supervision activities need to be longer	*"It is rare that the supervisor provides teachers with new skills and methods due to the short visit by the supervisor"*	Duration of training	Long training programs are more effective than short programs	*"I think long training programs are more effect than short programs. Teachers need more practice and that needs longer time"*
Notification of supervisor's visit	Physics teachers should be notified in advance about the supervisor's visit	*"I think the supervisor's visit should be arranged in advance (not suddenly) so the teacher can be ready"*	Period of training	Teachers prefer morning training programs	*"Teachers participate in morning programs more than evening programs"*

Discussion

This section interprets and contextualizes the findings obtained from interviews with Teachers (T), Principals (P), Trainer (TR) and Supervisor (SU). There are several themes derived from the data analysis as summarised in table 5.2. These themes are professional learning outcomes, professional learning activities, supervisor and trainer competencies, professional learning location and professional learning time. A discussion of the sub-themes follows.

Professional learning outcomes

Participants in this study were asked for their personal opinions on the outcomes of professional learning for physics teachers as a result of being involving in both on- and off-the-job training. The results showed that responses of interviewees were mixed. Therefore, their responses have been divided into two groups: supervision (on-the-job training) and training (off-the-job training) outcomes.

Supervision outcomes

Participants made clear statements about the positive impact on physics teachers' performance as a result of the physics supervisor's visit (on-the-job training). For example, one teacher who had experience supervision said:

T1: "For me, the physics supervisor's visits help me in the area of dealing with physics curriculum within my school context and my students' abilities"

During the visit, the supervisor can observe students within the school context. Thus, he can help the teacher to apply the most appropriate teaching strategy based on the characteristics of his students.

In addition, because trainees regularly receive immediate feedback on their performance, the likelihood of transferring new skills to their daily practice is greater (Fisher, Schoenfeldt & Shaw, 2006). Consequently, with on-the-job training, physics teachers are more likely to improve their teaching skills. The trends identified in relation to this first training group are supported by previous patterns reported by Almoqaid (2006), Al Qurashi (2007) and Abo Shamlah (2009). Their findings highlighted the need for an on-the-job presence by supervisors in demonstrating best practice. Such results affirm the trends identified in this study regarding the effectiveness of supervision activities such as classroom visits, and model lessons and workshops used by supervisors to improve teachers' performance.

In contrast, a number of participants stated the limited positive impact on physics teachers' daily practice as a result of physics supervisor's visit. Such poor impact on physics teachers' performance might refer to the weakness of supervision activities and lack of supervisor competencies in the area of providing physics teachers with skills and knowledge related to their daily practices. As highlighted in one teachers comment:

> *T2: "Professional learning activities can be improved by implementing supervision activities based on the needs of the content knowledge of* [the] physics curriculum"

These findings related to supervision outcomes concur with the research concerning the effectiveness of educational supervision reported by Kennedy (1991), Aljerjawi and Alnekhala (2008), Ihmeideh, Jumia'an and Al-Khoulda (2011) and Alzahrani (2013). These researchers outlined that the role of educational supervisors in improving teachers' performance was not satisfactory from the viewpoint of teachers.

They found that the inspection nature of the visits combined with lack of supervisor's competencies provided limited opportunities for learning. These findings affirmed the need for more effective supervision activities to avoid such limitations (Werner & Desimone, 2006).

Training outcomes

In regards to training program outcomes, several participants highlighted the positive impact on physics teachers' performance with respect to off-the-job training. Such a result is not surprising due to the advantages of this type of model of professional learning. For example, off-the-job training activity can allow trainees to focus on learning materials, and therefore minimize distractions and facilitate the attainment of desired outcomes (Fisher, Schoenfeldt & Shaw, 2006). Off-the-job training has therefore been successful with ongoing debate about the ideal length and frequency of such training (Straker, 1988; Power 2011). Consequently, physics teachers are more likely to improve their teaching skills effectively with off-the-job training. This finding is supported by previous studies (Jauhiainen, Lavonen, Koponen, & Kurki-Suonio, 2002); Lavonen, Jauhiainen, Koponen, & Kurki-Suonio, 2004); Barakat, 2005); Ahmed, 2007); Alzahrani, 2009); Attiat & Attiat, 2010); Morge, Toczek, & Chakroun, 2010); Hammad & Albahbahani, 2011); Naoreen, Aslam, Arshad, & Nausheen, 2011). These researchers reported the effectiveness of off-the-job training in improving teachers' performance by providing trainees with practical content and examples of teaching activities that related to their daily practice. The consistent finding within these studies was that academic achievement levels of students taught by trained teachers was greater than those students taught by untrained teachers.

In contrast, some participants stated that there is a limited positive impact on physics teachers' performance as a result of involvement in off-the-job training programs. This low level of impact on physics teachers' daily practice for off -the-job training programs might constitute many factors such as using unproductive training activities and lack of trainer competencies (as will be discussed later). The weakness of analyzing training needs for physics teachers also can decrease the effectiveness of training programs. This can occur because of using inaccurate approach for analyzing the needs of teachers such as relying on the personal experience of the supervisor as a teacher. In addition, the short visit does not allow the supervisor to accurately observe teachers' performance in the classroom, which in turn can lead to inaccurate assessment. This has been supported by the following comments:

T2: "Professional learning activities can be improved by implementing training activities based on the needs of physics teaching methods"

P4: "It is important to analyse training needs of teachers at the beginning of semester"

This finding that relates to assessment of training needs is similar to the results of several studies concerning the effectiveness of educational training. For example, Asunta (1997) reported that primary teachers in Finland felt they needed continuous support to meet their needs in improving their knowledge and understanding the subject, especially in chemistry and physics as a part of the science curriculum, and requested more practice in hands-on activity planning. Furthermore, Mac, Yip and Chung's (1999) findings indicated that science teachers in Hong Kong, being graduates in specialised areas in science, were not adequately prepared to teach a broad and balanced junior science curriculum. Abo Atwan (2008) found that poor assessment of training needs represented a barrier for in-service teacher training programs in Gaza. The results of studies conducted by Uysal (2012) and Kildan et al. (2013) also indicated that in-service training programs for teachers in Turkey have limitations in terms of their impact on teaching practice, as the programs did not target teachers' requirements in relation to curriculum and content knowledge.

Professional learning activities

Participant's opinions on professional learning activities for physics teachers will be considered in relation to supervision and training.

Supervision

All participants agreed that supervision involved procedures that were completed in a short time period and implemented as an inspection process rather than an improvement process for physics teachers' performance. As adult learners, physics teachers might not improve their teaching skills effectively under supervision, unless factors such as incorporation of a learner-centred model and learning style are considered. For example, Minton (1991), Rogers (1996) and Lawson (2006) proposed similar perspectives. Therefore, physics teachers may learn best when they are actively involved in the process of learning rather than listening passively to the supervisor's instructions. And people have different styles of learning (Marsh, 2004). For example, Willson (2006) found 46% are visual learners, 35% kinaesthetic learners, and the remaining 19% are auditory learners. Consequently, professional learning activities should use a range of pedagogies for teachers' learning approaches. Moreover, trainees can develop their skills more effectively learning at their own pace (Rogers, 1971) and when materials are presented to them according to a step-by-step job instruction technique including preparation of the trainee, presentation of the operation, performance tryout and follow-up (Dessler, 2013).

The supervision practice conducted in the current study may have been ineffective due to the short time available to conduct on-the-job training activities, because some supervisors were involved in administrative affairs such as assisting in providing schools with textbooks and instructional aides, activating school libraries and evaluating the results of students' exams (Department of Educational Supervision, 2008). This has been supported by comments from a principal and supervisor:

P1: "I think [the] supervisor should focus on developing teachers rather than [being] involved in some administrative affairs"

SU: "The supervisor is asked to help in some administrative tasks which might negatively affect the process of improving teachers' performance"

The finding that identified teachers' perceptions of a low quality level in supervision practice is reinforced in previous studies concerning supervision activities as an aspect of on-the-job training. For example, Al-Qurashi (1994) reported that visits by some supervisors were more like an inspection process than improving teachers. In addition, Alzahrani (2013) highlighted the weak impact of the educational supervisors in treating with the problems that encounter teachers' performance especially in the area of the implementation and evaluation of the developed curricula.

Training activities

The results showed that interviewees *have contrasting opinions* regarding training activities. Their responses were considered according to positive and negative perspectives held in relation to training activities.

Positive perspective group

Participants in this group made clear statements about the productive implementation of off-the-job training programs. These types of responses were to be expected and might refer to a range of factors such as using proper training methods and appropriate class size. For example, training methods should be designed to involve participants more actively (Lawson, 2006) by demonstrating practical methods that trainers want teachers to apply in their classrooms. The role of learner within such training activities is to participate effectively in order to accomplish the task (Print, 1993; Kyriacou, 2007) and thus teachers are more active, many skills are learnt and teachers receive immediate feedback. For that reason, many interactive training methods such as individual exercises, group discussion, workshops, demonstrations, brainstorming, role playing, case study and project are frequently used during training programs for educators at the educational training centre (Department of Educational Training, 2013). As a result, physics teachers are more likely to effectively engage in, and benefit from, professional learning using these types of training activities. This finding is supported by the results of previous studies such as Ahmed (2007), Harris and Sass (2008), Attiat and Attiat (2010), Hammad and Albahbahani (2011), Tecpan, Zavala1 and Benegas (2011) and Jauhiainen (2013). These researchers reported the positive implementation of teacher training programs using interactive activities. Such results affirm the trends identified in current responses regarding the effectiveness of some training activities such as laboratory-based training, workshops and role playing, used by trainers in improving physics teachers' performance.

Furthermore, participants in this group reported their preference regarding the use of small groups in their learning activities. This finding supports the notion that learners are more likely to achieve positive academic outcomes in small groups (Jauhiainen, Lavonen, Koponen, & Kurki-Suonio, 2002; Wilkinson & Fung, 2002) because learners in small groups work together cooperatively (Print, 1993; Whitton, Sinclair, Barker, Nanlohy, & Nosworthy, 2004) and in managing their task using their own words, views and ideas (Harris-Barnett, 2007). Several teachers found this to be the case, for example:

T4: "Cooperative training activities are good enough"

T5: "Using small groups in training programs is excellent"

Negative perspective group

In contrast, participants in this negative perspective group stated the unproductive implementation of off-the-job training programs. In particular, a weakness associated with the applicability of content covered during learning activities (e.g. inquiry approach which can be difficult to implement in Saudi Arabian schools, with the real world context of their schools setting and with their student groups. For example:

T6: "The effectiveness of professional learning for physics teachers can [be] increased by providing the teacher with new, applicable ideas followed by instant demonstration by the supervisor in [the] physics class"

P6: "Teachers sometimes fail to apply what they learnt during [their] training programme due to the school environment and lack of school facilities"

TR: "Some training programs contain non-applicable content knowledge"

Moreover, participants' responses in relation to poor delivery of content (e.g. the expository model, regularly used during training activities), is not surprising due to the weakness previously identified for this model of professional learning (Print, 1993; Lawson, 2006). For example, the role of the instructor is to transmit information while learners receive information (Print, 1993). Thus, it emphasizes passive behaviour on the part of learners, the retention rate of information tends to be low over time and learners receive minimal feedback. Such unproductive learning methods should be avoided during professional learning activities. Two teachers commented about poor delivery of content during training activities as follows:

T3: "I think there is no weakness in training programs except the long theoretical introductions of some programs"

T6: "Boring lectures in the training programs should be avoided"

The training practices highlighted by the negative perspective group (off-the-job training), are similarly considered in earlier research findings. Specifically, Abo Atwan (2008), Alzahrani (2009), Boitshwarelo (2009) and Jauhiainen (2013) determined that the poor delivery of professional learning activities represents a barrier to fully benefitting from participating within in-service teachers' training programs in Gaza, Saudi Arabia, Botswana and Finland respectively.

Trainer (TR) and Supervisor (SU) competency

Participants in this study were asked to consider and comment on the third theme of competency for both trainers and supervisors. The interview responses were mixed in that no interviewees were satisfied with supervisors' competency but they were satisfied and dissatisfied with trainers.

Supervisor (SU) competency

All participants reported that supervisory skills are not sufficiently developed to conduct supervision activities for physics teachers. The identification of weaknesses in supervisor's skills might refer to the limited opportunity for supervisors to engage in training courses that aim to increase their competency (Al-Sayegh ١٩٩٢; Al-Hammad ٢٠٠٠). This issue was also reinforced by comments such as:

P4: "In order to increase the effectiveness of professional learning for physics teachers, supervisors should be trained"

SU: "Supervisors' skills in technology and other areas should be developed"

This finding supports Al-Sayegh (١٩٩٢), Al-Qurashi (1994), Al-Hammad (٢٠٠٠) and Al khateeb's (2001) arguments. The results of these studies reinforced that unless the educational supervisor is qualified in the area of supervision activities (on-the-job training), teachers may not be able to fully benefit from their professional learning.

Trainer (TR) competency

Participants' opinions were mixed on the trainer's competency. Some were satisfied and others dissatisfied.

Satisfied group

Participants in this group indicated their satisfaction with the trainers' competency during off-the-job training programs. This finding concurs with previous research undertaken by Aboul Gheit (2011) and Hammad and Albahbahani (2011). These researchers highlighted the need for competent trainers to be able to present ideas clearly and demonstrate best practice in the classroom during training programs.

Dissatisfied group

In contrast, participants in the dissatisfied group declared the need to better qualify trainers who are skilled in developing units of study with engaging delivery approaches. Such skills would increase the effectiveness of training programs. Such weaknesses in the trainers' skills might refer to lack of training courses that aim to improve trainers' skills (Al-Nemsha, 1997; Alnooijm, ٢٠٠٥).

T5: "Some trainers are not knowledgeable enough and download free pre-designed training programs from the internet instead of designing them. I think the effectiveness of professional learning for physics teachers can be increased by training the trainers"

P3: "A difficulty that may face the improvement of physics teachers is the poor competence of some trainers. Some trainers' skills need to be developed"

The current finding highlighting lack of competencies of trainers has also been identified in previous studies. For example, Al-Nemsha (1997) reported the weakness of trainers' skills in using modern training methods and learning aids at the institute of Border Guards in Riyadh. Furthermore, Mansour (2003) indicated an apparent lack of trainers' abilities in assisting teachers during different types of in-service training programs in Syria. And Al-Shehri (٢٠٠٦) identified lack of experience of trainers in training programs for officers at the King Khalid Military College in Riyadh. Moreover, Boitshwarelo (2009) suggested that training providers should use blended methods in better ICT practices in order to assist science teacher in Botswana to professionally develop.

Professional learning location

The fourth theme emerged from discussions with participants about the location of implementation of professional learning activities for physics teachers. Their responses can be divided into two subthemes.

Location

Participants reported that the implementation of training activities outside schools is better for physics teachers to learn professionally. This result is not surprising due to the advantages of this type of format for professional learning (Fisher, Schoenfeldt & Shaw, 2006). For example, trainees are more likely to focus on learning materials thus minimizing distractions, and subsequently desired learning outcomes can be achieved. This perspective has been supported by comments such as:

T3: "[The] physics teacher attends training programs outside school with less stress (more relaxed) because he is away from his workplace"

TR: "I think teachers respond to training programs outside schools (as a relaxation opportunity) more than the supervisor's visit"

This response is supported by Nankervis, Compton and Baird's (2005) findings. These researchers highlighted the importance of providing employees with some training away from their usual workplace to assist them to effectively engage in professional learning.

However, participants reported the limited possibility of physics teachers leaving during the day so as to be involved in professional learning activities outside schools. Such a restriction might constitute the negative affect that can be caused by the absence of teachers (e.g. missing some classes due to the revised school timetable). For example:

T5: "Regarding training programs, [the] school timetable is negatively affected due to teachers taking leave during the school day"

P5: "The only difficulty is that [the] timetable is negatively affected due to teachers taking leave during the school day"

This finding concurs with that of a study concerning the absence of teachers and how this impacts educational achievement. Raby (2007) concluded that teachers' absence from schools has a negative impact on achievement during the compulsory stage (Grades 1 to 10) and students' behaviour in Qalqilya.

Facilities

On the other hand, participants agreed that the facilities at both schools (on-the-job training) and the educational training centre (off-the-job training) assist the implementation of professional learning activities for physics teachers. This type of positive statement is to be expected, especially for the educational training centre, which was basically established to develop teachers' skills (Department of Educational Training, 2012).

T5: "My school is fully equipped and ready for supervision activities"

P5: "The facilities at schools support the implementation of professional learning activities"

T4: "Training location is good enough and I think the facilities at [the] educational training centre support the implementation of professional learning activities reasonably"

P4: "Facilities are available at [the] educational training centre and [the] training location is suitable"

This finding is supported by previous studies concerning the relationship between school facilities and learners' achievement. For example, Vandiver (2011) revealed that quality and pedagogical adequacy of educational facilities were significantly associated with students' performance and teachers' turnover in US high schools located in northeast Texas.

Professional learning timing

The fifth theme centered on timing with participants in this study being asked to identify their personal opinions regarding the timing of professional learning for physics teachers. The results comprise different points of view.

Duration of supervision

Many respondents indicated that the duration of supervision is too short. Insufficient time for visits can decrease the efficiency of supervision activities (i.e. analyze teachers' performance and provide them with guidance in relation to their skills and methodological approaches).

T4: "I receive some brief notes during the visit of physics supervisor"

P5: "It is rare that the supervisor provides teachers with new skills and methods due to the short visit by the supervisor"

Furthermore, as an aspect of on-the-job training, supervision activities comprise four main steps: preparation of trainees, presentation of operation, performance tryout, and follow-up (Dessler, 2013). These steps should be conducted and given sufficient time for them to take place.

T6: "Professional learning activities can be improved by providing the teacher with new practical ideas followed by instant demonstration by the supervisor in physics class. I think such practice cannot take place in short time visit"

This issue might be due to the shortage of supervisors as reported by Al-Sayegh (١٩٩٢) and Al-Hammad (٢٠٠٠). For example:

P5: "The number of supervision visits, especially for new teachers, should be increased. I prefer visits to be at least four times a year (increasing the amount of time for training). The number of supervisors should be increased"

P6: "The number of supervisors and visits should be increased"

Consequently, the general negative opinion of respondents regarding the duration of supervision reinforces the necessity for a change in approach. Visits need to be long enough in order to enable supervisors to run supervision activities effectively and hence assist physics teachers to improve their teaching skills.

Duration of training

Appropriate length of time for any training program represents an important element in trainees' development (Lawson, 2006). Thus, duration should be considered when designing professional learning activities. Similar to the duration of supervision, long training programs which are conducted at the educational training centre seem to be more effective than short programs from the point of view of many participants.

P6: "I think long training programs are more effect than short programs. Teachers need more practice and that needs more time"

This viewpoint is not surprising, due to the role of such model of professional learning in developing trainees' skills. This finding is supported by several studies concerning educational training effectiveness such as Mansour (2003)**,** *Johnson (2006),* Sarpong (2006) and Al-Zahrani (2009). Results showed that the short duration of in-service training programs is considered to be a professional development obstacle for teachers in Syria, Central America, Ghana and Saudi Arabia respectively. These researchers highlighted the need for more time in demonstrating best practice during training programs.

