The In-Service Training Needs Analysis of Non-Specialist Physics Teachers in Saudi Arabia

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INTRODUCTION

Teachers' professional development is a vital component of any educational system. Therefore, the policy of education in addition to the legislation of civil service in Saudi Arabia confirmed that training of teachers is a continuous process and considered as a part of their jobs both during working hours and out of working hours. The Ten-Year Plan of the Ministry of Education also included the improvement of male and female teachers' quality *(General Directorate of Planning, 2005)*.

Although there is a large number of professional development activities for teachers, students' achievement in physics are not satisfied according to the Department of Educational Supervision (2008). Poor practice of physics education is still dominated in schools and consequently, the desired outcomes of learning physics are not achieved properly.

This situation generated the need to investigate the in-service training needs of non-specialist physics teachers in Saudi Arabia in the area of experimental skills related to contents knowledge of science curriculum as a first step toward meet their training needs and consequently to assist them to teach physics topics in intermediate schools effectively.

LITERATURE REVIEW

As an important field of science, physics is needed to be taught using effective approaches such as investigation activities. However, in spite of the importance of such methods on assisting students to learn physics concepts properly, many teachers are not often use them during physics classes which might occur because of two main reasons. Firstly, the lack qualification of physics teachers plays a vital role in this area as some researchers argued. For instance, in order to evaluate pre-service physics teachers' qualifications a study conducted by Eryilmaz and İlaslan (1999) on fifty pre-service physics teachers from four universities in turkey. The results showed that pre-service physics teachers had not sufficient knowledge on subject matter, teaching methods, measurements and evaluations and classroom management. Consequently, many specialist organization suggested standards to be considered in teachers' preparation programs to assist them to teach physics efficiently. National Science Teachers Association (NSTA) for example recommended 26 standards for Teachers of Physics as following:

> Core Competencies:
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> All teachers of physics should be prepared lead students to understand the unifying concepts required of all teachers of science, and should in addition be prepared to lead students to understand:

1. Energy, work, and power.
2. Motion, major forces, and momentum.
3. Newtonian principles and laws including engineering applications.
4. Conservation of mass, momentum, energy, and charge.
5. Physical properties of matter.
6. Kinetic-molecular motion and atomic models.
7. Radioactivity, nuclear reactors, fission, and fusion.
8. Wave theory, sound, light, the electromagnetic spectrum and optics.
9. Electricity and magnetism

10. Fundamental processes of investigating in physics.
11. Applications of physics in environmental quality and to personal and community health.

Advanced Competencies:

In addition to the core competencies, teachers of physics as a primary field should be prepared to effectively lead students to understand:

12. Thermodynamics and relationships between energy and matter.
13. Nuclear physics including matter-energy duality and reactivity.
14. Angular rotation and momentum, centripetal forces, and vector analysis.
15. Quantum mechanics, space-time relationships, and special relativity.
16. Models of nuclear and subatomic structures and behavior.
17. Light behavior, including wave-particle duality and models.
18. Electrical phenomena including electric fields, vector analysis, energy, potential, capacitance, and inductance.
19. Issues related to physics such as disposal of nuclear waste, light pollution, shielding communication systems and weapons development.
20. Historical development and cosmological perspectives in physics including contributions of significant figures and underrepresented groups, and evolution of theories in physics.
21. How to design, conduct, and report research in physics.
22. Applications of physics and engineering in society, business, industry, and health fields.

Supporting Competencies:

All teachers of physics should be prepared to effectively apply concepts from other sciences and mathematics to the teaching of physics including concepts of:

23. Biology, including organization of life, bioenergetics, biomechanics, and cycles of matter.
24. Chemistry, including organization of matter and energy, electrochemistry, thermodynamics, and bonding.
25. Earth sciences or astronomy related to structure of the universe, energy, and interactions of matter.
26. Mathematical and statistical concepts and skills including statistics and the use of differential equations and calculus.

National Science Teachers Association NSTA (2003)

Unproductive teaching methods however, still widespread in many physics learning situations which might refer to the neglect of such standards in many preparation programs of physics teachers.
Secondly, in many cases, teachers might be required to teach outside their specialist areas and as a result science 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 in the 11-16 age range were run by inappropriately qualified teachers (Straker, 1988). Such problems might occur due to the shortages of qualified teachers or as a result of curriculum reorganization (Millar, 1988). Therefore, learning physics is more likely to be affected negatively when physics classes are run by unqualified teacher who might have different capability to the qualified teacher (Lubben, 1994).
Therefore, more effective professional in-service training programs are required to be available for all physics teachers in general and non-specialists physics teachers in particular in order to help them to teach physics teachers efficiently.

