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Saudi Arabian Science Teachers and Supervisors' Views of Professional Development Needs

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Abstract

Problem Statement: Teacher professional development is a prominent feature in the educational landscapes of both developed and developing countries. Teacher development can be conceptualised as a mechanism for driving change in educational systems and/or as a strategy for empowering teachers to improve their professional knowledge and pedagogy. To ensure effective teacher professional development, Science teachers need to be more in control of their own PD. More studies of teacher professional needs have been carried out in Western societies rather than Arab societies. In addition, supervisors' voices in regard to the PD of teachers have not been emphasised by international or national studies. Changing the research contexts might introduce a new understanding of the priority of professional needs.

Purpose of the Study: This study aimed to identify and explore science teachers' needs for both pedagogical and content knowledge as a first step toward making decisions and recommendations about the elements of

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CPD programme(s) required for science teachers. The purpose of the study was to determine the professional development needs perceived by science teachers and their supervisors in Saudi Arabia.

Methods: The main instrument used was a questionnaire. The validity and reliability of the instrument were systematically established through relevant test procedures. The questionnaire seeks feedback on the main aspects of science teachers' needs, including generic pedagogical knowledge and skills, knowledge and skills in science subjects, managing and delivering science instruction, diagnosing students' needs, evaluating students' work, planning science instruction, administering the use of facilities and equipment, integrating multimedia technology, and informal science learning. Additionally, the questionnaire covers the key science subject domains in which science teachers might need professional development (PD).

Findings and Results: This study argues that science teachers' voices concerning their PD needs are the key guide for their CPD. While science teachers may share a number of perceived needs with science supervisors, teachers have distinct pedagogical and content knowledge needs that may differ according to individual interests.

Suggestions and Recommendations: Attention should be given to ensure that individual teachers' differing needs are met because providing the same programme for all teachers may not meet the needs of them all. Science teachers, supervisors, policy makers, and in-service and pre-service training planners need to work together to consider the recommendations that have been identified in the teachers' PD research.

Keywords: Teachers' Professional Development (PD) Needs - Continuing Professional Development (CPD) - Teacher Education.

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Introduction

Teacher professional development is a prominent feature in the educational landscapes of both developed and developing countries. Teacher development can be conceptualised as a mechanism for driving change in educational systems and/or as a strategy for empowering individuals and teams to improve their professional knowledge and pedagogy (Day & Sachs, 2004). Dillon (2010) argues that teacher development can either play a critical role in meeting teachers' needs and wants, or it can frustrate teachers and keep them from reaching their full potential. He also argues that teachers might both want and need PD. In contrast, someone in a different profession, such as an inspector or a line manager, might identify that an employee has a need that they themselves are unaware of, such as a need for training in different questioning techniques. Nevertheless, for the purposes of this paper, we will explore the difference between the needs required for teaching science effectively, represented by the inspectors' opinions, and the needs of teachers.

Professional development is an intensive, ongoing, and systemic process that aims to enhance teaching, learning, and school environments (Elmore, 2002; Fenstermacher & Berliner, 1985). Rubba (1981) devoted his studies to determining science teachers' in-service needs and concluded that while science teachers might share a number of perceived needs, they also have distinct needs depending on the science discipline taught and possibly the geographic region. In this study, we adopt Hewson's (2007) definition of teacher PD in science:

> First, it [professional development] is about teachers and their teaching activities involving curriculum, instruction and assessment. Second, it is about teachers being professional who have an extensive knowledge base of conceptions, beliefs, and practices that they bring to bear on the unique complexities of their daily world lives, a knowledge base that is shared within a professional community. Third, it is about teachers as adult learners who have an interest in and control over the continuing development of their professional practice throughout their working lives. Finally, it is about science and the epistemologies, methodologies, and bodies of knowledge about the natural world that give scientific disciplines their distinctive character. (p.1181)

From the professional development point of view, Borko and Putnam (1995) argue that current educational reform recommends a shift toward a student-centred paradigm. This entails a substantial departure in teacher approach from a traditional transmission of knowledge to a cognitive and social construction of knowledge. David Hargreaves (1994) identified the shifts in culture, values, and practices of teachers in a knowledge society:

> At its core, the new professionalism involves a movement away from teacher's traditional professional authority and autonomy towards new forms of relationships with colleagues, with students and with parents. These relationships are becoming closer as well as more intense and collaborative, involving more explicit negotiation of roles and responsibilities. (p. 424)

The tradition of 'in-service days' as the norm in PD has been criticized as inadequate and inappropriate in the context of current educational reform efforts; it has also been criticized as being out of step with current research about teacher learning (Darling-Hammond & McLaughlin, 1995). One possible reason for the unsatisfactory results of in-service teacher training might be that the objectives of programmes were not congruent with teachers' personal and classroom needs. It might be reasonable to better understand the target audience before prescribing any intervention. Thus, to simply impose a training programme on teachers without considering their needs makes little sense (Noh, Cha, Kang, & Scharmann, 2004). Baird and Rowsey (1989) also highlight teachers' complaints that much time spent during in-service programmes and activities was wasted when such programmes did not meet their respective classroom needs. Loughran and Invarson (1993) argue that it is important that as a profession we are able to articulate what science teachers need to know and be able to do.