In spite of the importance of the trainer as an expert, he is not the only source of knowledge; teachers' prior experience should also be considered (Knowles, Holton, & Swanson, 2005). Learners can learn from each other and the instructor (Print, 1993; Whitton, Sinclair, Barker, Nanlohy, & Nosworthy, 2004). This was reinforced by the following teachers' comment:

T1: "Training programs provide the teacher with many teaching skills. I believe that these programs represent a strong support for the physics teacher due to exchanging experience with other teachers"

Trainers therefore should assist trainees to improve their skills by creating efficient learning opportunities both inside and outside the classroom. Such opportunities need to be given a suitable length of time, so as to positively involve and engage teachers in these opportunities so they can learn from each other (Westheimer, 2008). For example, in the classroom, teachers can learn formally from each other in small groups (Wilkinson &Fung, 2002), and outside the classroom teachers can learn informally by sharing their teaching experience during breaks. Such learning opportunities need to be considered during the design of training activities and allow sufficient time for them to be implemented.

Furthermore, teaching a new skill requires enough time to be mastered by learners and the length of time depends on the nature of the skill, as well as the learner's readiness to learn. Learning comprises four stages. For physics teachers in *Onaizah*, this involved understanding inquiry-based learning and how this can be applied to teaching physics. These four stages which identified by different combinations of consciousness and competence include; unconscious incompetence, conscious incompetence, conscious competence and unconscious competence (Howell, 1982). The following example shows how the four stages in a training program can be applied.

Program Title: Teaching physics with a SMART Board

Stage 1: Unconscious incompetence

At the beginning of the training program, teachers are not aware of the value of using a SMART Board in physics classes and do not know how to use it. Thus, the role of the instructor during this stage is to move teachers to the next stage to become conscious of their incompetence before development of the new skill. This can take place by giving a short presentation by the instructor using a SMART Board to demonstrate the difference between this board and the more traditional whiteboard or chalkboard. By recognising the advantages of the SMART Board, teachers can realise the benefit of using this type of technology to increase their teaching effectiveness. This activity needs approximately one hour.

Stage 2: Conscious incompetence

Teachers become aware of the value of using a SMART Board in physics classes but they do not know how to use it. The role of the instructor during this stage is to develop the new skill, by demonstrating the proper use of a SMART Board, followed by performance tryouts by teachers. The demonstration may be broken down into steps small enough to be practised such as displaying the computer screen, writing, drawing, erasing, saving, sharing and presenting. This activity needs approximately five hours.

Stage 3: Conscious competence

During this stage teachers can reliably give a short presentation using a SMART Board under the guidance of the instructor. However, they still need to concentrate and think in order to perform the skill. Therefore, the instructor, by the end of training program, encourages teachers to ideally continue practising the new skill in order to move to the next stage (unconscious competence) and subsequently be able to use a SMART Board in physics classes effectively. This activity needs approximately two hours.

Stage 4: Unconscious competence

This stage takes place after completing the training program. The teachers at this stage are able to reliably use a SMART Board without concentrating or thinking about it. These stages are presented in the following table.

Table 5.7 Applying the four stages in a training program

Stages	***Content***	***Activities***	***Duration***
Unconscious incompetence	✓ Difference between SMART Board and other boards ✓ Advantage and disadvantage of SMART Board	A short presentation by the instructor using SMART Board	1 hour
Conscious incompetence	Using SMART Board: ✓ displaying computer screen ✓ writing ✓ drawing ✓ erasing ✓ saving ✓ sharing ✓ presenting	Step-by-step demonstration about the proper use of SMART Board by the instructor followed with performance tryouts by teachers	5 hours
Conscious competence		Individual short presentation using SMART Board by teachers under the guidance of the instructor	2 hours
Unconscious competence		This stage takes place when the teachers return to their schools after completing the training program	

As shown, this example of SMART board training activities need to be frequent and of a long enough duration to develop the skills being presented. Consequently, in order to enable trainers to run training activities effectively and hence assist physics teachers to improve their teaching skills, the duration of training programs needs to be adequate based on the complexity of skills being taught. For example, one training day can teach a simple skill such as using a SMART Board. However, multi-skilled training programs (e.g. using cooperative learning in physics classes) require more time. The following comments support this finding:

T4: "The teacher needs longer training programs to learn [a] new teaching technique well, one or two weeks"

TR: "The one-day duration training program is acceptable for a simple skill. However, training programmes need to be longer for complex or multi-skilled teaching methods"

Understanding and applying some contemporary teaching approaches, such as inquiry-based learning in physics, is complex. Teachers who were unconscious and incompetent did not apply this model of learning in their classrooms. Most professional learning activities regarding inquiry-based learning help teachers to move to the second level (conscious incompetent). That means teachers are aware about the new skills but unable to effectively implement them. Therefore, it is important to keep moving teachers to the next stage (conscious competence), to be able to implement the new skill and transfer this model of learning to their classrooms.

This finding is supported by several studies concerning educational training effectiveness such as Adey (2006) and Birman, Desimone, Porter and Garet (2000). Results showed that one-day training can be suitable for teaching a simple skill (e.g. using a SMART Board), and a five-day summer professional development institute allowed adequate time for science teachers, in the small, rural district of Washington, to learn multi-skilled teaching approaches.

Notification of supervisor's visits

Participants reported the importance of notifying physics teachers in advance about supervisor's visits to their schools in order to obtain good results. Sudden visits may alter the teacher's perception about the nature of the supervisor's visits, so they are considered as part of an inspection process instead of professional learning activities. This may negatively impact the daily practice of physics teachers. This has been supported by interview comments such as:

T1: "Some supervisor's visit teachers in order to find out teachers' mistakes instead of improving them"

P4: "Some supervisors do not realize the real role of the visit; they think they are inspectors"

These findings concur with the research concerning educational supervision effectiveness undertaken by Al-Qurashi (1994) and Al khateeb (2001). These studies reinforced that supervision practices could be improved by notification of supervisor's visits in advance, as teachers would be more relaxed and receptive to supervision feedback.

Period of training

From a practical perspective, morning seemed to be the favoured period for physics teachers to participate in training programs. This preference was supported by findings of previous studies regarding the impact of time of day on students' academic achievement. For example, Sjosten-Bell's (2005) study showed that the morning hours positively impacted academic performance in computing mathematical algorithms and the basic statistics of elementary students in Columbus State. Moreover, Ray (2009) reported that academic performance of students enrolled in twelve units of the Basic Statistics I course at the Liberal Arts College had a positive impact when taught in the morning. However, the preference for morning training programs contradicts previous studies by Barron, et al. (1994) and Spickler, Hernandez-Azarraga and Komorowski (1997). They found that afternoon instruction positively impacted elementary students' achievement in the mastery of reading skills and a hands-on science program respectively. This could be due to the fact that research shows that short-term memory is better in the morning, while long-term memory is better in the afternoon (Jensen, 2000). Hence, learning activities involving short-term memory, such as mathematics and science, may be better run in the morning (Brewer, & Campbell, 1991) while learning activities involving long-term memory, such as art and hands-on activities, may be better conducted in the afternoon (Brewer & Campbell, 1991; Stanciu, 2007). Therefore, by implementing training activities in the morning, physics teachers are more likely engage in activities associated with physics content knowledge. Furthermore, the afternoon period can be used to conduct training activities containing topics involving long-term memory such as planning for physics classes, teaching methods and classroom management.

Summary

This chapter has presented and discussed the research plan applied in the qualitative study and resultant findings. Information was presented in relation to sampling, measurement instruments used, procedures of data collection, data analysis plus interpretation and contrasting results with the literature.

The research questions concerned the differences between the two main forms of professional learning of physics teachers in the city of *Onaizah*, Saudi Arabia. Educators (teachers, principals, trainer and supervisor) who responded to this qualitative study were asked to evaluate the practice for both on- and off-the-job training as tools of professional learning for physics teachers. The results also showed that interviewees *have dissimilar opinions and* therefore this qualitative study can be summarized as follows:

First group of findings: supervision procedures (on-the-job training)

While some participants made clear statements about the positive impact on physics teachers' performance as a result of the supervisor's visit, the majority provided contrasting perspectives. Furthermore, all participants agreed that supervision activities involved procedures that were completed in a short time period and implemented as an inspection process rather than improving physics teachers' performance. All participants reported the need to develop supervisors' skills in relation to professional learning activities for physics teachers. Participants agreed that school facilities support the implementation of supervision activities for physics teachers as an aspect of the on-the-job training. In addition, many respondents reported that the duration of the supervisor's visit is not long enough and affirmed the importance of notifying physics teachers in advance of supervisor's visit in order to obtain better training outcomes.

Second group of findings: training programs (off-the-job training)

Some participants made clear statements about the limited positive impact on physics teachers' performance as a result of involvement in off-the-job training programs; the majority of participants considered there was a positive change regarding physics teachers' performance as a result of their involvement in training programs. Participants also reported a productive implementation of off-the-job training programs, including practical contents, in their learning activities. However, a number of participants referred to the unproductive implementation of off-the-job training programs, highlighting a weakness in developing relevant content during learning activities. Moreover, the majority of participants declared the need for more qualified trainers in order to increase the effectiveness of training programs. Participants also reported that the implementation of training activities outside schools is better for professional learning. They agreed that the facilities at the educational training centre supported the implementation of relevant learning activities for physics teachers. In addition, from the viewpoint of many participants, long training programs which run at the educational training centre might be more effective than short programs. Furthermore, they seemed to prefer mornings for training programs.

The findings and discussion in this chapter has led to the conclusion that this sample of Saudi physics teachers are more likely to learn professionally and further develop their teaching performance when they are involved in training programs outside their schools.

The next chapter discusses the interpretation of quantitative and qualitative findings. It contrasts the patterns identified in both studies regarding the effectiveness of professional learning for physics teachers in the city of *Onaizah*, Saudi Arabia.

CHAPTER 6: GENERAL DISCUSSION

Introduction

The focus of this thesis is the professional development of male physics teachers at secondary and intermediate schools in the city of *Onaizah*, Saudi Arabia. The aim of the research was to review the effectiveness of in-service training as a tool for professional learning for physics teachers.

The research was guided by the following primary research question: *What are the most effective formats for physics teachers in the city of Onaizah, Saudi Arabia to learn professionally*? This primary question is supported by the following sub-questions:

1. What are the expectations of physics teachers concerning the effectiveness of their on-the-job, off-the-job and combined training programs?
2. What are the reported experiences of physics teachers concerning the effectiveness of their on-the-job, off-the-job and combined training programs following training?
3. What similarities and differences exist between the expectations and experiences of physics teachers concerning the effectiveness of different modes of professional learning?
4. How do supervisors, trainers, principals and physics teachers evaluate different modes of in-service training as a tool for professional learning?

Effective professional learning for the development of teachers' classroom practice

Effective professional learning plays a vital role in development of in-service teachers' classroom practice. For example, professional development can support physics teachers by addressing any gaps in their knowledge and skills acquired through preparation programs (Birman, Desimone, Porter & Garet, 2000; MacPhail, 2011). Even with detailed knowledge of physics concepts, physics teachers still encounter some technical obstacles to utilize science teaching approaches due to technology revolution and progress in science education standards (Carla, 2006). The other purpose of professional learning is to keep teachers updated with current and relevant instruction techniques that can lead to more successful learning outcomes for their students (Timperley, Wilson, Barrar & Fung, 2007; Yoon, Duncan, Lee, & Shapley, 2008; Behlol & Anwar, 2011).

According to the Department of Educational Supervision in *Onaizah* (2010), students' achievements in physics are not satisfactory. Poor teaching practice is still present in schools and consequently, desired learning outcomes for physics are not being achieved. This has the potential to impact negatively on academic achievement, particularly as physics students move on to university. Thus, more effective professional learning activities are needed to develop physics teachers' classroom practice in Saudi Arabia.

Physics teachers in this study had different levels of content knowledge (CK) regarding the science domain of physics (Department of Educational Supervision, 2010). As represented in the participants of this study had different backgrounds in science from their undergraduate and pre-service teaching studies. Due to the shortage of qualified physics teachers in *Onaizah*, 27 teachers of the 62 who participated in this study found themselves teaching physics without an adequate physics background.

Physics teachers in this study also had different levels of PK, which is the general knowledge needed for planning and delivering teaching and learning (Department of Educational Supervision, 2010). This variation is reflected by their pre-service qualifications with 37 teachers having graduated from educational institutions, completing programs (e.g. Bachelor of Education in Science), while 25 teachers completed non-educational programs (e.g. Bachelor of Science from the Faculty of Science) and have no formal university training.

In addition, teachers' PK may vary due to the different levels of updating this knowledge during their careers through involvement in professional learning activities. From the sample, 39 physics teachers did not have an opportunity to attend any training programs at the educational training centre before participating in this study. This centre is one of the key providers of training and focuses on developing in-service teachers' pedagogical knowledge.

Need for new approaches to teaching physics

Every concept of physics has its own special features, thus different teaching approaches are required to present different concepts (Jauhiainen, 2013). Physics teachers need to modify their general pedagogical knowledge to suit specific learning areas in physics. This process of modifying practice is the essence of pedagogical content knowledge (PCK), when teachers apply particular PK to enhance student learning in a specific field (Shulman, 1986). In physics teaching this includes how to choose, plan and apply the most effective instructional strategies to specific physics concepts (Janík, Najvar, Slavík, & Trna, 2009; Etkina, 2010). This means physics teachers draw on physics PCK to organise student learning. Moreover, the elements of PCK should also be selected based on students' characteristics, backgrounds, prior knowledge and the context in which the teaching takes place, such as school environment, facilities and community (Janík, Najvar, Slavík, & Trna, 2009; Mushtaq & Khan, 2012; Jauhiainen, 2013).

This study found that physics teachers needed to develop their PCK in relation to teaching physics concepts. This was most notable when teachers started teaching new curriculum or moved to another school. The following narrative highlights this need when obtaining help from a supervisor during his visit with teaching new curriculum.

T1: "For me, physics supervisor visits helps me in the area of deal with physics curriculum within my school context and my students abilities".

Supervisors also noticed this need in relation to new teachers or teachers who had recently arrived at a school.

SU: "Regarding the supervisor visit, I notice that there is a positive change (about 30%) on physics teachers' performances, especially the new teacher or those who had recently moved to the school"

Need for development of physics teachers' pedagogical content knowledge

Pre-service training programs usually provide student teachers with general PK, but they have less opportunities to develop PCK as these pedagogies are selected based on student characteristics, background and prior knowledge within a particular teaching contexts (Janík, Najvar, Slavík, & Trna, 2009; Mushtaq & Khan, 2012; Jauhiainen, 2013). As PCK development is linked to teaching practice, pre-service studies do not cover the broad range of situations needed to experiment with all concept areas.

Generally, teachers' PCK is built up over time through their own teaching experiences and discussions with colleagues. However, this can be limited if there is a lack of opportunities for colleagues to support each other (French, 1997). This represents an opportunity for in-service development programs to support the expansion of teachers' PCK (Halim & Meerah, 2002; Rohann, Taconis & Jochems, 2010). However, current training programs are often not specifically orientated enough to influence physics teachers' PCK. This can be due to ineffective training activities, and short time allocation for professional learning programs. This has been supported by the results from both quantitative and qualitative studies (see chapters 4 and 5). For example, descriptive analysis of pre-test EPLAQ scores indicated that more than half of physics teachers preferred to be involved in professional learning activities over longer time period of 1-4 days. For example:

> *T6: "Professional learning activities can be improved by providing the teacher with new practical ideas followed by instant demonstration by the supervisor in physics class. I think such practice cannot take place in short time visit"*

Limited effectiveness of current professional learning activities

Physics teachers in this study found that their current professional learning opportunities were ineffective in addressing their classroom practice needs. The limited positive impact of current in-service training programs on teachers' performance has been mentioned by many participants:

> *T1: "Some supervisors visit teachers in order to find out teachers' mistakes instead of improving them"*

P1: "In reality, unfortunately physics supervisor visit is just routine and useless"

T5: "Some training programs outside school are wasting time"

P3: "I note there is no big change on the teachers' performance as a result of participating in training programs"

These comments identify a range of concerns. The ineffectiveness of current professional learning activities may refer to many factors including inaccurate identification of training needs, weaknesses in linking training content to practice and using non-productive learning activities.

Training needs in the three areas of teachers' knowledge (i.e. CK, PK and PCK), must be accurately identified before creating any program through an analysis of teachers' performance (Kroehnert, 2000). Poor identification of training needs can lead to a decrease in the effectiveness of professional learning programs. This was highlighted by some respondents:

T2: "Professional learning activities can be improved by implementing the training activities based on the needs of physics teaching methods"

P2: "I hope to run training programs based on training needs"

Effective professional learning programs start by identifying the needs of teachers and how these requirements relate to their school and student learning. When trainers present teaching and learning approaches without consideration of the context of different schools and students, teachers may find it difficult to transfer new approaches into their practice, as identified by one principal.

P6: "Teachers sometimes fail to apply what they learn during [the] training programme"

Successful professional learning programs also go beyond teachers' current experience and provide them with PK and PCK informed by research to build their professional knowledge base (Timperley, Wilson, Barrar & Fung, 2007; Yoon, Duncan, Lee, & Shapley, 2008; Behlol & Anwar, 2011). Many respondents affirmed that this initiative rarely took place:

P5: "It is rare that the supervisor provides teachers with new skills and methods due to the short visit by the supervisor"

T5: "Sometimes, I found the content of the training program did not match with its modern title. The program contains some out of date knowledge about teaching and learning"

Previous research has identified that only one format of training activities does not usually produce a major influence on science teachers' PCK (Driel, Verloop & Vos, 1998). A wide variety of professional learning activities are needed to take into consideration teachers' different school contexts and requirements. Many teachers identified the advantages of using both on- and off-the-job training for physics teachers because they complement each other. For example:

T4: "I think both types of professional learning should be applied. The physics supervisor's visit is an integration of the training programs"

T6: "No, I think both supervision activities and training programs are needed. As only supervision activity is insufficient."