METHODS

The research reviews data from a relevant sample (N=87) of non-specialist physics teachers at intermediate schools in the city of *Onaizah,* Saudi Arabia.
Written survey research was used in the study to determine Teachers' in-service training needs.

As well as open-ended questions, closed questions have been used so that teachers respond through the indication of the extent to which they agreed with specific statements on a Likert-type scale (from 1 to 5, with 1 indicating strong agreement and 5 strong disagreements).

FINDINGS

Teachers who responded to this survey were asked to identify their in-service training needs. The results derived from the statistical analysis of teachers' responses to the questionnaires as following:

		Strongly agree	Agree	Not sure	Disagree	Strongly disagree
1	Using a balance scale is easy	67.8	20.7	5.7	4.6	1.1
2	Electrical devices such as Galvanometers and Generators are difficult to operate	2.3	23.0	18.4	47.1	5.7
3	It is easy to use a gas burner	72.4	19.5	3.4	2.3	1.1
4	A Graduated cylinder is not difficult to use	85.1	9.2	1.1	1.1	2.3
5	Dealing with a Liquid battery is difficult	17.2	17.2	31.0	24.1	8.0
6	A Liquid thermometer is easy to use	59.8	34.5	2.3	2.3	1.1
7	It is complicated to operate a Photometer	9.2	17.2	31.0	28.7	11.5
8	A Spring scale is easy to use	47.1	37.9	6.9	3.4	4.6
9	Operating a timer is a difficult procedure	5.7	3.4	5.7	44.8	40.2
10	It is easy to use a tuning fork	80.5	16.1	1.1	0.0	2.3
11	Analysis of light spectra is easily conducted	31.0	29.9	19.5	14.9	2.3
12	verify of the laws of reflection is very difficult	6.9	17.2	23.0	33.3	19.5
13	density of objects cannot be measured easily	8.0	31.0	9.2	34.5	14.9
14	It is easy to draw longitudinal waves	46.0	42.5	4.6	5.7	0.0
15	It is easy to draw transverse waves	51.7	36.8	5.7	5.7	0.0
16	The illustration of force graphically is complicated	2.3	17.2	14.9	49.4	12.6
17	The drawing of a temperature scale is complicated	34.5	41.4	13.8	8.0	0.0
18	It is easy to measure the volume of gas	28.7	33.3	8.0	17.2	11.5
19	volume measurement of regular objects is simple	67.8	26.4	2.3	3.4	0.0
20	volume measurement of irregular objects is difficult	5.7	13.8	3.4	46.0	31.0

DISCUSSION

The ease found regarding to operation and use of the seven physical devices listed before, is not surprising for the following reasons:

1. The simple design of some devices such as graduated cylinder and tuning fork makes no extraordinary skills required to operate and use, and

2. Various devices such as scales (both balance and spring), liquid thermometer and gas burner are commonly used in daily life and as a result teachers (as everyday people) should have skills needed to use such devices.

However, the finding for the 'use of timer' contradicts a previous finding by Saunders, Dawson, Tripp, Pentecost, Chaloupka, and Saunders (1997) in the ranking of device skills. While the operation of timing devices placed in the first rank in the Saunders, et al. (1997) list, it is categorized as an easy skill for teachers who responded to the *Onaizah* survey. Such a difference might refer to the dissimilar design between the timer type built in 1997 and the timer type used by science teachers in 2008 when the *Onaizah* survey study has been conducted. Therefore, the operation and use of timer does not represent a training need for non-specialist physics teachers who participated in this study.
4.2.2.2 In addition, uncertainties about two areas include dealing with liquid battery (31%) and operating the photometer (31%) corresponds with the findings of the study conducted by Millar (1988). This result can be attributed to the poor facilities of science laboratories in some schools. Such poor facilities may include the following:

- Absence of devices and equipment
- Faulty devices and equipment

This has been supported by open comments in the survey instrument such as:
"Some devices are absent in my school laboratory"
"There is no timer in my school laboratory"
"Some equipment is faulty. As a result, I am not sure if they are easy or difficult to use"
"Some devices such as photometer are not present in my school laboratory"
"It is difficult to show my students the different kinds of waves because of the lack of appropriate springs"

Instructional practices also, as well as supervision policy might play very important roles in this area. If we consider that:

1. Teachers do not conduct experimental activities (including the use of devices in science classes) as declared by some respondents:
   "I did not use some devices before and I am not sure therefore, if they are easy or difficult to use" and "I did not teach some topics"
   That is perhaps due to the lack of time for both preparation and implementation. A teacher in Saudi Arabia is likely to be teaching for (4-5) hours per day, as well as monitoring student's behaviour during recess and lunch time (Department of educational supervision, 2008: 17). This may lead to fatigue.
2. Teachers use devices but they were not sure if they use them properly or not as stated by some respondents and that might refer to the lack of the feedback by their educational supervisors of sciences due to the low number of official visits (normally: two visits a year)