Proposed model of professional learning

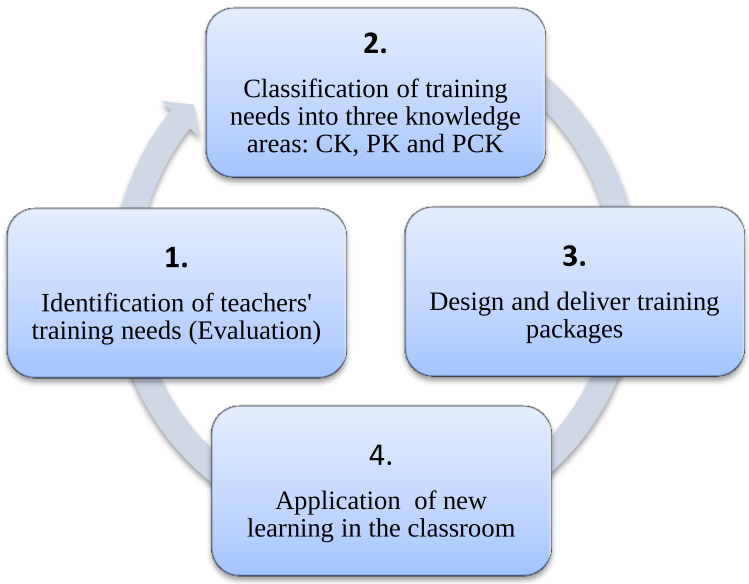
Professional learning can support and extend the three areas of teachers' knowledge. For example, CK is normally updated when teachers start working after graduation within their profession through access to text books, engaging with colleagues, and utilizing available school resources (Bartholomew, Moeed & Anderson, 2011). However, due to the shortage of qualified teachers or curriculum reorganization (Millar, 1988; Straker, 1988; Alhaggass, 2009), physics can be taught by non-specialist teachers who require more professional development programs to build their CK. Physics supervisors, as experts in physics, can support teachers' CK development through their school and classroom visits by guiding teachers through difficult concepts in addition to providing them with some materials related to the physics curriculum. These materials may include physics problems with answers, explanation of scientific concepts and demonstrations of how to use tools and equipment in the physics laboratory.

Teachers usually start developing their PK as a part of a pre-service training program and continue updating this knowledge during the early years of teaching (Etkina, 2010; Choy, Wong, Lim & Chong, 2013). However, there is a need to develop teachers' PK as an ongoing process of continual professional development to support student learning as society evolves and changes. This continued professional development could happen with regular training programs for teachers, involving activities inside and outside their schools.

In addition to updating PK, teachers also have to apply pedagogy to a specific teaching situation. Jauhianinen (2013) suggested that different concepts require different PCK. This necessitates modifying general pedagogy to suit a specific learning area. Such modification may be quite involved, depending on students' characteristics, backgrounds, prior knowledge and learning difficulties as well as the context in which the teaching takes place, such as the school environment, facilities and community (Janík, Najvar, Slavík, & Trna, 2009; Mushtaq & Khan, 2012; Jauhiainen, 2013). Support in developing teachers' PCK is managed through supervisor's visits and observations by the supervisor of teachers working in the classroom with their students (Halim & Meerah, 2002; Rohann, Taconis & Jochems, 2010). Such specific observations can provide targeted and effective advice and training. Effective professional learning can develop any of the three areas of teachers' knowledge using different approaches. If training needs are clearly identified through observation or teacher self-evaluation, appropriate programs have the potential to develop teacher's CK, PK or PCK.

Effective and ongoing professional learning should be guided by the needs of physics teachers who drive the process rather than learning requirements being decided in isolation from external sources. The model proposed here includes planning, implementing and evaluating learning activities (Minton, 1991; Rogers, 1996; Lawson, 2006). The teaching and learning approach has four stages that begin with identification of training needs and finish with evaluating teachers' new learning. As illustrated in Figure 6.1, the assessment of training needs is guided by the three knowledge areas. This provides the basis for design and delivery of training packages tailored to meet the identified needs of teachers and aligned with specific knowledge areas. Teachers having completed the training will implement new learning in their classrooms. This can be followed up by expert support, as a component of a supervisor's visit that involves classroom observation and evaluation of teaching practice. Such a process can build physics teacher's capacities through a cycle of evaluation of training needs, design, delivery, implementation and follow-up evaluation that informs the next round of professional learning.

Figure 6.1 Four stages of professional learning



Stage 1: Evaluation of the needs of physics teachers is identified in order to develop the most effective learning program.

Stage 2: Identified needs are classified into the three area of teachers' knowledge: CK, PK and PCK.

Stage 3: Training packages are designed and delivered to meet needs identified and aligned with specific knowledge areas.

Stage 4: Physics teachers apply their professional learning in the classroom.

Once again to Stage 1: Teachers' learning outcomes from the professional learning are evaluated by teachers with experts during supervisor visits to inform the next cycle of professional learning.

Application of continued professional learning of physics teachers in Saudi Arabia

Typically, physics teachers in Saudi Arabia are involved in a wide variety of professional learning activities. These activities can be categorized as on-the-job training and off-the-job training.

On-the-job training consists of one-to-one training sessions within schools. This type of training is designed and delivered by a specialist supervisor in physics teaching. It begins with observation and assessment of individual teaching performance in the classroom. Observation is followed by a review of teaching performance and a discussion on a set topic for teaching and learning activities. Currently the observation and assessment by the supervisor are seen by many teachers as inspections of their teaching practice not opportunities for learning.

Off-the-job training consists of formal training programs. These programs are designed and delivered by qualified trainers at educational training centres. A range of programs are offered across a wide range of areas focused on pedagogy. Teachers choose or are directed towards particular programs by their principal. This type of training usually offers different courses about teaching practice and policy for all teachers regardless of their specialist area, focusing on general pedagogical knowledge.

The current practice of on- and off-the-job training is lacking in efficacy. This situation generates the need for reviewing the current approaches to meet the needs of teachers and, as a consequence, changes in practice may be positively reflected in the results for students. Therefore, based on the structure of professional learning of physics teachers in Saudi Arabia and findings from this study propose a model of professional learning for physics teachers that can be applied when the following elements are considered:

1. On-the-job training is complemented with off-the-job training
2. The process of professional learning design and delivery are applied collaboratively by both the supervisor and trainer.

These elements are detailed below.

Need for on- and off-the-job training

Professional learning programs address a diversity of teaching and learning issues. These programs should involve different learning activities rather than offering a single model of training (Garet, Porter, Desimone, Birman & Yoon, 2001; Adey, 2006; Timperley, Wilson, Barrar & Fung, 2007; Helmer, Bartlett, Wolgemuth & Lea, 2011). On-the-job training, for example, is commonly used to improve teachers' performance by utilizing experts during the school day (Mathis & Jackson, 2011; Dessler, 2013), while off-the-job training provides physics teachers with training away from their usual workplace (Nankervis, Compton & Baird, 2005). However, on-the-job training may provide less opportunities to explore more complex pedagogical approaches comparing with off-the-job training (Ihmeideh, Jumia'an and Al-Khoulda, 2011; Alzahrani, 2013). While off-the-job training may not provide the guidance needed to transfer training to the classroom when compared with on-the-job training (Fisher, Schoenfeldt & Shaw, 2006). Consequently, applying both forms of professional learning will benefit teachers so these models can support each other. Thus physics teachers can learn more effectively when the supervisor's visits are complemented with off-the-job training. This has been supported by the results of both quantitative and qualitative studies (see chapters 4 and

5). Results of the ANOVA indicated that significant differences existed between pre- and post-test EPLAQ scores of physics teachers in professional learning outcomes. From the EPLAQ1 data, physics teachers did not expect to increase their understanding of inquiry learning through training. From the EPLAQ2 data, physics teachers reported increased understanding of inquiry learning and classroom approaches. Participants therefore reported a positive result from their involvement in the three different modes of professional learning activities. Even though all approaches support teachers' learning, the participants indicated that the combined training program was the most effective format because both on-the-job training (supervisor's visit) and off-the-job training (training programs) can improve teachers' performance in different ways. This was highlighted by teachers, principals and supervisors:

T6: "I think both supervision activities and training programs are needed. Both of them have positive impacts on teacher's performance"

P2: "The physics supervisor visit and training programs try to improve teachers' performance in different ways"

SU: "According to my experience, I think that each [mode of training] complements the other. Supervisor's visits represent 50% and training programs represent 50% from professional learning activities"

Collaboration between supervisor and trainer in applying elements of professional learning

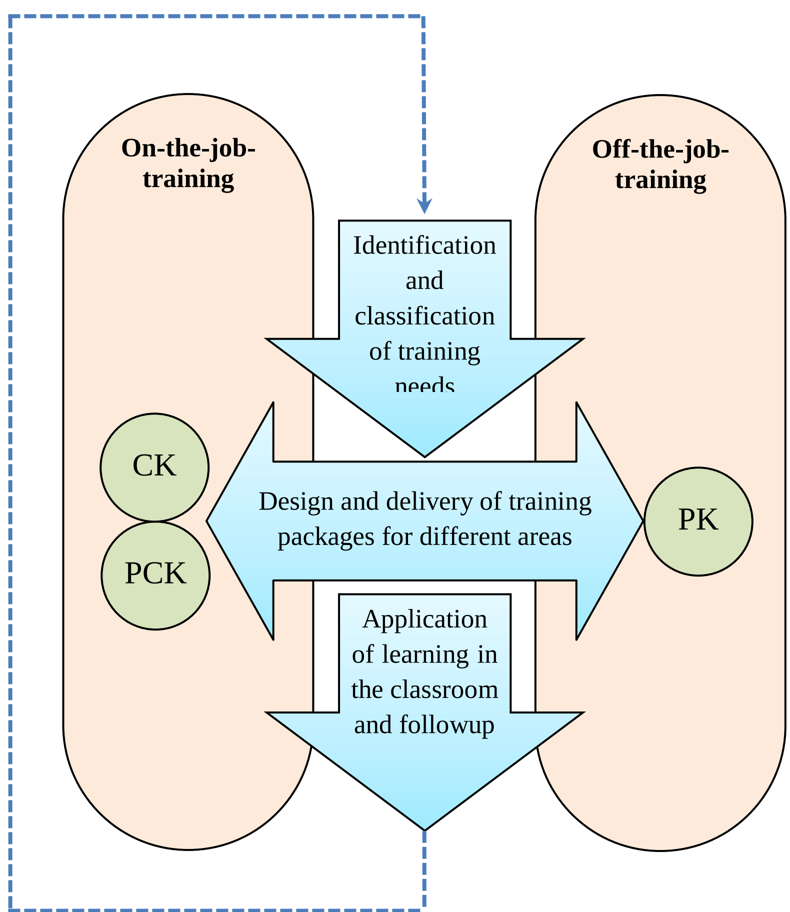
For on-the-job training (supervisor's visit) and off-the-job training (training programs at the educational training centre) to be effective, strong collaboration is required between these training formats. This was highlighted by both teachers and principals:

T2: "I think the most important role for decision makers is to make an effective correlation between the supervision department and the training centre"

P5: "Departments of training and department of supervision should be combined to foster teacher's improvement by reorganizing different training processes"

The current structures that provide training through on- and off-the-job delivery can be improved by using the four stages of continuous professional development. For teachers' learning requirement to be achieved well-developed professional learning opportunities, and collaboration between the supervisor and trainer in applying elements of professional learning must occur. This process is summarised in Figure 6.2.

Figure 6.2 Proposed collaboration between the supervisor and trainer in applying elements of professional learning for physics teachers



Identification and classification of training needs

Commencing with identification and classification of training needs, teachers' readiness to learn can occur as a result of realization that the training program is relevant to their daily lives (Rogers, 1971; Knowles, Holton, & Swanson, 2005). In order to benefit organizations in the area of professional development, training needs must be accurately identified before creating any program to bridge gaps between the required and current performance of employees (Kroehnert, 2000; Salas & Cannon-Bowers, 2001; DeSilets, 2007; Moskowitz, 2008). Training needs can be identified through surveys, feedback and consulting with experts and specialists (Kroehnert, 2000; Nixon, 2006). Applying direct observation followed by evaluation of the physics teacher's performance by experts (e.g. educational supervisors) can also help in identifying training needs. This was noted by a range of participants in this study:

T5: "No, I think training programs and supervision procedures are dissimilar. Training improves the teacher in many different areas while the supervisor should evaluate the teacher's performance before and after attending training programs

P1: "Training should be based on analysing training needs at the beginning of semester. [The] supervisor should do that"

TR: "Training programs improve teacher's performance while supervision evaluates teacher's performance to determine the training needed"

Once identified, the different professional learning needs should be classified clearly into the three areas of teachers' knowledge (CK, PK and PCK). This is a key step in developing targeted programs that meet the different needs of teachers effectively.

Design and delivery of training packages

Once professional learning needs have been identified and classified supervisors and trainers will design both on- and off-the-job training programs. The approach taken will differ for CK, PK and PCK regarding professional learning needs.

Content Knowledge: Many teachers due to a generalist content background from their teacher preparation studies, changes in the field of knowledge or a change in curriculum may need to build their CK of their subject area. For example, many physics teachers that come from a general science background may have to strengthen their physical science knowledge to teach senior classes.

Teachers who require additional professional development programs to build their CK may demonstrate variations in the area of physics that require improvement. For this reason, developing teachers' knowledge in physics can be more effective if designed and delivered by the supervisor, who can target specific areas that require extension. As an expert in physics, supervisors are best placed to provide the learning and guidance during the school visit. This learning and guidance is usually achieved by providing teachers with personal learning plans to help them study particular content areas they are weak in. This has been supported by teachers and principals comments:

T5: "Physics supervisor visit is most welcomed. I really wait for the supervisor to get some improvement in my skills regarding curriculum elements"

T6: "A number of physics teachers welcome supervisor visit. Physics supervisor usually has a positive impact on teachers' knowledge about physics subject matter. The last version of physics textbook has several new concepts and equations"

P5: "Curriculum has been changed; therefore, more training is needed nowadays to update teachers' knowledge in relation to subject matter by expert in physics"

As highlighted in the last comment, principals are aware of the need for training and teachers have acknowledged that supervisors can identify and support the development of their CK. The key is the supervisor working with them to develop individual learning plans to build their knowledge as required by the curriculum.

Pedagogical Knowledge: Even though teachers usually start developing their PK as part of a pre-service training program (Etkina, 2010), they continue updating this knowledge during their first year of teaching (Choy, Wong, Lim & Chong, 2013). This in fact continues over the course of a teacher's career, as social change and new understanding of teaching and learning lead to changes in pedagogical approaches (Rohann, Taconis & Jochems, 2010). Development of teachers' PK can be achieved through providing teachers with informed knowledge by qualified pedagogy instructors. This development can occur through training programs designed and implemented by trainers at the educational training centre. This was supported by both teachers and principals:

T2: "Training programs are the most helpful way to improve physics teachers' performance using contemporary teaching techniques. We still need more training programs"

T6: "The impact of training programs on teachers' performance is excellent. The physics teachers gain new skills as a result of being involved in training programs outside school"

P5: "I think teachers, especially new teachers, respond to training programs outside school because they need to develop their basic teaching skills"

Pedagogical Content Knowledge: Physics teachers start teaching new topics with general PK, with teachers' PCK being built up over time through their own experiences and discussion with colleagues (Driel, Verloop & Vos, 1998; Williams & Lockley, 2012; Rohann, Taconis & Jochems, 2010). Support for teachers' PCK through in-service training can shorten the long process for teachers to acquire the skills needed to become experts in physics (Halim & Meerah, 2002; Rohann, Taconis & Jochems, 2010). However, normal teachers' training programs usually fail to produce a key influence on science teachers' PCK (Driel, Verloop & Vos, 1998). It is important to develop PCK for physics teachers by using other training formats within the school and involving an experienced physics educator (i.e. the supervisor). For example, through demonstration and modeling of lessons by the supervisor, physics teachers' PCK can be developed (Appleton, 2008). Moreover, students' characteristics and school context should be taken in account when selecting elements of PCK (Janík, Najvar, Slavík, & Trna, 2009; Mushtaq & Khan, 2012; Jauhiainen, 2013). Thus, physics teachers' PCK can be developed through working with the supervisor and their own students and school contexts. As a result, it is important to design and deliver these professional learning activities during supervisor visits.

T1: "For me, the physics supervisor visits help me in the area of [sic] deal with physics curriculum within my school context and my students' skills"

T6: "Well, by providing the teacher with new practical ideas [that] suit students' characteristics followed by immediate demonstration by the supervisor in [the] physics class"

Application of learning in the classroom and follow up

Many trained teachers fail to consider and implement new instructional approaches within their classroom practice (Guskey, 2002; Uysal, 2012). This may be due to many reasons. For example, a shortage of facilities at the school, poor classroom condition and lack of instructional materials needed for applying new skills can hinder the transfer of training outcomes in the classroom. Thapa (2012) argued that the training situation should be similar to the teacher's working situation to maximize the transference of training. This can take place when physics teachers are trained by the supervisor within their schools. This was the case for participants in this study, as highlighted by the following comments:

P6: "Teachers sometimes fail to apply what they learn during training programs due to the school building type, school environment and lack of school facilities"

TR: "Some training programs contain non-applicable content knowledge in each school"

Physics teachers must be familiar with practical teaching techniques that can be applied to their teaching. This can occur when teachers have a prepared transfer strategy in their schools with regular monitoring by an expert in physics education such as the physics supervisor. This was found to be the case for both teachers and supervisors, as reflected in the following comments:

T5: "Well, I wait for the physics supervisor to get some action plan for improvement"

SU: "Well, I try to make my supervision visit friendly and supportive. So, I try to provide teachers with some new learning materials like software and the proposed plan for teacher development"

As suggested by teachers, principals and supervisors who were interviewed, the transfer of learning needs to be supported. The role of the supervisor as a mentor and coach, following up on either previous supervisor visits or outcomes from training Centre programs, appears to be essential for many teachers in order for them to apply new teaching approaches in their classrooms.

Back to step one: Identification of training needs

Sparks (2002) argued that without the provision of follow-up activities, less than 10 percent of teachers fully integrate new strategies gained from professional development programs into their classroom practice. Observation of teaching and feedback provided by an expert (e.g. school principals or experts from outside the school) is commonplace as a means of enhancing quality teaching and learning (French, 1997). Physics supervisors can run these types of follow-up activities successfully.

T5: "No, I think training supervision is different. Training improves the teacher in many different areas while supervision evaluates the teacher's performance before and after training programs as a follow-up activity"

P3: "Both types of training are needed. Yes, I think training programs are better to be first followed by the physics supervisor visit as a follow-up activity"

SU: "According to my experience as a physics supervisor, it is better to evaluate the teacher's performance before and after training programs"

The proposed model versus current professional learning

The proposed model differs from the current model of professional development in the city of *Onaizah* and Saudi Arabia in general. Teachers involved in current training practice may have access to only one format of training (on- or off-the-job training) rather than being involved in different professional learning activities. For example, 39 physics teachers out of 62 were involved in supervision procedures in their schools as an aspect of on-the-job training. However, these teachers did not get a chance to be involved in off-the-job professional learning activities outside their schools before participating in this study. The current practice of professional learning adopts the traditional approach. This approach often assumes there is a deficit in teachers' knowledge and skills that can be developed using activities such as inviting an expert into the classroom to improve teachers' pedagogy (Birman, Desimone, Porter & Garet, 2000). This approach often fails to distinguish between different teaching styles within schools or classrooms contexts plus the different needs of teachers (Hofman & Dijkstra, 2010).

The proposed model, in contrast to the traditional approach, adopts a reform approach of professional learning that offers different learning activities rather than offering a single type of training. It also goes beyond meeting the current deficit in teachers' knowledge and skills and provides teachers with CK, PK and PCK to build their professional knowledge base, by taking into account the different needs of teachers and the context of the teaching environment. This approach also includes ongoing support to assist the implementation of new knowledge and skills, which may promote continued change within teachers' classrooms.

This proposed approach is different because training needs are accurately assessed as a first step to designing the professional learning, which is not considered in the current professional learning practice in the city of *Onaizah*. Training programs at the educational training centre, in particular, were designed based on previous experiences of trainers when they were working as teachers, rather than current needs of teachers.

The current format of professional learning, which provides both supervision activities and training programs, can often overlap by both approaches covering similar practices and / or content material. Because of this physics teachers do not have a clear understanding of which approach may be most effective for a particular issue, so they tend to choose training depending on its availability. The following comments highlight this perspective:

T4: "Supervision procedures and training programs play the same role"

T6: "I think there is no difference. Both of them have positive impacts on the teacher's performance"

P5: "More training programs are needed nowadays. Yes, I think training programs are sufficient"

TR: "Well, I think training programs are enough, provided that the principals of the schools are trained to follow up with teachers"

However, in the proposed model, the strengths of each training delivery method are matched with the most effective way to support specific knowledge areas. The training needs of the teacher is met by either the supervision activities or a training program. This is identified through evaluation of the teacher's knowledge associated with CK, PK and PCK and the areas that require development.

The current training format is somewhat disjointed, without clear evaluation, delivery and follow up. For example, training programs are being designed and implemented, while the assessment of training and follow-up activities has not really been considered. The proposed model, in contrast, has four defined stages that link and supports the learning of teachers and their application of new learning in their classrooms.

Efficacy of the proposed model compared with alternative professional learning models

Various professional learning approaches are being promoted around the world (e.g. coaching, monitoring, e-training) (Department of Educational Supervision, 2008). At the present time, this proposed model could be more effective in the city of *Onaizah*, Saudi Arabia than other approaches. For example, in spite of the effectiveness of coaching in improving teachers' performance (Mathis & Jackson, 2011; Dessler, 2013), utilising coaching is difficult in Saudi Arabia due to the shortage of trainers at the educational training centre (Department of Educational Training, 2013). Furthermore, coaching by an expert from outside the school (e. g. training institution) is also unattainable because of limited school budgets to invite qualified coaches in addition to the shortage of such institutes in Saudi Arabia (Department of Educational Supervision, 2008).

Furthermore, expert monitoring of physics teaching by, for example, a retired physics teacher cannot be applied due to limited numbers of such teachers. For example, according to the database of the Directorate of Education in *Onaizah* (2014), only one physics teacher retired in 2014. Monitoring by colleagues is also difficult due to lack of free time during the school day. As the average teaching load of physics teachers is 4-5 classes a day with 1-2 periods for developing learning materials, preparing experimental classes in the physics laboratory and remarking student work (Department of Educational Supervision, 2008).

Moreover, postgraduate study (e.g. certificate course, diploma, Masters) does not represent a good option for physics teachers to learn professionally. Firstly, the educational system in Saudi Arabia rarely permits teachers to leave schools for further education during the school day (Department of Educational Training, 2013). Secondly, there are chances to undertake postgraduate programs during the evenings but there are only a few programs available.

E-training could be a good option for physics teachers to learn professionally. However, this sort of professional learning is not recognised by the Ministry of Education at present, which is a disincentive for teachers becoming involved in online learning. (Department of Educational Training, 2013). It is an area that could be explored further by the Ministry of Education identifying possible approaches that could support the current approaches.

Future direction of professional learning of physics teachers

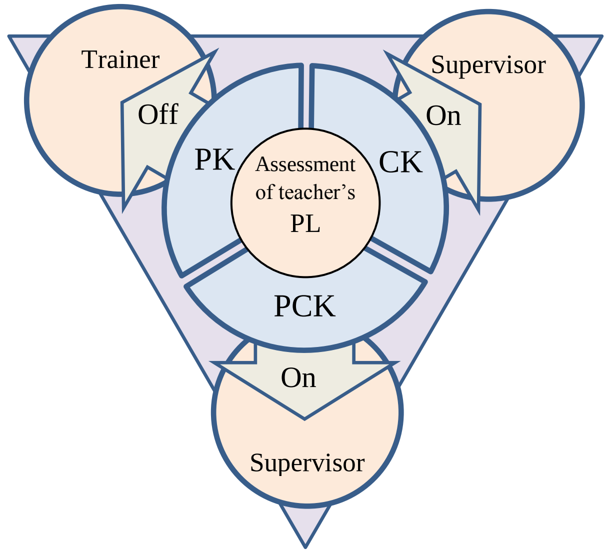
Findings of this study can be used to inform the future direction of professional learning of physics teachers in the city of *Onaizah*. This could occur through adopting a prescribed set of steps as outlined in the following sections.

Clarification of the different formats of professional learning activities

If physics teachers understand the structure of professional learning delivered and what to expect during different training sessions, they will be more likely to achieve desired training outcomes (Townsend, 2003; Knowles, Holton & Swanson, 2005; Lawson, 2006). As outlined in the model evaluation, classification of teachers' professional learning needs is a first step in the professional development process. If teachers are aware of this process they can become involved in identifying their own learning goals and subsequent professional development. For example, a teacher may identify they are struggling with understanding some of the physics concepts in the curriculum. As summarised in Figure 6.3 below, the teacher, having identified the need to expand their content knowledge, would approach their supervisor for help. Having a clear idea of how particular learning needs are met means the teacher can take some responsibility for their own learning.

Teacher's professional learning can also be supported by principals and supervisors who would use the same approach. For example, a principal who identifies a teacher who needs help with expanding their PK would discuss this with the teacher and possibly refer the teacher to a training centre for an off-the-job program.

Figure 6.3 Assessment of teacher's professional learning



Developing the capacities of supervisors and trainers

Training will be more effective when the professional learning activities are implemented by a trained instructor (Lawson, 2006; Malley, Brown & Perez, 2006). Physics teachers are more likely to successfully develop knowledge and skills when the trainer is skilled in adult learning and their knowledgeable of their needs. This was the seen in the current study. Both the supervisors and the trainers were trained before implementing the three types of professional learning activities for physics teachers. As the results of the ANOVA indicated, positive significant differences in the area of competence of supervisors and trainers existed between pre- and post-test EPLAQ scores of physics teachers. The results that related to instructor competence generates the need to recruit and engage qualified supervisors and trainers who are skilled in developing training activities with engaging delivery approaches. This was identified in many comments such as:

P3: "A difficulty that may face the improvement of physics teachers is the poor competence of some trainers. Some trainers' skills need to be developed"

SU: "Supervisors' skills in the area of technology and other areas should be developed"

In order to improve physics teachers' knowledge, skills, and motivation using the proposed model of professional learning, selected supervisors and trainers need to be exposed to quality training programs that focus on increasing their capacities to run professional learning activities effectively (Kroehnert, 2000; Yoon, Duncan, Lee, and Shapley, 2008). This can occur via two crucial steps:

First step: Recruiting supervisors and trainers

A qualified instructor plays an important role in increasing the effectiveness of professional learning (Kroehnert, 2000). Therefore, supervisors and trainers should be recruited and selected from experienced teachers based on training standards.

Second step: Improving knowledge and skills of supervisors and trainers

Once supervisors and trainers are being recruited, they need to be trained to support them in their proficiency to demonstrate best practice during professional learning activities effectively. The training of supervisors and trainers should include the following areas of knowledge:

1. Knowledge in the subject being taught (CK, PK and PCK) with the ability to relate content to participants' situations (Lawson, 2006).

2. Knowledge about planning, design, delivery of learning activities, and the evaluation of learning using a variety of techniques (Malley, Brown, & Perez (2006; American Society for Training & Development ASTD, 2013).

Designing professional learning activities

Professional learning activities should be designed based on the needs of teachers. In the proposed model, the training needs of physics teachers should be assessed by the supervisor in collaboration with teachers. However, the supervisor cannot identify the needs of all teachers and thus other experts are needed. For example, school principals can be trained to assess the training needs of physics teachers regarding their PK, while the supervisor could focus on training needs related to their PCK.

Implementing professional learning activities

In order to implement professional learning activities effectively, supervision and training activities need to complement each other. This can occur as follows:

1. It is recommended that the supervisor attend the entire training program regarding PK at the educational training centre before conducting supervision activities about PCK. This can support the supervisor to help physics teachers transfer their learning into their teaching practice, in addition to developing their PCK, based on PK gained from training programs at the educational training centre.
2. It is also recommended that the trainer visit and observe within a range of schools (e.g. different stages, locations, types of building, etc.) before designing and delivering training programs. This can help the trainer to consider the different

context of schools when conducting PK training activities at the educational training centre.

3. Collaboration between the trainer and the supervisor should be organized before running on- and off-the-job training. This procedure can reduce duplication and conflict regarding different types of professional learning activities.

Evaluation and follow-up of professional learning activities

Typically, the supervisors operating within in this model are most likely to follow up and evaluate professional learning activities. However, due to the shortage of supervisors, it is difficult for supervisors to cover all physics teachers in the city of *Onaizah*. Therefore, to apply the proposed model effectively, other experts should help in this area. For example, school principals can be trained to run follow-up activities in the area of PK, while the supervisor, as an expert in physics education, focuses on follow-up activities in the area of PCK.

The next chapter will present a thesis summary, followed by limitations of the study and conclusions. Possibilities and suggestions for future research and applied outcomes are also presented in the concluding chapter.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

This chapter presents the conclusion and recommendations of the research as an outcome of the review of existing literature and the results derived from the instruments and interviews used in this project. The chapter is presented as follows: a general overview of the key findings, implications of the research, limitations of the study, further research, recommendations for practice, and conclusion.

Key Research Findings

Effective professional development for in-service physics teachers is not occurring in the city of Onaizah, Saudi Arabia.

This study revealed that effective professional development for in-service physics teachers is not occurring in the city of *Onaizah*, Saudi Arabia. According to the Department of Educational Supervision (2010), current teaching approaches are limited in their scope and poor instruction practice in physics is still present in schools. Consequently, students' achievement in physics, is not satisfactory. These practices have the potential to impact negatively on the academic achievement of students in the field of physics, particularly as they move to the university. This issue is not confined to *Onaizah* but is an issue across Saudi Arabia and other parts of the world as found in Ghana, Gaza, United States of America, Jordan, Finland and Turkey (Sarpong, 2006; Abo Atwan, 2008; Hill, 2009; Ihmeideh, Jumia'an & Al-Khoulda, 2011; Jauhiainen, 2013; Kildan, Ibret, Pektas, Aydinozu, Incikabi, & Recepoglu, 2013).

Teachers and Principals are dissatisfied with the current professional development

Physics teachers and principals within this study believe that the current professional development programs could be more effective. As illustrated by the results of the ANOVA which indicated no significant differences existed between the pre-test and post-test EPLAQ scores of physics teachers for the professional learning activities. The result indicates the teachers did not expect a novel approach to be taken with the learning activities and this expectation was confirmed by the program delivery. It maybe this lack of creativity in program delivery that lead teachers make to comments such as, *"Some training programs outside school are wasting time"*. This concern was not restricted to teachers, principals who have the responsibility of school improvement and insuring that all students succeed are also frustrated by aspects of the current professional development as principal one highlighted, *"In the reality, unfortunately physics supervisor visit is just a routine and useless".* These comments have student achievement at their core with both teachers and principals focused on wanting to access opportunities to improve their teaching practice and effectiveness of their schools. This concern is not limited to *Onaizah*, but is of concern in many counties as Hill (2009) points out about the professional development in the United States of America, *"The professional development "system" for teachers, by all accounts is broken. Despite evidence that specific programs can improve teacher knowledge and practice and student outcomes, these programs seldom reach real teachers to a large scale" (p.470)*. This is also the case in *Onaizah* where there were occasions where professional development was effective for a particular teacher as teacher five who thought off-the-job programs were a waste of time, found a supervisor visit that provided him with new insights, as he recounted, *"Physics supervisor visit is most welcomed. I really wait for him to get some improvement".* The problem with professional development in *Oniazah* is that it is sporadic and reliant on skilled individual trainers, supervisors and teachers rather than being a system of target professional development that can support all teachers to develop more effective pedagogy to support the learning of students.

Aspects of the current approach that are ineffective

Teachers in *Onaizah* clearly affirmed that poor identification of training needs of teachers lead to decreasing the effectiveness of their professional learning programs as teacher two outlined, *"Professional learning activities can be improved by implementing the training activities based on the needs of physics teaching methods".* Principals also realise that programs would be improved if "*based on training needs" (interview Principal Two).* These comments indicate that the real needs of teachers are not met and training programs are not targeted to their goals to improve classroom practice. This situation limits teacher's readiness to learn, which might decrease opportunities for improving their physics teaching practice and effectiveness of their schools (DeSilets, 2007; Yoon, Duncan, Lee, & Shapley, 2008; İnceçay & Bakioğlu, 2010). Many countries share this concern as Mphale (2014) points out about the professional development in the Republic of Botswana, *"Teachers believe that the current professional development initiatives do not enhance their performance in the execution of the daily duties. Other revelation from the research are that teachers' professional development initiatives fail to identifying teachers training needs, enhance career progression"(p.87)*.

This poor identification of training needs is exacerbated by not including the teachers in the process of needs identification. Rather, professional development is planned based on the view of the supervisors at the Directorate of Education and trainers at the educational training centre. Teachers have no choice but to attend these professional learning activities regardless of their real needs. This approach required teachers to do the best they can with the training on offer rather than supervisors, trainers and principals consulting with teachers to develop programs that would support all teachers to develop more effective pedagogy for the learning of their students.

Teachers were concerned that professional learning programs rarely went beyond teachers' current experience to build their professional knowledge base as teacher five summarised, *"Sometimes, I found the content of the training program did not match with its modern title. The program contains some out of date knowledge about teaching and learning".* This indicates that providing physics teachers with out-of-date knowledge can limit their abilities to overcome barriers relevant to their daily practice they may encounter. This case is a global concern as *Johnson (2006)* reports regarding the professional development of *science teachers* in the *central US, "*even with effective professional development, science teachers still encounter technical, political, and cultural barriers to implementation. More support is required for professional development efforts to be successful*" (p.1)*.

Principals in the city of *Onaizah* are concerned that the teachers in their classrooms are not applying the teaching approaches presented in the training programs. It appears that the each school has a unique context that may require modification of approaches presented to match the school setting. This difference between the presentation context of the new approach and the school settings in which it is to be applied may be hindering the implementation of new pedagogy into their teaching practice, as principal six emphasised, *"Teachers, sometimes, fail to apply what they learn during training programme due to the school environment and the lack of school facilities"* This is also an issue for in-service training programs in Turkey where, *"the teachers had concerns mainly with applying the new approaches and techniques they learned in the course into their own contexts; thus, they mainly expect solutions that would fit into their own realities as well as useful materials and resources" (Uysal, 2012, p.23)*.

An additional issue with professional development in *Onaizah* is that supervisors and trainers are not focusing solely on training procedures. They are asked to be involved in many administrative affairs and different incidental tasks, due to the shortage of secretaries and administrative employees. This situation could be influencing the supervisors and trainers to run professional learning activities in a routine manner delivering the same courses repeatedly, rather than evaluating teacher needs and adjusting courses or approaches accordingly. This has resulted in little improvement, in teachers' performance and the desired outcomes of training are not achieved. Principal one asserted that, "*In reality, unfortunately, the physics supervisor's visit is just routine*". To cope with the short time available to design effective training activities, many supervisors and trainers use pre-designed learning materials available from the web to guide professional learning activities as teacher five affirmed," *Some trainers are not knowledgeable enough and download free pre-designed training programs from the internet instead of designing them*". Teachers receive these materials as part of the training as ideal materials to be used in physics teaching regardless of their appropriateness. This may not support all teachers to develop more effective pedagogy to support the learning of their students.

Aspects of the current approach that are effective

A number of studies into professional development, Garet, Porter, Desimone, Birman and Yoon (2001), Adey (2006), Timperley, Wilson, Barrar and Fung (2007) and Helmer, Bartlett, Wolgemuth and Lea, (2011) have found that professional development should involve various learning activities rather than offering a single format of training. This was the case in this study with the delivery of professional development being provided through off-the-job and on-the-job training. Off-the-job training programs could provide teachers with detailed information on new pedagogies with on-the-job visits by supervisors having the potential to discuss classroom practice within the context of the school. The ANOVA result indicated that significant differences existed between the pre-test and post-test EPLAQ scores of physics teachers in the areas of professional learning outcomes. Teachers in *Onaizah* reported some positive results of their involvement in the combined training programs as teacher six highlighted, *"I think both supervision activities and training programs are needed. Both of them have positive impacts on the teacher's performance".* Principals also identified the potential of a combined approach to teacher learning as principal two highlighted, *"The physics supervisor visit and training programs try to improve teachers' performances in different ways"* The key is 'different ways' using the strengths of each approach to enhance the learning of teachers. For example, Jauhiainen (2013) found with the use of extended off-the-job training programs, physics teachers have updated their knowledge in various physics education issues and pedagogies. However, being able to explore such new pedagogies in the depth required for teachers to be able to adjust and modify the pedagogies to their classroom and school setting. This can take place when physics teachers are involved in on-the-job training within their schools (Thapa, 2012). These types of programs could be enhanced with on-site follow-up as Sparks (2002) study found with follow-up activities involving skilled coaches working with teachers in their classrooms.

Implications of the research

Changes to current professional development practice

The current practices of both on and off-the-job training are lacking efficacy, with few teachers in the study indicating positive benefits of training they received with principals frustrated by the lack of application of new practices in classrooms. This situation generates the need for a change in the current approaches to meet the needs of teachers and as a consequence changes in practice may be positively reflected in the classroom practice and finally in improved student learning. Elements of the proposed model of professional learning attend to the deficiencies outlined and strengthen the potential of improved learning for teachers. A strong collaboration between supervisors and trainers is required in applying the continuous professional development. These elements include:

1. The proposed model brings the different learning approaches together with on and off-the-job training operating as a coherent training program.

2. The proposed model goes beyond meeting the current deficit in teachers' knowledge and skills and provides teachers with research-informed CK, PK and PCK to build their professional knowledge base by taking into account the different needs of teachers and the contexts of the teaching environments.
3. The proposed model includes ongoing support to assist implementation of new knowledge and skills, which may promote continued change within teachers' classrooms.
4. The proposed model starts with assessing training needs accurately as a first step to designing the different type of professional learning (on and off-the-job training).
5. In the proposed model, the strengths of each training delivery method are matched with the most effective way to support specific knowledge areas. Training needs are met by either the supervisor or the trainer based on the area of teacher knowledge associated with CK, PK and PCK areas that require development.
6. The proposed model has defined stages that link and support the learning of teachers and their application of the new learning to their classrooms.