The difficulty found in dealing with the liquid battery for female teachers compared with male was quite pronounced. Looking at broad social norms, this may be due to the lack of female experience with this technology. Because women are not permitted to drive in Saudi Arabian context, males in general may have frequently opportunities to handle liquid battery as a part of the competency required for driving and maintaining their cars, whereas women are perhaps more familiar with the use of non-liquid (dry cell) battery used within domestic environment. Therefore, although female teachers may need to learn more about dealing with the liquid battery (60%) in comparison with male teachers (40%), this skill represents a training need for all non-specialist physics teachers participated in this study.
The confusion expressed in the data on the operation and use of electrical devices such as Galvanometers and Generators represents a reasonably predictable result, due to the difference in

teachers' background. Although some teachers did not show any problem to operate electrical devices, others (25.3%) stated the difficulty of devices operation and use supporting the studies findings of many researchers such as Millar (1988) and Osborne and Freeman (1989).

Whilst these studies were conducted in the 1980s, there is a little evidence to contradict them in the year 2009. In addition, it is expected to find that (45.5%) of teachers specialist in biology declared the difficulty in the area of operating electrical devices in comparison with the rest of specialists in other fields. Such a result might refer to the nature of syllables of biology pre-service program which lack adequate practical classes including the use of electrical devices (Al Ketheri, Sallam and Al Huthaifi 1990). Therefore, the ability of operating electrical devices represents a training need for some non-specialist physics teachers participated in this study.

The ease found regarding performance of the eight practical process listed, is not astonishing n itself, due to the nature of these procedures. For instance, only basic waves both longitudinal and transverse should be taught in intermediate schools according to science curriculum of this stage (General directorate of curriculum, 2008) and as a result, such simple shapes are easy to be drawn by non-specialist physics teachers. Similarly, this hold true for force graphic and temperature scale. In addition, volume of gas, in the current science teaching approach, is required to be measured using uncomplicated methods (General directorate of curriculum, 2008). Measurement the volume of regular objects also, does not require any particular skill to be accomplished excepting the use of a normal ruler, a skill which should be possessed by any science teacher.

However, the finding of measurement the volume of irregular objects contradicted the statement of Hawaii's Space Grant College (1996) who affirmed that defining volumes of irregular objects cannot be easily measured without using water displacement techniques. Such a difference might refer to the sort of irregular objects used in intermediate science classes. These are usually uncomplicated items and because the majority of respondents stated the ease of use of graduated cylinder (which can be used for water displacement techniques) measurement the volume of irregular objects therefore, is not seen as a critical training need for non-specialist physics teachers who participated in this study.

In addition, uncertainties about two areas, namely the analysis of light spectra (19.5%) and verifying of the laws of reflection (23.0%), can occur as a result of missing these experimental activities during science classes due to many reasons: Firstly, poor facilities of science laboratory such as:

1. Absence of optical equipments, and
2. Faulty optical equipments.

Secondly, poor instructional practices such as:

1. Teachers may not conduct experimental activities due to the lack of time for both preparation and implementation.
2. Due to the ease of such experimental activities, teacher may left conduct them by their students as homework.
3. Due to the clear results of such experimental activities, teacher may explain these results theoretically instead of proving them practically.

Thirdly, the lack of teachers' practical skills which refer to:

1. The nature of pre-service program as occur usually with biology teachers' program which lack to sufficient practical classes related to physics topics including analysis of light spectra and verifying of the laws of reflection.
2. The poor of in-service training programs for non-specialist physics teachers in the area of physics topics

The confusion found in the measurement of objects' density represents a relatively predictable result due to the difference in teacher backgrounds. Although some teachers (39%) did not show any problem to measure objects' density, others (49.4%) stated the difficulty in the area, this supports the findings of other researchers such as Millar (1988) and Choi, Woo and Lee (2008). It is interesting that this finding appears consistently in two studies with such a wide time gap between them. It was not considered unusual to find that (40.5%) and (26.2%) of teachers specialist in biology and chemistry respectively declared the difficulty in the area of measurement of objects' density which might refer to the nature of pre-service program of biology and chemistry teachers which lack to adequate practical classes related to the area of physics topics according to Al Ketheri, Sallam and Al Huthaifi (1990). Therefore, measuring the densities of objects represents a training need for the non-specialist physics teachers participated in the Onaizah study.

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