Proposed model and the characteristics of effective professional development

The proposed model has the characteristics of effective professional development as outlined in the literature. These characteristics include: needs-based training, linking content to practice, varied learning activities, following up and sustainability as following:

1. The proposed model starts with analysing teachers' performance to identify their training needs before creating any program. This identification of training needs is used to frame the training process, the design, delivery and evaluation of the program (Salas & Cannon-Bowers, 2001; DeSilets, 2007; İnceçay & Bakioğlu, 2010).
2. The proposed model provides teachers with relevant research-based knowledge about CK, PK and PCK to build their professional knowledge base (AL-Wreikat & Bin Abdullah, 2010; Rohann, Taconis & Jochems, 2010; Behlol & Anwar, 2011).
3. The proposed model involves a range of internal and external learning opportunities rather than offering single format of training to meet different training needs (Garet, Porter, Desimone, Birman & Yoon, 2001; Adey, 2006; Timperley, Wilson, Barrar & Fung, 2007; Helmer, Bartlett, Wolgemuth & Lea, 2011).
4. The proposed model involves follow-up activities to support teachers in transferring their professional learning to the classroom (French, 1997; Guskey, 1999; Gosling, 2001; Sparks, 2002).
5. The proposed model includes ongoing and coherent professional learning activities contributing to an improvement in both schools and teaching practices (Newmann, King, & Youngs, 2001; Kennedy, 2005; Timperley, Wilson, Barrar & Fung, 2007; Yoon, Duncan, Lee, & Shapley, 2008).

Proposed model within the Saudi Arabia context

The proposed model can be used by other educational districts across Saudi Arabia due to the similarity of these districts. For example, all districts follow the same education policy. The Ministry of Education is the central administration for the country meaning all educational districts use the same procedures for different educational and administrative activities including professional development of teachers. All educational districts in Saudi Arabia are required to apply the national curriculum including the same textbook, learning materials, learning assessment system, the length of the school year and school days, as well as the timing of holidays. However, each district may modify the implementation of the proposed model of professional learning depending on what was already in place based on the schools' context across that districts.

The proposed model draws on the understanding of effective professional development and has taken into account the structural and cultural influences of the Saudi Arabia education system as it is delivered in *Onaizah*. A number of effective professional development approaches have not been selected as these would not be effective in the *Onaizah* context. For example, using coaching as described by Dessler (2013), would be difficult due to the shortage of trainers at the educational training centre in addition to the limited budget of schools to invite qualified coaches from other academic institutes. Moreover, online professional development offers a valuable alternative to traditional teachers training (Dash, Kramer, O’Dwyer, Masters, & Russell, 2012; Holmes, 2013). However, due to Ministry reasons, such online courses are not yet a viable option for physics teachers in Saudi Arabia.

The proposed model concerns the professional learning activities for physics teachers focusing on the three areas of teachers' knowledge CK, PK and PCK. However, the model is appropriate for teachers in all subject areas and not just for physics teachers as every teacher needs to know what to teach (CK) and how in general to teach (PK). In addition, all teachers need to modify the PK to suit a specific learning area that will enhance students learning in a specific field (Shulman, 1986).

Furthermore, findings derived from the quantitative and qualitative studies make a contribution to the theoretical understanding of professional learning styles and extends prior research findings through seeking evidence drawn from the Saudi educational field. For example, the three areas of teachers' knowledge CK, PK and PCK can be used as a structure to frame professional development programs. Both types of professional learning, on and off-the-job training, can also be collaboratively used for improving teachers' skills based on teachers training needs; CK, PK and PCK. Moreover, the EPLAQ appears to be a useful instrument to be used, in association with other qualitative tools, for identifying the effectiveness of in-service professional learning activities for educators in general. The study also, offers those in the educational field further strategies to improve professional learning activities which may assist teachers who are less competent to teach science in general and physics in particular. Finally, this research contributes to a growing body of knowledge in the professional learning field.

Limitations of the Study

This investigation was based in Saudi Arabia and focused on professional development of physics teachers in the city of *Onaizah*. The sample size for the quantitative study using EPLAQ scores involved 62 physics teachers at intermediate and secondary boy schools (representing 96.88% of the total number of physics teachers in the city of *Onaizah*). In addition, the sample for the 14 interviewees involved physics teachers, principals, supervisor and trainer. All the participants were male as there are not any female teachers working in the area of physics teaching at boy schools. The researcher could not use this data for female physics teachers at girls' schools in Saudi Arabia as female teachers are involved in only on-the-job training format run by female supervisors.

The study has high relevance to other schools and directorates of education in Saudi Arabia due to the similarity in culture (e.g., language, belief, law and custom) and the work under same system of education. It also, has some relevance to other Arabic counties which have similar culture and educational system.

The study has less relevance to other countries because of the unique Islamic culture and education system. For example, Saudi government provides free education through the educational ladder system including postgraduate studies. Furthermore, Saudi education is entirely single-gender schools as male teachers cannot teach female students and vice versa. General education in Saudi Arabia comprises three academic stages; elementary, intermediate and secondary stages applying a national curriculum in separate school buildings. Moreover, directorates of education in every district, works under the same educational system including recruiting and developing teachers performance. However, it provides some new ideas around teacher knowledge that may be useful to a variety of context including non-Arabic settings. These include the identification of teacher knowledge and needs plus the use of more than one approach to the delivery of professional learning. With this in mind people should be attentive to the Saudi context when applying these findings within different cultural settings and educational systems.

Future Research

Outcomes of the current study have highlighted a lack of research on professional learning of teachers in the Saudi Arabia. A suggestion for further research could be to test the effectiveness of the proposed model of professional learning. Furthermore, a study is needed to examine why supervisors and trainers in Saudi Arabia seem to be less effective and what skills and knowledge they need to run professional learning activities effectively. Because of the role of school principals in Saudi Arabia includes the responsibility of staff supervision besides student' achievement, and school administration, a study on what role could principals play in the area of teachers professional learning within their schools can be carried out. Moreover, the outcome of a study concerning the use of other models of professional learning such as coaching, mentoring and peer observation, could provide a new approaches to teachers practice in Saudi Arabia that are currently not being considered.

Recommendations

In addition to the recommendations for educational practice detailed in Chapter 6, there are some additional strategic recommendations. These related to the Ministry of Higher Education and the Ministry of Education.

Ministry of Higher Education

1. Review the course of science teaching method within the pre-service training program to clearly provide student teachers with sufficient skills in the areas of PK and PCK.
2. Explore the development of postgraduate courses (e.g. certificate course, diploma, masters... etc.) in the area of professional learning that prepare educators to be trainers.
3. Organize annual conference to increase awareness within Saudi society about professional learning formats and how they affect the academic achievement of students.
4. Encourage faculty members to carry out studies on professional learning of teachers in all stages of Saudi education in order to develop this field.
5. Establish an association of professional learning of teachers.

Ministry of Education

1. Supervisors and trainers in the Saudi educational system work at different departments; Department of Educational Supervision and the Department of Educational Training respectively. In order to apply the proposed model effectively, the two different departments would need to work more closely together. Consequently, it might be useful to merge these departments into one department using a new title “Department of professional learning".
2. Physics curriculum developers and textbook authors in Saudi Arabia should become familiar with PCK and could develop a guidebook for teachers associated with the school textbooks to help physics teachers to teach different concepts using appropriate PCK.

3. Professional development for supervisors and trainers could be part of a more collaborate approach between the departments. Also, it might be useful to develop a guidebook about professional learning process (step by step) to help supervisor and trainers run different formats of professional learning effectively.

Conclusion

In conclusion, the study found that effective professional learning for physics teachers in the city of *Onaizah*, Saudi Arabia can occur when on-the-job training is complemented with off-the-job training, and both supervisor and trainer apply the elements of professional learning collaboratively. Different training needs of teachers should be identified and classified into the three areas of teachers' knowledge that are CK, PK and PCK, as a first step to develop the efficacy of the learning program. The needs identified should be met by both supervisors and trainers using different approaches based on professional learning needs of teachers in the three areas of knowledge. The learning gained from different professional development approaches needs to be transferred, and the supervisor should help teachers to apply the new teaching approaches in their classrooms. Furthermore, the skills of supervisors and trainers should be developed to strengthen collaboration of the different training modes with a focus on planning, implementing and evaluating in-service training activities.

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APPENDICES

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Appendix **A**

An investigation of the effectiveness of professional learning activities for male physics teachers in the city of *Onaizah*, Saudi Arabia

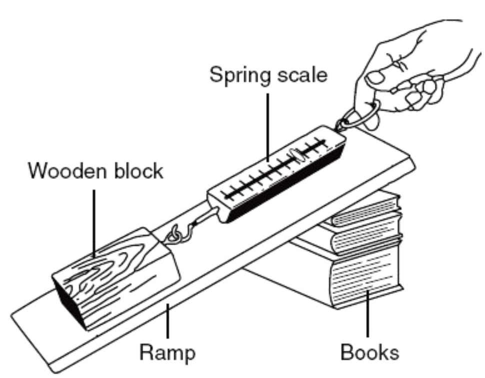
Researcher:

Yousef Alhaggass

Supervisors:

A/Professor Colleen Vale

Dr Anthony Watt



Part 1

DEMOGRAPHIC CHARACTERISTICS

In order to assist in the analysis of this questionnaire, some basic information about yourself and your school are needed. In responding to the following questions, please mark the appropriate box

SECTION A: ABOUT YOURSELF:

1. How old are you?

☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-60

2. How long have you been working as a teacher?

☐ Number of years

3. What level of qualification have you successfully completed?

☐ Diploma ☐ Bachelor ☐ Master ☐ Other ( )

4. What type of qualification have you successfully completed?

☐ Educational ☐ Non-Educational

5. What type of institution of qualification have you graduated from?

☐ University ☐ Teachers College ☐ S&M centre ☐ Other ( )

6. What was your major field of study?

☐ Physics ☐ Other ( )

7. Have you involved in professional learning activities before?

☐ No ☐ Yes. (Please give details)

- What?
  ....
  ....
- How?
  ....
  ....
- When?
  ....
  ....
- Where?
  ....
  ....

SECTION B: ABOUT YOUR SCHOOL:

8. What type of building is your school?

☐ Governmental ☐ Non-Governmental

9. How many classes in your school?

☐ Number of classes

Part 2

TEACHERS' EXPECTATIONS ON THE EFFECTIVENESS OF THEIR PROFESSIONAL LEARNING ACTIVITIES

SECTION A

EXPECTED PROFESSIONAL LEARNING OUTCOMES:

This section investigates your expectations on the outcomes of your professional learning activities PLA. Please mark the appropriate choice to indicate how strongly do you agree or disagree with each assessment's items.

(For each statement below, please mark one number):

PLANNING PHYSICS CLASSES:	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
1. PLA will improve my ability on setting phys learning objectives	1	2	3	4	5
2. PLA will improve my ability on designing observation activities for inquiry lessons	1	2	3	4	5
3. PLA will improve my ability on developing and testing hypothesis for inquiry lessons	1	2	3	4	5
4. PLA will improve my ability on planning for drawing the conclusion activities for inquiry lessons	1	2	3	4	5
5. PLA will improve my ability on designing communication activities for inquiry lessons	1	2	3	4	5

IMPLEMENTING PHYSICS CLASSES:

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
6. PLA will improve my physics content knowledge	1	2	3	4	5
7. PLA will improve my knowledge of the scientific inquiry process	1	2	3	4	5
8. PLA will improve my ability on using Expository teaching	1	2	3	4	5
9. PLA will improve my ability on using Interactive teaching	1	2	3	4	5
10. PLA will improve my ability on implement inquiry learning	1	2	3	4	5
11. PLA will improve my ability on using different kinds of display boards	1	2	3	4	5
12. PLA will improve my ability on using audi visual aids	1	2	3	4	5
13. PLA will improve my ability on using electronic resources of knowledge	1	2	3	4	5
14. PLA will improve my ability on designing classroom	1	2	3	4	5
15. PLA will improve my ability on managing students' behaviour	1	2	3	4	5
16. PLA will improve my ability on organizing my students' works	1	2	3	4	5

EVALUATING PHYSICS LEARNING:	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
17. PLA will improve my ability in using formative assessment	1	2	3	4	5
18. PLA will improve my ability in using summative assessment	1	2	3	4	5

Do you have any other comments?

....

....

....

....

SECTION B

PREFERRED FORMS OF PROFESSIONAL LEARNING:

This section investigates your preferred form of your professional learning activities PLA. Please mark the appropriate choice to indicate how strongly do you agree or disagree with each assessment's items.

NUMBER OF PARTICIPANTS

1. Based on the number of participants, how would you rank (1, 2, 3, or 4) the following as the most helpful ways of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

☐ As an individual

☐ As peers

☐ As a small group

☐ As a large group

(For each statement below, please mark one number):

PROFESSIONAL LEARNING ACTIVATES:	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
2. Expository training (lecture, demonstrations ... etc) would be most helpful for PLA	1	2	3	4	5
3. Interactive training (workshops, group discussions ... etc would be most helpful for PLA	1	2	3	4	5
4. Model physics lessons would be most helpfu for PLA	1	2	3	4	5
5. Focus should be on theoretical learning	1	2	3	4	5
6. Focus should be on practical learning	1	2	3	4	5

COMPETENCE OF TRAINERS/SUPERVISORS:

For the ***following*** competences, how would you expect your trainers/supervisor?

(Please tick only one option for each item below).

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
7. Will be knowledgeable	1	2	3	4	5
8. Will be well organised	1	2	3	4	5
9. Will be well communicator	1	2	3	4	5
10. Will be supportive	1	2	3	4	5

Do you have any other comments?

....

....

....

....

SECTION C

PREFERRED TIME AND LOCATION OF PROFESSIONAL LEARNING:

This section investigates your preferred time and location of your professional learning activities PLA. Please mark the appropriate choice to indicate how strongly do you agree or disagree with each assessment's items.

DURATION:

1. How would you rank (1, 2, 3, or 4) the following as the most helpful duration of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

- ☐ 1-4 hours
- ☐ 1-4 days
- ☐ 1-4 weeks
- ☐ Other duration (Please give details)

....

....

PERIOD:

2. How would you rank (1, 2, 3, or 4) the following as the most helpful period of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

- ☐ Morning
- ☐ Afternoon
- ☐ Evening
- ☐ Other period (Please give details)

....

....

DATE:

3. How would you rank (1, 2, 3, or 4) the following as the most helpful date of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

- ☐ At the beginning of semester
- ☐ At the middle of semester
- ☐ At the end of semester
- ☐ At summer holiday

PROFESSIONAL LEARNING LOCATION:

(For each statement below, please mark one number):

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
4. I will professionally learn better within my school	1	2	3	4	5

5. If you **strongly agree or agree**, how would you rank (1, 2, 3, or 4) the following as the most helpful location of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

- ☐ Staff room
- ☐ Physics laboratory
- ☐ School library
- ☐ Other location (Please give details)

....

....

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
6. I will professionally learn better outside my school	1	2	3	4	5

7. If you **<u>strongly agree or agree</u>,** how would you rank (1, 2, 3, or 4) the following as the most helpful location of your professional learning?

(1 is the most preferred rank while 4 is the least preferred rank)

☐ Educational Training Centre

☐ Directorate of Education

☐ Another school

☐ Other location (Please give details)

....

....

PROFESSIONAL LEARNING VENUE:

For the ***following*** environmental characteristics, how would you expect the learning venue to be?

(For each statement below, please mark one number):

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
8. Will be large enough	1	2	3	4	5
9. Will be well laid out	1	2	3	4	5
10. Will contain comfortable furniture	1	2	3	4	5
11. Will be well lit	1	2	3	4	5
12. Will be pleasantly colored	1	2	3	4	5
13. Will be well air conditioned	1	2	3	4	5
14. Will be isolated from sources of noise	1	2	3	4	5
15. Will be equipped with appropriate learning aids	1	2	3	4	5
16. Will contain suitable facilities	1	2	3	4	5

Do you have any other comments?

....

....

This is the end of the questionnaire

Thank you for your participation

Return to the *Onaizah* Educational Training Centre

Tel. 063643619

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MELBOURNE AUSTRALIA

Appendix **B**

اختبار فاعلية أنشطة التطوير المهني لمعلمي الفيزياء في مدينة عنيزة، المملكة العربية السعودية

(دراسة دكتوراه)

الباحث:

يوسف الهقاص

الإشراف:

م. بروفسور/ كولين فيل

د/ أنتوني وات

الجزء الأول

سمات ديموغرافية:

للمساعدة في تحليل هذه الاستبانة ؛ فإن بعض المعلومات الأساسية عن نفسك وعن مدرستك لابد من توفرها.
فضلاً ضع علامة ✓ في المربع المناسب فيما يلي:

القسم (أ): معلومات حول نفسك

١. **العمر**

☐ ٢٠-٢٩ ☐ ٣٠-٣٩ ☐ ٤٠-٤٩ ☐ ٥٠-٦٠

٢. **سنوات الخدمة كمعلم**

☐

٣. **المؤهل الدراسي**

☐ دبلوم ☐ بكالوريوس ☐ ماجستير ☐ آخر (   )

٤. **نوع التأهيل**

☐ تربوي ☐ غير تربوي

٥. **المؤسسة التعليمية التي تخرجت منها**

☐ الجامعة ☐ كلية المعلين ☐ مركز العلوم والرياضيات ☐ أخرى (   )

٦. **التخصص**

☐ ☐

فيزياء   غير فيزياء
فضلاً حدد (   )

٧. هل سبق أن خضعت لأنشطة تطوير مهني من قبل

لا   نعم. فضلاً أعط بعض التفصيل

▪موضوع النشاط:
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▪نوع النشاط:
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▪تاريخ النشاط:
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....

▪موقع النشاط:
....
....

القسم (ب): معلومات حول مدرستك

٨. نوع المبنى المدرسي

حكومي   غير حكومي

٩. عدد الفصول في المدرسة

فصل

الجزء الثاني

توقعات المعلم حول فاعلية أنشطة تطويرهم المهني (تعلمهم الوظيفي)

القسم (أ):

المخرجات المتوقعة لأنشطة التطوير المهني:

هذا القسم يختبر توقعاتك حول مخرجات أنشطة تطويرك المهني لهذا العام. فضلاً أشر للخيار الأكثر مناسبة فيما يلي:

(لكل فقرة فيما يلي اختيار واحد فقط)

أولاً: التخطيط لدروس الفيزياء:

	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
١. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على صياغة أهداف تدريسي	١	٢	٣	٤	٥
٢. أنشطة التطوير المهني لهذا العام ستحسن من فهمي لمراحل العملية الاستكشافية في التدريس	١	٢	٣	٤	٥
٣. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على تصميم أنشطة الملاحظة في الدروس الاستكشافية	١	٢	٣	٤	٥
٤. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على فرض الفروض واختبارها في الدروس الاستكشافية	١	٢	٣	٤	٥
٥. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على الاستنتاج في الدروس الاستكشافية	١	٢	٣	٤	٥
	١	٢	٣	٤	٥

٦. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على تصميم أنشطة الاتصال في الدروس الاستكشافية

ثانياً: التنفيذ لدروس الفيزياء:

العبارة	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
٧. أنشطة التطوير المهني لهذا العام ستحسن من استيعابي للمحتوى العلمي (المادة العلمية) في منهج الفيزياء	١	٢	٣	٤	٥
٨. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام الطرق الإلقائية في تدريسي	١	٢	٣	٤	٥
٩. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام أنشطة التدريس التفاعلية في تدريسي	١	٢	٣	٤	٥
١٠. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي على تطبيق دروس التعلم بالاستكشاف في تدريسي	١	٢	٣	٤	٥
١١. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام الأنواع المختلفة للسبورات ولوحات العرض	١	٢	٣	٤	٥
١٢. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام الوسائل السمعية والبصرية	١	٢	٣	٤	٥
١٣. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام المصادر الإلكترونية للمعلومات (انترنت، CD..)	١	٢	٣	٤	٥
١٤. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في تنظيم مواقع التعلم (الفصل الدراسي، المختبر ..)	١	٢	٣	٤	٥
١٥. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في إدارة سلوك طلابي أثناء الدروس	١	٢	٣	٤	٥
١٦. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في تنظيم أعمال طلابي	١	٢	٣	٤	٥

ثالثاً: تقويم تدريس الفيزياء:

العبارة	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
	١	٢	٣	٤	٥
	١	٢	٣	٤	٥

١٧. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام التقويم المستمر لتعلم طلابي

١٨. أنشطة التطوير المهني لهذا العام ستحسن من قدرتي في استخدام الاختبارات التحصيلية لتعلم طلابي

هل لديك تعليق أو إضافة؟

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القسم (ب):

الطريقة المفضلة للتطوير المهني:

هذا القسم يختبر طريقتك المفضلة للمشاركة في أنشطة تطويرك المهني لهذا العام. فضلاً أشر إلى الخيار الأكثر مناسبة فيما يلي:

أولاً: عدد المشاركين:

١. فيما يتعلق بعدد المشاركين في أنشطة التطوير المهني؛ كيف ترتب (١، ٢، ٣ أو ٤) العدد الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

- ☐ **بمفردي**
- ☐ **مع زميل آخر**
- ☐ **كمجموعة صغيرة**
- ☐ **كمجموعة كبيرة**

ثانياً: طبيعة أنشطة التطوير المهني:

(فضلاً .. لكل فقرة فيما يلي اختيار واحد فقط)

	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
٢. الطرق الإلقائية (المحاضرة، العرض العملي ..) ستكون هي الأنشطة الأكثر جدوى لتطويري المهني لهذا العام	١	٢	٣	٤	٥
٣. الطرق التفاعلية (المشغل، مجموعات النقاش ..) ستكون هي الأنشطة الأكثر جدوى لتطويري المهني لهذا العام	١	٢	٣	٤	٥
٤. الدروس التطبيقية ستكون هي الأنشطة الأكثر جدوى لتطويري المهني لهذا العام	١	٢	٣	٤	٥
٥. التركيز على الجوانب النظرية سيكون هو الأكثر جدوى لتطويري المهني لهذا العام	١	٢	٣	٤	٥
٦. التركيز على الجوانب العملية سيكون هو الأكثر جدوى لتطويري المهني لهذا العام	١	٢	٣	٤	٥

ثالثاً: كفاءة القائمين على أنشطة التطوير المهني (مشرفين، مدربين ...الخ):

فيما يتعلق بالكفايات التالية؛ كيف تتوقع أن يكون عليه مستوى من يقوم على أنشطة تطويرك المهني لهذا العام (مشرفاً كان أم مدرباً):

(فضلاً .. لكل فقرة فيما يلي اختيار واحد فقط)

	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
٧. من سيقوم على أنشطة تطويري المهني لهذا العام سيكون متمكناً من المادة العلمية	١	٢	٣	٤	٥
٨. من سيقوم على أنشطة تطويري المهني لهذا العام سيكون حسن التنظيم للأنشطة	١	٢	٣	٤	٥
٩. من سيقوم على أنشطة تطويري المهني لهذا العام سيكون متصلاً جيداً	١	٢	٣	٤	٥
١٠. من سيقوم على أنشطة تطويري المهني لهذا العام سيكون محفزاً وداعماً	١	٢	٣	٤	٥

هل لديك تعليق أو إضافة؟

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القسم (ج):

الزمان والمكان المفضلان للتطوير المهني:

هذا القسم يختبر الزمان والمكان المفضلين لك للمشاركة في أنشطة تطويرك المهني لهذا العام. فضلاً أشر إلى الخيار الأكثر مناسبة فيما يلي:

أولاً: المدة

١. فيما يتعلق بالمدة الزمنية لأنشطة التطوير المهني؛ كيف ترتب (١، ٢، ٣ أو ٤) طول المدة الزمنية الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

- ☐ **١-٤ ساعات**
- ☐ **١-٤ أيام**
- ☐ **١-٤ أسابيع**
- ☐ **مدة أخرى. فضلا أعط بعض التفاصيل:**

....

....

ثانياً: الفترة الزمنية

٢. فيما يتعلق بالفترة الزمنية لأنشطة التطوير المهني؛ كيف ترتب (١، ٢، ٣ أو ٤) الفترة الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

- ☐ **الفترة الصباحية**
- ☐ **العصر**
- ☐ **المغرب**
- ☐ **فترة أخرى. فضلا أعط بعض التفاصيل:**

....

....

ثالثاً: التوقيت

٣. فيما يتعلق بالتوقيت لأنشطة التطوير المهني؛ كيف ترتب (١، ٢، ٣ أو ٤) التوقيت الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

- ☐ **بداية الفصل الدراسي**
- ☐ **منتصف الفصل الدراسي**
- ☐ **نهاية الفصل الدراسي**
- ☐ **خلال عودة المعلمين (قبيل بدء العام الدراسي)**

رابعاً: موقع التطوير المهني:

(فضلاً .. لكل فقرة فيما يلي اختيار واحد فقط)

	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
٤. سيكون تطويري المهني لهذا العام أفضل إذا كان داخل مدرستي	١	٢	٣	٤	٥

٥. إذا كان اختيارك هو أوافق بشدة أو أوافق؛ فكيف ترتب (١، ٢، ٣ أو ٤) الموقع الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

- ☐ **غرفة المعلمين**
- ☐ **المختبر**
- ☐ **غرفة مصادر التعلم**
- ☐ ....
....

موقع آخر. فضلا أعط بعض التفاصيل:

٦. سيكون تطويري المهني لهذا العام أفضل إذا كان خارج مدرستي	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
	١	٢	٣	٤	٥

٧. إذا كان اختيارك هو أوافق بشدة أو أوافق؛ فكيف ترتب (١، ٢، ٣ أو ٤) الموقع الأكثر جدوى فيما يلي:

(رقم ١ هو الأكثر تفضيلاً بينما رقم ٤ الأقل تفضيلاً)

☐ مركز التدريب التربوي

☐ مبنى إدارة التعليم

☐ مدرسة أخرى

☐ موقع آخر. فضلا أعط بعض التفاصيل:

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خامساً: مكان التطوير المهني:

فيما يتعلق بمواصفات بيئة التعلم المادية؛ كيف تتوقع أن يكون المكان المعد لإقامة أنشطة تطويرك المهني عليه (سواءً كان ذلك داخل المدرسة أو خارجها):

(فضلاً .. لكل فقرة فيما يلي اختيار واحد فقط)

	أوافق بشدة	أوافق	غير متأكد	لا أوافق	لا أوافق بشدة
٨. سيكون المكان واسعاً بما فيه الكفاية	١	٢	٣	٤	٥
٩. سيكون حسن التصميم والتنظيم	١	٢	٣	٤	٥
١٠. سيحتوي على أثاث مريح	١	٢	٣	٤	٥
١١. سيكون جيد الإضاءة	١	٢	٣	٤	٥
١٢. سيكون ذا ألوان مناسبة	١	٢	٣	٤	٥
١٣. سيكون جيد التكييف والتهوية	١	٢	٣	٤	٥
١٤. سيكون جيد العزل عن مصادر الضوضاء	١	٢	٣	٤	٥
١٥. سيكون مجهزاً بتقنيات التعلم المناسبة	١	٢	٣	٤	٥
١٦. ستتوفر فيه المرافق والتسهيلات المساندة	١	٢	٣	٤	٥

هل لديك تعليق أو إضافة؟

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نهاية الاستبانة، شكراً لمشاركتك

فضلاً: تعاد الاستبانة إلى مركز التدريب التربوي

ت: ٠٦٣٦٤٣٦١٩

VICTORIA UNIVERSITY
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Appendix **C**

MEMO

TO	A/Professor Colleen Vale School of Education Victoria University	DATE	15/8/2011
FROM	Dr Mary Weaven Acting Chair Arts, Education & Human Development Human Research Ethics Subcommittee		
SUBJECT	Ethics Application – HRETH 11/163		

Dear Colleen,
Thank you for resubmitting this application for ethical approval of the project entitled:

HRETH 11/163 An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia

(AEHD HREC 11/116)

The proposed research project has been accepted and deemed to meet the requirements of the National Health and Medical Research Council (NHMRC) 'National Statement on Ethical Conduct in Human Research (2007)', by the Acting Chair, Faculty of Arts, Education & Human Development Human Research Ethics Subcommittee. Approval has been granted from 15/8/2011 to 5/1/2012.

Continued approval of this research project by the Victoria University Human Research Ethics Committee (VUHREC) is conditional upon the provision of a report within 12 months of the above approval date or upon the completion of the project (if earlier). A report proforma may be downloaded from the VUHREC web site at:
http://research.vu.edu.au/hrec.php

Please note that the Human Research Ethics Committee must be informed of the following: any changes to the approved research protocol, project timelines, any serious events or adverse and/or unforeseen events that may affect continued ethical acceptability of the project. In these unlikely events, researchers must immediately cease all data collection until the Committee has approved the changes. Researchers are also reminded of the need to notify the approving HREC of changes to personnel in research projects via a request for a minor amendment.

If you have any further queries please do not hesitate to contact me on 9919 9510.

On behalf of the Committee, I wish you all the best for the conduct of the project.
Kind regards,

Dr Mary Weaven
Acting Chair
Victoria University Human Research Ethics Committee

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Appendix **D**

Kingdom of Saudi Arabia	المملكة العربية السعودية
Ministry of Education	وزارة التربية والتعليم
Directorate of Education in *Onaizah*	إدارة التربية والتعليم في محافظة عنيزة
Educational Affairs	الشؤون التعليمية

وزارة التربية والتعليم
MINISTRY OF EDUCATION

17 May 20١١

To whom it may concern

We would like to affirm that Mr. Yousef Saleh Alhaggass has the authority to conduct his academic study under the title: An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia, in the city of *Onaizah* during the 1st semester of Saudi Arabian educational system; 10th of Sep 2011 – 5th of Jan 2012.

For further information please do not hesitate to contact the *Onaizah* directorate of education on 063641042.

Kind regards,

[redacted]

Yousef Abdullah Al Romaih

Director of Directorate of Education in *Onaizah*

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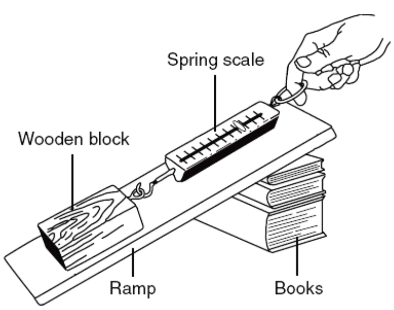
Appendix **E**

DIRECTORATE OF EDUCATION IN THE CITY OF ONAIZAH

Educational Training Centre

Teaching Physics by Inquiry

(Off-the-job Training Program)



Designed especially for the PhD thesis:

An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia

2011

PROPOSED PROGRAM OUTLINE

PROGRAM DESCRIPTION:

Many recent educational theories try to provide educators in general and teachers in particular with a variety of choices not merely about what is taught and learned, but also about how it should be taught and learned. This program should assist physics teachers to utilise scientific inquiry as a productive approach more effectively in physics education.

PROGRAM DETAILS:

Program Code:	E-T-PH-07
Program Title:	Teaching Physics by Inquiry
Program Attendees:	Male teachers of physics at secondary and intermediate schools in the city of *Onaizah*
Program Designers:	Yousef Alhaggass
Program Coordinator:	Mr Ali Alharbi
Program Location:	Educational Training Centre
Program Time:	1st Semester 2011
Program Length:	4 hours
Program Language:	Arabic
Program Fees:	$0 (free course)

PROGRAM OUTCOMES:

At the end of this course, attendees will be able to:

- Plan learning activities in physics using the inquiry approach
- Implement their planned inquiry activities in physics classes

PROGRAM UNITS:

This program consists of two units.

Unit 1

Topic:

PLANNING FOR INQUIRY LESSONS IN PHYSICS CLASSES

Content	Activities	Learning Materials & equipments	Duration
Learning objectives including the three domains: ✓ Cognitive ✓ Affective ✓ Psychomotor	▪ Short lecture: The trainer is going to give a short presentation as introduction to learning objectives ▪ Individual exercise: Every single teacher will be given a sheet of paper contains a list of behavior outcomes and asked to distinguish between them based on the three domains of learning objectives ▪ Group discussion: As small groups, teachers will be given handouts about *Learning Objectives* and asked to check the result of the individual exercise	✓ Data show projector ✓ Laptop computer ✓ White board ✓ Marker pens ✓ Handouts	60 minutes
Designing inquiry	▪ Short lecture:	✓ Data show projector	60

learning activities: ✓ Observation ✓ Developing hypothesis ✓ Testing the hypothesis ✓ Drawing the conclusion ✓ Communicating	The trainer is going to give a short presentation as introduction to the Inquiry approach ▪ Video: The trainer is going to play a short video of an inquiry class in action. ▪ Group discussion: Based on watching the short video, teachers as small groups, will be asked to determine the key steps of the Inquiry approach ▪ Workshop: As small groups, teachers will be asked to build inquiry lesson plans for physics classes using physics textbooks	✓ Laptop computer ✓ White board ✓ Marker pens ✓ Flipchart ✓ Physics textbook	minutes

Unit 2

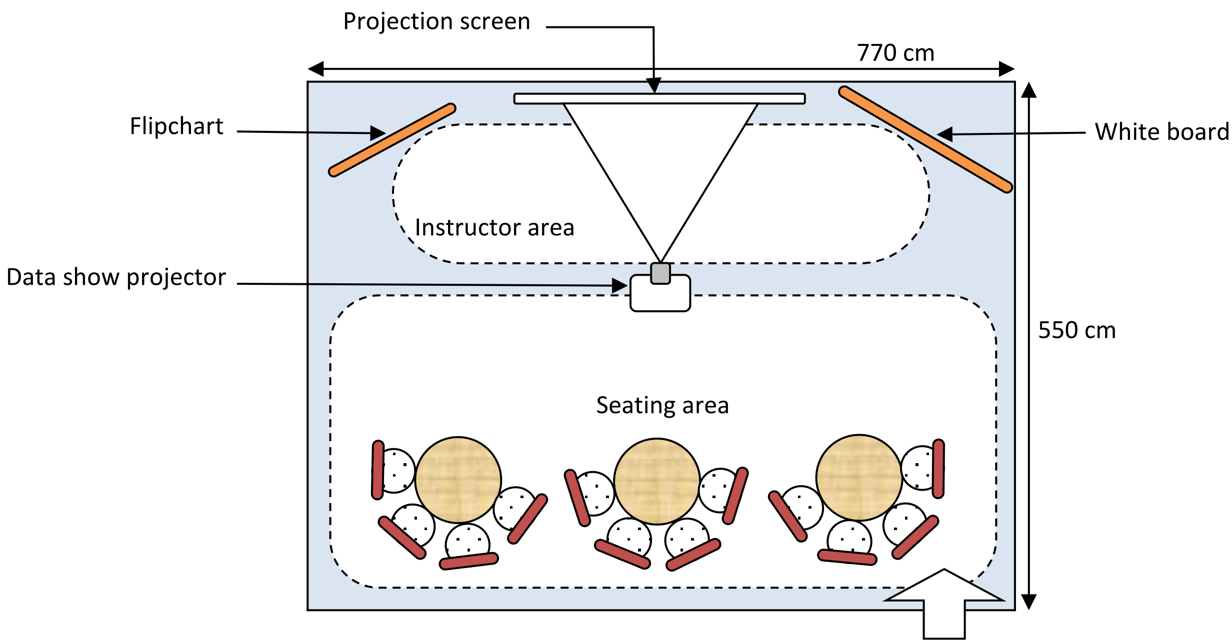
Topic:

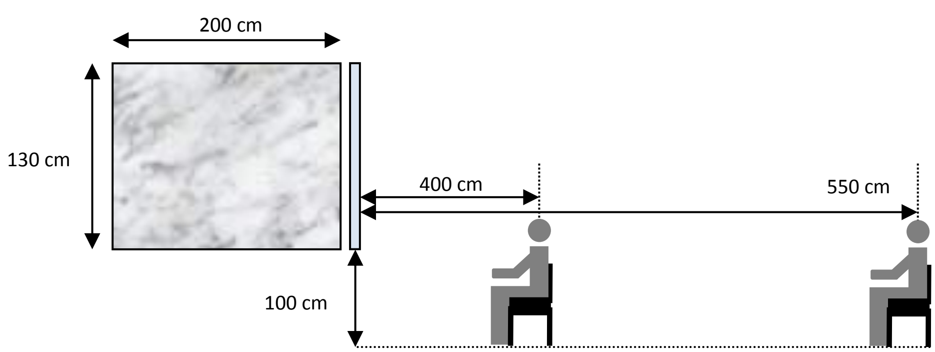
IMPLEMENTING INQUIRY LESSONS IN PHYSICS CLASSES

Content	Activities	Learning Materials & equipments	Duration
Implementing inquiry learning activities: ✓ Observation ✓ Developing hypothesis ✓ Testing the hypothesis (by designing an experiment) ✓ Drawing the conclusion ✓ Communicating	▪ Group presentation: As small groups, teachers will be asked to present their inquiry lessons plan for the whole group ▪ Role playing: Every single small groups, will be asked to implement its inquiry lessons plan practically for the whole group	✓ Data show projector ✓ Laptop computer ✓ White board ✓ Marker pens ✓ Flipchart ✓ Physics textbook	80 minutes
Challenges for implementing inquiry activities	▪ Group discussion: As small groups, teachers will be asked to expect the obstacles for implementing inquiry activities in physics classes and give some suggestions to overcome the challenges of implementing inquiry activities ▪ Conclusion:	✓ Data show projector ✓ Laptop computer ✓ White board ✓ Marker pens	40 minutes

Program Location:	Educational Training Centre in the city of *Onaizah*
Physical environment of learning venue:	Size of learning venue: • L= 770 cm • W= 550 cm • H= 270 cm Lighting: *Natural lighting:* • Windows size: 2 x 140 cm H x 140 cm W *Artificial lighting:* • Direct fluorescent lamps: 8 x 4 x 20 watt Air quality: • Temperature: 25°C • Humidity: 35-45% relative humidity
learning aids:	• Desktop computer • Data show projector • Projection screen • White board • Flipchart • Marker pens
Facilities:	• Car park • Building signs • Room numbers • Rest rooms • Drinking fountains • Tea & coffee making facilities

LAYOUT OF LEARNING VENUE





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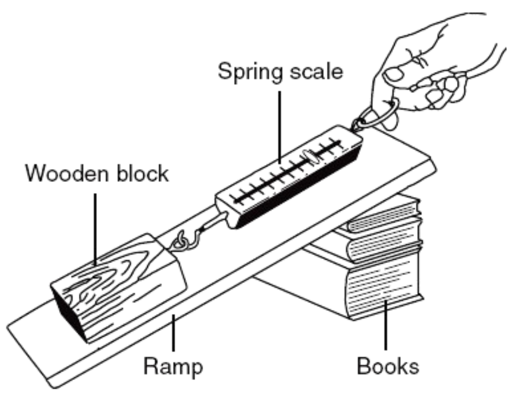
DIRECTORATE OF EDUCATION IN THE CITY OF ONAIZAH

وزارة التربية والتعليم
MINISTRY OF EDUCATION

Educational Training Centre

تدريس الفيزياء باستخدام المدخل الكشفي

برنامج تدريبي خارج موقع العمل



2011

PROGRAM DETAILS:

Program Code:	**E-T-PH-07**
Program Title:	**المدخل الكشفي في تدريس العلوم**
Program Attendees:	**معلمو الفيزياء في المرحلة الثانوية ومعلمو العلوم في المرحلة المتوسطة**
Program Designers:	**يوسف الهقاص**
Program Coordinator:	**مركز التدريب التربوي**
Program Location:	**مركز التدريب التربوي**
Program Time:	**محرم ١٤٣٣هـ**
Program Length:	**٤ ساعات (يوم واحد)**
Program Language:	**اللغة العربية**
Program Fees:	**البرنامج مجاني**

أهداف البرنامج:

في نهاية البرنامج سيكون كل مشارك قادراً على أن:

- يخطط لتدريس الفيزياء باستخدام المدخل الكشفي
- ينفذ المدخل الكشفي في دروس الفيزياء

وحدات البرنامج:

يتكون البرنامج من وحدتين:

الوحدة الأولى:

التخطيط لتدريس الفيزياء باستخدام المدخل الكشفي

المحتوى	الأنشطة	الأجهزة والمواد	الزمن
الأهداف التعليمية (السلوكية)	• محاضرة قصيرة (تعريف الهدف السلوكي، مجالاته، صياغته) • نشاط فردي (صياغة أهداف سلوكية) تقويم النشاط جماعياً	• جهاز عرض البيانات • حاسب آلي • سبورة بيضاء • أقلام	٤٠ دقيقة
تصميم الأنشطة الكشفية	• محاضرة قصيرة (تعريف النشاط الكشفي) • تبادل أفكار (عناصر النشاط الكشفي) • ورشة عمل (تصميم نشاط كشفي لأحد الدروس)	• جهاز عرض البيانات • حاسب آلي • سبورة بيضاء • أقلام • كتاب فيزياء مدرسي	٦٠ دقيقة

الوحدة الثانية:

التنفيذ لدروس الفيزياء باستخدام المدخل الكشفي

المحتوى	الأنشطة	الأجهزة والمواد	الزمن
تنفيذ النشاط الكشفي	• بيان عملي (كل مجموعة تقوم بعرض خطة النشاط الكشفي التي قامت بتصميمه ومن ثم تقوم بتنفيذه عملياً أمام بقية المجموعات)	• جهاز عرض البيانات • حاسب آلي • سبورة بيضاء • أقلام • كتاب فيزياء مدرسي	٥٠ دقيقة

عوائق تنفذ الأنشطة الكشفية في مدارسنا	• مناقشة جماعية	• سبورة بيضاء • أقلام	**١٠** دقائق

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

برنامج المدخل الكشفي في تدريس العلوم

تمرين:

أمامك مجموعة من العبارات، صاغها بعض المعلمين كأهداف تعليمية.

بالتعاون مع أفراد مجموعتك ادرس هذه العبارات ثم أعد صياغتها سلوكياً، يمكن الاسترشاد بالأنموذج التالي:

أن	+	فعل سلوكي	+	الطالب	+	مصطلح من المادة العلمية

١. مشاهدة فيلم عن ظاهرة الصدى.
٢. أن يعدّد الطالب أجزاء الميكروسكوب ويقوم بحساب قوة تكبيره ويقارن ذلك بالتلسكوب.
٣. سيشرح المعلم تركيب البارومتر الزئبقي.
٤. أن يدرك الطالب أهمية الاحتكاك في الحياة اليومية.
٥. حساب فرق الجهد الكهربائي.
٦. القانون الأول للحركة.
٧. إجراء تجربة انكسار الضوء.

تمرين:

أمامك مجموعة من الأفعال السلوكية، بالتعاون مع أفراد مجموعتك صنّف هذه الأفعال إلى مجالاتها الرئيسة.

يعدّد	يرسم	يتطوع
يبرهن	يقارن	يركّب
يصوّب	يقدّر	يعرّف
يعلّل	يقص	يحترم
يتبرع	يفسّر	يشرّح

معرفي **مهاري** **وجداني**

برنامج المدخل الكشفي في تدريس العلوم

ورشة:

المطلوب التعاون في بناء خطة لدرس في مادة الفيزياء باستخدام المدخل الكشفي، وللمساعدة يمكنكم الاسترشاد الجدول التالي:

المادة	الموضوع	اليوم	التاريخ	الصف	الحصة

الأهداف السلوكية:

١.
٢.

سير الدرس:

رقم الهدف	كيف؟ الخطوات	بماذا؟ الوسيلة	كم؟ الزمن	أين؟ المكان	هل؟ التقويم

مناقشة:

يعتقد بعض المعلمين أن ثمة عوائق تحول دون تطبيق المدخل الكشفي في مدارسنا:

1. **هل تتفق مع هذا الاعتقاد؟**
2. **إن كانت إجابتك بنعم؛ فما تلك العوائق؟ يمكن الاسترشاد بالجدول أدناه:**

عوائق فنية (تتعلق بالمنهج وما يلزمه من تجهيزات ومواد)	عوائق إدارية (تتعلق بالإدارة والزمان والمكان)	عوائق شخصية (تتعلق بالمعلم من حيث قدرته ودافعيته)	عوائق أخرى

3. **كم عدد الدروس التي يمكنك تنفيذها باستخدام المدخل الكشفي خلال الفصل الدراسي الواحد؟**

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Appendix **F**

توزيع معلمي الفيزياء على المجموعات

Grouping the physics teachers

المجموعة ١	المجموعة ٢	المجموعة ٣
On	**Off**	**On+Off**

م	المدرسة	المرحلة	نوع المبنى	نوع التعليم	عدد الفصول	معلمي الفيزياء	عدد الطلاب	المجموعة
1	عنيزة العامة	ثانوي	حكومي	حكومي	11	1	253	2
2	مجمع العليان	ثانوي	حكومي	حكومي	10	2	283	2
3	الفتح	ثانوي	حكومي	حكومي	12	2	313	3
4	الشبيلي	ثانوي	حكومي	حكومي	15	3	396	1
5	الفاخرية	ثانوي	حكومي	حكومي	15	2	433	2
6	ابن عثيمين	ثانوي	حكومي	حكومي	15	3	466	3
7	ابن سعدي	ثانوي	حكومي	حكومي	17	2	512	1
8	سعيد بن زيد	ثانوي	مستأجر	حكومي	9	2	169	2
9	المنارات	ثانوي	مستأجر	أهلي	9	1	180	3
10	الامير سلطان	ثانوي	مستأجر	حكومي	6	1	114	2
11	عنيزة الأهليه	ثانوي	مستأجر	أهلي	5	1	85	3
12	الروغاني	ثانوي	مستأجر	حكومي	4	1	58	1
13	الخويطر	ثانوي	مستأجر	حكومي	3	1	50	1
14	ابي عبيدة	متوسط	حكومي	حكومي	10	2	218	1
15	حطين	متوسط	حكومي	حكومي	10	2	286	2
16	فلسطين	متوسط	حكومي	حكومي	10	3	274	2
17	مجمع العليان	متوسط	حكومي	حكومي	9	2	208	1

18	سهيل بن عمرو	متوسط	حكومي	حكومي	9	2	227	3
19	ابن صالح	متوسط	حكومي	حكومي	9	2	233	1
20	القادسية	متوسط	حكومي	حكومي	9	2	223	3
21	ابن تيمية	متوسط	حكومي	حكومي	8	2	165	2
22	المانع	متوسط	حكومي	حكومي	8	2	214	3
23	مجمع الفاخرية	متوسط	حكومي	حكومي	8	2	213	1
24	المثنى	متوسط	حكومي	حكومي	8	1	181	1
25	حفص	متوسط	حكومي	حكومي	6	1	122	2
26	الشاطبي	متوسط	حكومي	حكومي	6	1	102	3
27	الحفيرة	متوسط	حكومي	حكومي	3	1	59	3
28	ابن مسعود	متوسط	مستأجر	حكومي	9	2	185	3
29	حسان	متوسط	مستأجر	حكومي	9	1	156	2
30	الانصار	متوسط	مستأجر	حكومي	9	2	131	1
31	الملك فهد	متوسط	مستأجر	حكومي	8	2	126	3
32	ابي هريرة	متوسط	مستأجر	حكومي	7	2	110	2
33	ابن رواحة	متوسط	مستأجر	حكومي	6	2	74	1
34	عمرو بن العاص	متوسط	مستأجر	حكومي	5	1	70	1
35	المنارات	متوسط	مستأجر	أهلي	3	1	27	2
36	الروغاني	متوسط	مستأجر	حكومي	3	1	49	3
37	عنيزة الأهليه	متوسط	مستأجر	أهلي	3	1	48	2

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Appendix **G**

Training the trainer & Consultation with the supervisor and collaboration between the trainer and the supervisor

Program Title:	Training the trainer & Consultation with the supervisor and collaboration between the trainer and the supervisor
Program Attendees:	✓ One trainer at the educational training centre in the city of *Onaizah* ✓ One physics supervisor at the educational supervision department in the city of *Onaizah*
Program Location:	Educational Training Centre
Program Time:	1st Semester 2011
Program Length:	3 hours

PROGRAM DETAILS:

PROGRAM OUTCOMES:

At the end of this course, attendees will be able to:

- Implement the professional learning activities for the 62 male physics teachers efficiently

PROGRAM UNITS:

This program consists of three parts.

Part 1:

TRAINING THE TRAINER

Content	Activities	Learning aids	Duration
▪ Specific training skills needed for training science teachers ▪ Using inquiry learning activities in physics classes	▪ Short presentation The researcher is going to give a short presentation on the area of: ▪ General trainer's competence ▪ Video: The trainer is going to play a short video of an inquiry class in action. ▪ Discussion: Based on watching the short video, the trainer will be asked to determine the: ▪ Specific trainer's competence needed for training science teachers	✓ Data show projector ✓ Laptop computer ✓ White board ✓ Marker pens	60 minutes

Part 2:

CONSULTATION WITH THE SUPERVISOR

Content	Activities	Learning aids	Duration
Competence of	▪ Short presentation	✓ Data show	60

supervisor: ✓ knowledgeable ✓ well organized ✓ well communicator ✓ supportive	The researcher is going to give a short presentation on the area of: ▪ General supervisor' competence ▪ Video: The trainer is going to play a short video of an inquiry class in action. ▪ Discussion: Based on watching the short video, the supervisor will be asked to determine the: ▪ Specific supervisor' competence needed for improving science teachers	projector ✓ Laptop computer ✓ White board ✓ Marker pens	minutes

Part 3:

COLLABORATION BETWEEN THE TRAINER AND THE SUPERVISOR

Content	Activities	Learning aids	Duration
The three types of professional learning activities for physics teachers: ✓ On-the-job training ✓ Off-the-job training ✓ On + off-the-job	▪ Short presentation The researcher is going to give a short presentation on: ▪ The three types of professional learning activities for physics teachers	✓ Data show projector ✓ Laptop computer ✓ White board ✓ Marker	60 minutes

training	▪ The role of the supervisor in the area of professional learning for physics teachers ▪ The role of the trainer in the area of professional learning for physics teachers ▪ Discussion: ▪ Collaboration between the trainer and the supervisor in the three types of professional learning for physics teachers	pens	

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Appendix **H**

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة التربية والتعليم (٢٨٠)
إدارة التربية والتعليم في محافظة عنيزة
شؤون تعليم البنين
التدريب التربوي

وزارة التربية والتعليم
Ministry of Education
تزرعان العطاء فتحصدان الوفاء

الرقم : ٣٣١٢٧٠١٧
التاريخ: ١٧/١/١٤٣٣هـ
المرفقات: ٣

نشرة عاجلة للمدارس حسب المرفق

إلى: مدير مدرسة........... وفقه الله.
من: مساعد مدير التربية والتعليم لشؤون تعليم البنين.
بشأن: عقد برنامج المدخل الكشفي في تدريس العلوم.

السلام عليكم ورحمة الله وبركاته'''' وبعد:
حيث أن قسم التدريب بالتعاون مع الإشراف التربوي (شعبة العلوم) سينفذان برنامجاً وفق البيانات الآتية:

اسم البرنامج	المدخل الكشفي في تدريس العلوم	المدرب	مجموعة من المختصين
المنظمون	قسم التدريب التربوي / شعبة العلوم	اليوم	المجموعة الأولى الأحد ١٤٣٣/١/٢٣هـ المجموعة الثانية الاثنين ١٤٣٣/١/٢٤هـ
الفئة المستهدفة	معلمو الفيزياء في المرحلتين المتوسطة و الثانوية	الزمن	٨ – ١٢

ويرفقه الإعلان الخاص بالبرنامج.
لذا نأمل حضور المعلم في الوقت المحدد.
كما نأمل منكم مراعاة مع ما يلي:

١. توقيع المعلم في يوم البرنامج في مركز التدريب التربوي.
٢. يوضع أمام اسم المعلم في دفتر التوقيع الرمز (٧) دورة تدريبية.
٣. سيتواصل معكم قسم التدريب في حال غياب المعلم أو تأخره.

[redacted]

والسلام عليكم ورحمة الله وبركاته

عبدالله بن علي القرزعي
[redacted]

ص. للإشراف التربوي.
ص. للتدريب التربوي.
ص. لشعبة العلوم.
ص. للاتصالات.

سنترال الإدارة : ٠٦٣٦٤١٠٤٢ فاكس ٠٦٣٦٤٢٠٨٠ التدريب التربوي ٠٦٣٦٤٣٦١٩ فاكس ٠٦٣٦٥١٥٠٩ dtrain@onaizahedu.gov.sa

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة التربية والتعليم (٢٨٠)
إدارة التربية والتعليم في محافظة عنيزة
شؤون تعليم البنين
التدريب التربوي

وزارة التربية والتعليم
Ministry of Education

تزرعان العطاء فتحصدان الوفاء

الرقم :
التاريخ: /١٤٣٣/١هـ
المرفقات:

المجموعة الأولى يوم الأحد ١٤٣٣/١/٢٣هـ

م	اسم المعلم	المدرسة
١	زاكي مريزيق السهلي	ث. العامة
٢	منيف رزيق المطيري	ث. العليان
٣	عبدالله صالح الواصل	ث.الفاخرية
٤	حمد عبدالله السريح	ث. سعيد بن زيد
٥	فواز إبراهيم الصائغ	ث . الأمير سلطان
٦	إبراهيم عبدالعزيز الغشام	م. حطين
٧	سليمان محمد الغشام	م. فلسطين
٨	فهد عبدالعزيز الغشام	م. ابن تيمية
٩	بادي عبدالعزيز البادي	م. حفص
١٠	ماجد الحميدي النفيعي	م. حسان
١١	يحيى محمد آل ساكن	م. أبي هريرة
١٢	جلال غالب العتيبي	م. المنارات
١٣	فواز نور المطيري	م. عنيزة الأهلية
١٤	عبدالعزيز إبراهيم الخليفي	ث. الفتح
١٥	فهد عبدالله الشبل	ث. ابن عثيمين
١٦	خالد عبدالله الفيفي	م . سهيل بن عمرو
١٧	منصور عبدالله المنصور	م. القادسية
١٨	سلطان عبدالله المالكي	م. ابن مانع
١٩	صالح إبراهيم الحجي	م. ابن مسعود
٢٠	سليمان عبدالله الشويمان	م. الملك فهد

[redacted]

سنترال الإدارة : ٠٦٣٦٤١٠٤٢ فاكس ٠٦٣٦٤٢٠٨٠ التدريب التربوي ٠٦٣٦٤٣٦١٩ فاكس ٠٦٣٦٥١٥٠٩ dtrain@onaizahedu.gov.sa

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة التربية والتعليم (٢٨٠)
إدارة التربية والتعليم في محافظة عنيزة
شؤون تعليم البنين
التدريب التربوي

وزارة التربية والتعليم
Ministry of Education
تزرعان العطاء فتحصدان الوفاء

الرقم :
التاريخ: /١٤٣٣/١هـ
المرفقات:

المجموعة الثانية يوم الاثنين ١٤٣٣/١/٢٤هـ

م	اسم المعلم	المدرسة
١	عبدالرحمن عبدالله الحربي	ث .العليان
٢	عمار محمد المحيميدي	ث.الفاخرية
٣	نواف فاطم العتيبي	ث. سعيد بن زيد
٤	حمدان عبدالعزيز الوسمي	م. حطين
٥	محمد محسن العتيبي	م. فلسطين
٦	عماد علي الزهراني	م. ابن تيمية
٧	بدر إبراهيم البريدي	ث . الفتح
٨	سامي عبدالله المسند	ث . ابن عثيمين
٩	محمد حمود الصائغ	ث . ابن عثيمين
١٠	محمد أحمد دفع الله	ث . عنيزة الأهلية
١١	أحمد عبدالعزيز الزهراني	م . سهيل بن عمرو
١٢	عبدالله مبروك الغامدي	م. القادسية
١٣	مبارك عبدالله القحطاني	م. ابن مانع
١٤	صابر معويض العصيمي	م. الشاطبي
١٥	أحمد سعد الدهاسي	م. الحفيرة
١٦	خالد صالح الزهراني	م. ابن مسعود
١٧	عادل محمد المالكي	م. الملك فهد
١٨	بدر محمد المالكي	م. الروغاني
١٩	سطام صالح الرشيدي	ث. الخويطر

[redacted]

سنترال الإدارة : ٠٦٣٦٤١٠٤٢ فاكس ٠٦٣٦٤٢٠٨٠ التدريب التربوي ٠٦٣٦٤٣٦١٩ فاكس ٠٦٣٦٥١٥٠٩ dtrain@onaizahedu.gov.sa

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study into addressing the issue of professional development of physics teachers in Saudi Arabia by reviewing the effectiveness of their in-service training activities in terms of meeting their training needs and assisting them to teach physics topics effectively

CERTIFICATION BY SUBJECT

I, ... of ....

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: An investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia, being conducted at Victoria University by A/Professor Colleen Vale, Dr Anthony Watt, and Mr Yousef Alhaggass.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Mr Yousef Alhaggass and that I freely consent to participation involving the below mentioned procedures:

- Completion of the two questionnaires, teachers' expectations questionnaire and teachers' experience questionnaire
- Participating in interviews if required
- Participating in the professional learning activities as coordinated by the Directorate of Education in *Onaizah* city

I am also consenting to the student researcher contacting me on the following phone number ....

Or using the following email .... to coordinate my involvement schedule in the study.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: .... Date: ....

Any queries about your participation in this project may be directed to the researcher

- A/Professor Colleen Vale (Colleen.Vale@vu.edu.au)
- Dr Anthony Watt (Anthony.Watt@vu.edu.au)
- Student researcher Mr Yousef Alhaggass (yousef.alhaggass@live.vu.edu.au), (0432616714)

If you have any queries or complaints about the way you have been treated, you may contact the Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (+613) 9919 4148.

[*please note: Where the participant/s are aged under 18, separate parental consent is required; where the participant/s are unable to answer for themselves due to mental illness or disability, parental or guardian consent may be required.]

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بطاقة موافقة على المشاركة في الدراسة

معلومات للمشاركين:

أخي المعلم:

يسرنا دعوتك لأن تكون جزءاً من هذه الدراسة الأكاديمية والتي تعالج موضوع تحسين الأداء الوظيفي لمعلمي الفيزياء في المملكة العربية السعودية وذلك عن طريق اختبار فاعلية أنشطة تطويرهم المهني على رأس العمل بغية إشباع حاجاتهم التدريبية وبالتالي مساعدتهم في تدريس موضوعات الفيزياء بفاعلية أكبر.

أنموذج الموافقة على المشاركة:

أنا: (الاسم) .... **أعمل في:** (اسم المدرسة) ....

أوافق ـ تطوعاً ـ على المشاركة في الدراسة تحت عنوان: اختبار فاعلية أنشطة التطوير المهني لمعلمي الفيزياء في محافظة عنيزة، المملكة العربية السعودية ، والتي تقوم بها جامعة فكتوريا في مدينة ملبورن الاسترالية ممثلة بكل من: م. بروفسور/ كولين فيل، د/ أنتوني وات والباحث/ يوسف الهقاص.

وتشمل موافقتي القيام بما يلي:

- إكمال (تعبئة) جميع الاستبانات التي ترسل إلي
- المشاركة في المقابلة الشخصية إن طلب مني ذلك
- المشاركة في أنشطة التطوير المهني لمعلمي الفيزياء المنفذة من قبل إدارة التربية والتعليم في محافظة عنيزة إن طلب مني ذلك

وعليه فإن الباحث يمكنه التنسيق المباشر معي بهذا الشأن بواسطة الهاتف الجوال ذي الرقم: ....
أو عن طريق البريد الإلكتروني ....

إضافة إلى ما ذكر أعلاه؛ فإني على علم بأني أملك حرية الانسحاب من المشاركة في هذه الدراسة في أي وقت دون أن يترتب على انسحابي أدنى ضرر. كما أن المعلومات التي أقدمها ستحاط بالسرية التامة.

التوقيع: ....

التاريخ: ....

أخي المعلم:

للاستفسار أو لمزيد من المعلومات يمكنك الاتصال المباشر بفريق البحث:

- A/Professor Colleen Vale (Colleen.Vale@vu.edu.au)
- Dr Anthony Watt (Anthony.Watt@vu.edu.au)
- Mr Yousef Alhaggass (yousef.alhaggass@live.vu.edu.au)

وفي حال وجود شكوى يمكنك الاتصال بالإدارة المختصة:

The Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (+613) 9919 4148.

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INFORMATION TO PARTICIPANTS

INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled an investigation of the effectiveness of professional learning activities for physics teachers in Saudi Arabia.

This project is being conducted by a student researcher Yousef Alhaggass as part of a PhD study at Victoria University under the supervision of A/Professor Colleen Vale and Dr Anthony Watt from School of Education.

Project explanation

This study will address issues in the professional development of physics teachers in Saudi Arabia by reviewing the quality of their in-service training activities in terms of meeting their training needs and assisting them to teach physics topics. The research will focus on both subject matter knowledge and pedagogical knowledge.

What will I be asked to do?

As a part of this study we would like you to:

- Complete the two questionnaires: teachers' expectations questionnaire and teachers' experience questionnaire
- Participate in interviews if required
- Participate in professional learning activities as coordinated by the Directorate of Education in *Onaizah* city

What will I gain from participating?

The information gathered in this study will be used to support improvements in the current practices of professional learning for physics teachers. The results of this study may also provide the school education domain with additional information of the impact of professional learning on physics teachers' practice and the potential impact on their students' learning.

How will the information I give be used?

Findings of this study will be reported in the student researcher's thesis. It is also possible findings will be presented at conferences and published in professional journals.

What are the potential risks of participating in this project?

It is possible that participants may have concerns or be anxious regarding the sensitivity of the information they provide if they perceive that their responses may reflect a lack of skill associated with their teaching abilities. Participants may also feel that their individual information regarding evaluations of the training programs may be identifiable in the public domain. These risks will be minimised because all data regarding participants will remain confidential by the use of code numbers and pseudonyms rather than names. Participants who experience any issues are able to take a short break from the research activities or if concerns remain are free to withdraw from the study. Participants that have continuing anxiousness as an outcome of their participation will be able to contact the counsellors at the Directorate of Education in *Onaizah* city to discuss any issues causing psychological distress raised by the study' procedures.

How will this project be conducted?

- At the beginning of semester1, 2011, information details of the study, consent form and accessibility of an online version of the first questionnaire on physics teachers' expectations will be emailed to all principals of secondary and intermediate schools in *Onaizah* city. They will receive instructions to forward the whole documents for completion to all physics teachers in their school. Completing and returning the questionnaire is deemed to constitute consent to participate in the research.
- Physics teachers who consent to further involvement will be divided into three roughly equivalent heterogeneous groups based on their demographic characteristics. They will then participate in one of the three types of professional learning activities as follows:

  Group 1: On-the-job training, normal supervision activities (by the supervisor of physics)

  Group 2: Off-the-job training, formal training program (by the chosen trainers at training centre)

  Group 3: On + off-the-job training, both normal supervision activities and formal training program

- At the end of semester1, 2011, the second questionnaire on physics teachers' experience will be mailed to all principals of secondary and intermediate schools in *Onaizah* city, who will receive instructions to forward the instruments for completion to all physics teachers in their school.
- In order to evaluate the effectiveness of teachers' professional learning, the perspective of the following professionals will be sought (interviews); Physics supervisor, trainers, some principals and some physics teachers
- Documents used in the professional learning programs will be used to review the nature of teacher' professional learning activities. These documents will include plans, reports and instructional materials on supervision and training activities

Who is conducting the study?

- A/Professor Colleen Vale (Colleen.Vale@vu.edu.au) +61 3 99194893
- Dr Anthony Watt (Anthony.Watt@vu.edu.au) +61 3 99194119
- Student researcher Mr Yousef Alhaggass (yousef.alhaggass@live.vu.edu.au), (0432616714)

Any queries about your participation in this project may be directed to the Principal Researcher listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (+613) 9919 4148.

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Appendix **I**

	التاريخ		**اليوم**

بطاقة زيارة إشرافية

On-the-job training

حول المعلم:

النصاب التدريسي	**سنوات الخدمة**	**التخصص**	**التأهيل**	**اسم المعلم**

حول المدرسة:

مستوى أداء محضر المختبر	**مستوى تجهيز المختبر**	**عدد الفصول**	**نوع المبنى المدرسي**	**اسم المدرسة**

أداء المعلم:

الأنشطة الإشرافية المقدمة	توفر المهارة	المهارات	الكفايات
		١. اشتقاق الأهداف وصياغتها	تخطيط الدروس
		٢. إستراتيجية تحقيق الأهداف (اختيار أنشطة التعليم-التعلم، اختيار تقنيات التعليم، تحديد زمن الأنشطة .. الخ)	
		٣. التمكن من المادة العلمية	تنفيذ الدروس
		٤. استخدام الطريقة الاستكشافية: الملاحظة	
		٥. استخدام الطريقة الاستكشافية: الفروض	

	٦. استخدام الطريقة الاستكشافية: الاستنتاج		
	٧. استخدام الطريقة الاستكشافية: الاتصال		
	٨. استخدام تقنيات التعليم (سبورة، أجهزة، أدوات، عينات ..الخ)		
	٩. استخدام مصادر المعلومات: مطبوعة وإلكترونية (انترنت، CD.. الخ)		
	١٠. تنظيم موقع التعلم (الفصل، المختبر .. الخ)		
	١١. إدارة سلوك الطلاب		
	١٢. تنظيم أعمال الطلاب		
تقويم الدروس	١٣. استخدام التقويم البنائي		
	١٤. استخدام التقويم الختامي		

ملاحظات عامة

Summary of on-the-job training activities

Schools	Locations	Durations	Supervision activities
متوسطة حطين	Physics laboratory	15 min	Individual meeting about the topics: • cooperative learning • inquiry-based approach • classroom management Providing the teacher with CD contains some learning and teaching materials
متوسطة حفص لتحفيظ القرآن	Principal office	25 min	Individual meeting about the topics: • cooperative learning • inquiry-based approach • mind maps Providing the teacher with CD contains some learning and teaching materials
متوسطة منارات عنيزة الأهلية	Vice Principal office	40 min	Individual meeting about the topic: • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials Demonstration about the topics: • cooperative learning • inquiry-based approach
متوسطة حطين	Principal office	40 min	Individual meeting about the topics: • cooperative learning

			• inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
متوسطة عمرو بن العاص	Principal office	40 min	Individual meeting about the topic: • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
ثانوية عنيزة العامة	Principal office	20 min	Individual meeting about the topic: • using physics laboratory effectively Providing the teacher with CD contains some learning and teaching materials Demonstration about the topic: • inquiry-based approach
ثانوية سعيد بن زيد	Principal office	45 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials

			Demonstration about the topic: • inquiry-based approach
متوسطة فلسطين الرائدة	Principal office	45 min	Individual meeting about the topics: • cooperative learning • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
ثانوية مجمع العليان	Secretary office	25 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
ثانوية مجمع الفاخرية	Vice Principal office	25 min	Individual meeting about the topic: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
متوسطة عبدالله بن رواحة	Principal office	40 min	Individual meeting about the topic: • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
متوسطة ابن تيمية	Principal office	30 min	Individual meeting about the topic: • inquiry-based approach

			Providing the teacher with CD contains some learning and teaching materials
ثانوية مجمع الفاخرية	Vice Principal office	30 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
متوسطة ابن تيمية	Principal office	25 min	Individual meeting about the topics: • cooperative learning • mind maps • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
ثانوية الأمير سلطان	Principal office	30 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials
متوسطة عنيزة الأهلية	Advisor office	45 min	Individual meeting about the topic: • inquiry-based approach Providing the teacher with CD contains

			some learning and teaching materials Demonstration about the topics: • inquiry-based approach • cooperative learning
متوسطة حسان بن ثابت	Physics laboratory	30 min	Individual meeting about the topic: • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials Demonstration about the topics: • inquiry-based approach • cooperative learning
متوسطة فلسطين الرائدة	Principal office	25 min	Individual meeting about the topics: • cooperative learning • inquiry-based approach • using worksheets Providing the teacher with CD contains some learning and teaching materials
ثانوية مجمع العليان	Vice Principal office	20 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Demonstration about the topics:

			• inquiry-based approach
ثانوية سعيد بن زيد	Principal office	40 min	Individual meeting about the topics: • using physics laboratory effectively • inquiry-based approach Providing the teacher with CD contains some learning and teaching materials Demonstration about the topic: • inquiry-based approach
متوسطة أبو هريرة	Principal office	15 min	Individual meeting about the topics: • inquiry-based approach • cooperative learning Providing the teacher with CD contains some learning and teaching materials

Appendix **J**

Questions of the interview

عنوان الدراسة: اختبار فاعلية أنشطة التطوير المهني لمعلمي الفيزياء في محافظة عنيزة، المملكة العربية السعودية

The main question of the interview is:

How do physics teachers, principals, trainer and supervisor evaluate the different modes of in-service training as a tool of professional learning of physics teachers?

Sub-questions:

6. *What similarities and differences exist between on and off-the-job training for physics teachers?*
7. *What are the advantages and disadvantages of using one or both types of training for physics teachers?*
8. *To what extent do physics teachers usually respond to professional learning activities?*
9. *Are there any difficulties physics teachers may face while involved in on or off-the-job training?*
10. *What role should the decision makers in the city of Onaizah play in order to increase the effectiveness of professional learning for physics teachers?*

١. **أنشطة الإشراف التربوي (زيارة مشرف المادة) وبرامج التدريب لمعلمي الفيزياء:**
- ✓ ما أوجه الشبه بينهما؟
- ✓ ما أوجه الاختلاف بينهما؟

٢. **ماذا تتوقع أن يتغيّر لدى معلم الفيزياء (إيجاباً أو سلباً):**
- ✓ بعد زيارة مشرف المادة له في مدرسته؟
- ✓ بعد مشاركته في البرامج التدريبية خارج مدرسته؟

٣. **إخضاع معلم الفيزياء لنوع واحد من الأنشطة خلال العام (إشراف فقط أو تدريب فقط):**
- ✓ ما المزايا؟
- ✓ ما العيوب؟

٤. **إخضاع معلم الفيزياء لكلا النوعين من الأنشطة خلال العام (إشراف + تدريب):**
- ✓ ما المزايا؟
- ✓ ما العيوب؟

٥. **إلى أي مدى يستجيب معلم الفيزياء –عادة– لكل من:**
- ✓ زيارة مشرف المادة له في مدرسته؟
- ✓ برامج التدريب خارج مدرسته؟

٦. **هل هناك أي صعوبات/عوائق يمكن أن تواجه معلم الفيزياء أثناء:**
- ✓ زيارة مشرف المادة له في مدرسته؟
- ✓ مشاركته في برامج التدريب خارج مدرسته؟

٧. **هل تعتقد أن الإمكانات والتسهيلات:**
- ✓ في المدرسة تدعم تنفيذ أنشطة الأشراف؟
- ✓ في مركز التدريب التربوي تدعم تنفيذ أنشطة التدريب؟

٨. **كيف تقيّم فاعلية:**
- ✓ أنشطة الأشراف (زيارة مشرف المادة) من حيث: هدف الزيارة، أسلوبها، مكانها، توقيتها، مدتها؟
- ✓ برامج التدريب من حيث: هدف البرنامج التدريبي، أسلوب تنفيذه، مكانه، توقيته، مدته؟

٩. **كيف تقيّم أثر:**
- ✓ أنشطة الأشراف (زيارة مشرف المادة) على أداء المعلم؟
- ✓ برامج التدريب على أداء المعلم؟

١٠. **كيف يمكن تطوير:**
- ✓ أنشطة الأشراف (زيارة مشرف المادة)؟
- ✓ برامج التدريب؟

١١. **لزيادة فاعلية التطوير المهني لمعلمي الفيزياء؛ما الدور الذي ينبغي أن يلعبه:**
- ✓ صانع القرار في المحافظة (مدير التعليم مثلاً)
- ✓ مدير المدرسة

١٢. **إذن .. ما الأسلوب الأكثر فاعلية لمعلمي الفيزياء كي يتطوروا مهنياً من وجهة نظرك:**
- ✓ أنشطة الأشراف (زيارة مشرف المادة)؟
- ✓ أنشطة التدريب؟
- ✓ أنشطة أخرى؟ فضلاً.. أعط أمثلة.

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Appendix **K**

Descriptive percentage for Chi-square analyses

		GROUP SIZE				*DURATION*				*PERIOD*				*SCHEDULING*				*WITHIN SCHOOL*					*OUTSIDE SCHOOL*				
		As an individual	As peers	As a small group	As a large group	1-4 hours	1-4 days	1-4 weeks	Other	Morning	Afternoon	Evening	Other	At the beginning of semester	At the middle of semester	At the end of semester	At summer holiday	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
AGE	20-29	22.20%	14.80%	37.00%	25.90%	14.80%	59.30%	14.80%	11.10%	88.90%	7.40%	3.70%	0.00%	63.00%	3.70%	22.20%	11.10%	7.40%	7.40%	37.00%	25.90%	22.20%	26.90%	23.10%	34.60%	7.70%	7.70%
	30-39	26.90%	7.70%	26.90%	38.50%	26.90%	50.00%	19.20%	3.80%	88.50%	7.70%	3.80%	0.00%	26.90%	19.20%	23.10%	30.80%	11.50%	15.40%	15.40%	42.30%	15.40%	26.90%	46.20%	15.40%	7.70%	3.80%
	Over 40	22.20%	22.20%	33.30%	22.20%	44.40%	33.30%	11.10%	11.10%	88.90%	0.00%	0.00%	11.10%	55.60%	0.00%	22.20%	22.20%	22.20%	22.20%	22.20%	11.10%	22.20%	33.30%	33.30%	22.20%	11.10%	0.00%
TYPE OF QUALIFICATION	Educational	27.00%	8.10%	35.10%	29.70%	27.00%	48.60%	16.20%	8.10%	94.60%	0.00%	2.70%	2.70%	40.50%	16.20%	24.30%	18.90%	16.20%	13.50%	21.60%	29.70%	18.90%	30.60%	25.00%	27.80%	8.30%	8.30%
	Non-Educational	20.00%	20.00%	28.00%	32.00%	20.00%	56.00%	16.00%	8.00%	80.00%	16.00%	4.00%	0.00%	56.00%	0.00%	20.00%	24.00%	4.00%	12.00%	32.00%	32.00%	20.00%	24.00%	48.00%	20.00%	8.00%	0.00%
TYPE OF INSTITUTION	University	25.60	15.40	30.80	28.20	30.80	51.30	12.80	5.10%	87.20	10.30	2.60%	0.00%	48.70	10.30	20.50	20.50	10.30	12.80	25.60	33.30	17.90	23.10	41.00	23.10	10.30	2.60%

		%	%	%	%	%	%	%		%	%			%	%	%	%	%	%	%	%	%	%	%	%	%	
	Non-University	21.70%	8.70%	34.80%	34.80%	13.00%	52.20%	21.70%	13.00%	91.30%	0.00%	4.30%	4.30%	43.50%	8.70%	26.10%	21.70%	13.00%	13.00%	26.10%	26.10%	21.70%	36.40%	22.70%	27.30%	4.50%	9.10%
MAJOR	Physics	25.70%	8.60%	31.40%	34.30%	17.10%	60.00%	14.30%	8.60%	85.70%	11.40%	2.90%	0.00%	45.70%	5.70%	25.70%	22.90%	8.60%	11.40%	17.10%	37.10%	25.70%	29.40%	44.10%	8.80%	11.80%	5.90%
	Other	22.20%	18.50%	33.30%	25.90%	33.30%	40.70%	18.50%	7.40%	92.60%	0.00%	3.70%	3.70%	48.10%	14.80%	18.50%	18.50%	14.80%	14.80%	37.00%	22.20%	11.10%	25.90%	22.20%	44.40%	3.70%	3.70%
HAVE YOU INVOLVED	No	34.80%	13.00%	34.80%	17.40%	26.10%	47.80%	17.40%	8.70%	91.30%	8.70%	0.00%	0.00%	69.60%	8.70%	8.70%	13.00%	21.70%	8.70%	26.10%	21.70%	21.70%	36.40%	31.80%	18.20%	4.50%	9.10%
	Yes	17.90%	12.80%	30.80%	38.50%	23.10%	53.80%	15.40%	7.70%	87.20%	5.10%	5.10%	2.60%	33.30%	10.30%	30.80%	25.60%	5.10%	15.40%	25.60%	35.90%	17.90%	23.10%	35.90%	28.20%	10.30%	2.60%