Science teachers need to be more in control of their own PD. They need real opportunities to participate in meaningful PD that meets their needs and influences their classroom practice. Therefore, in developing a strategy for PD, it is important to talk to science teachers to ascertain their views on what they want in the future. The concept of need has diverse interpretations. In the literature, 'need' is used variously to mean a discrepancy, a recognized problem, the requirement for more services, and the wants of people (Packwood & Whitaker, 1988; Stufflebeam, Mc Cormick, Bronkerhoff, & Nelson, 1985). For this study, need is defined as the wants or preferences of an individual or a group of people. Need in this context is seen as a want (which implies interest or motivation) felt by an individual or group to eliminate a lack (Queeney, 1995; Stufflebeam et al., 1985).

Science teachers in Saudi Arabia, as in many other parts of the world, are considered as among the nation's greatest assets. As such, teachers must be able to play their roles and fulfil their responsibilities to their utmost capabilities. To be able to do so, teachers must be well prepared for the profession, but they must also maintain and improve their skills through lifelong career learning (Osman, Halim, & Meerah, 2006). To this end, Baird and Rowsey (1989), based on their survey of secondary school science teachers' needs, conclude that without accurate data on teachers' needs, planning is not only difficult, but results generated are likely to be disappointing to both teachers and those who offer science teacher education.

The Rationale and Purpose of the Study

A major shift in the development of science education in Saudi Arabia occurred in the mid-1970s when science education experts at the American University in Beirut developed the science curricula. With the wide implementation of these curricula from the mid-1970s until recently, Saudi science educators increasingly expressed concerns that these curricula did not reflect the current and future social, cultural, and economic needs of Saudi society and were not serving the needs of all students (Alabdulkareem, 2004; Al-Ghanem, 1999). As a result of this type of critique and of the pressure created by the emergence of new trends in science education such as science education standards and scientific literacy (AAAS, 1993; NCATE, 1998), as well as the low achievement of Saudi Arabian students recorded in Trends in International Mathematics and Science Study–2003 (Mullis, Martin, Gonzalez, & Chrostowski, 2004 , 2004b; Mullis, Martin, & Foy, 2008), the goals for science teacher education in Saudi Arabia have been reshaped to better reflect the nature and goals of inquiry-oriented instruction in science - a reform of science education that began in 2003. As part of such reform, the ministry of education translated and modified the McGraw-Hill series for the preparation of the new science curricula through a project called 'Mathematics and Natural Sciences Project' (Obikan for Research and Development, 2010).

These new curricula are being implemented gradually and will cover all school grades by 2013. However, effective implementation cannot be achieved unless science teachers are prepared and equipped with the skills and knowledge required to teach these new curricula (Alshamrani, 2010; Mansour, 2010; Van Driel, Beijaard, & Verloop, 2001). Therefore, any mature reform of science education should emphasise science teacher professional development programmes (Garet, Porter, Desimone, Birman, & Yoon, 2001). These programmes should help teachers develop an in-depth knowledge of their disciplines as well as pedagogical content knowledge and skills (Mansour, 2010). Consequently, the professional development of science teachers is widely recognised as a national priority (Obikan for Research and Development, 2010). In this sense, Alshamrani (2010) conducted a study trying to identify science education research priorities in Saudi Arabia. Alshamrani 's study stressed that science teacher PD is the main research priority in the field of science education in Saudi Arabia and aims to effectively put the reform of the science curricula into action in the science classroom. More studies of teacher professional needs have been carried out in Western societies than Arab societies (Loughran & Invarson, 1993; Van Driel et al., 2001). Changing the research contexts might introduce a new understanding of the priority of professional needs. This research might also explain the unique requirements of professional needs for teachers in particular settings to teach new curricula in different settings. In addition, we explore the differences between the needs required for teaching science effectively as expressed by the opinions of supervisors and teachers. This focus of research on supervisors' voices in regard to the PD of teachers has not been emphasised by international or national studies.

Accordingly, this study aimed to identify and explore science teachers' needs in both content and pedagogical knowledge and skills as a first step toward making decisions and recommendations about the elements of CPD programme(s) required for science teachers.

The purpose of the study was to determine the professional development needs perceived by science teachers and their supervisors in Saudi Arabia. The following research questions were used:

1. What professional development needs in science content knowledge are identified by science teachers and their supervisors in Saudi Arabia?
2. What professional development needs in pedagogical knowledge and skills are identified by science teachers and their supervisors in Saudi Arabia?
3. Is there a difference among teachers' professional development needs related to variables such as gender, teaching experience, and school level (elementary, intermediate, high school)?

Method

Sample

The population of this study included 2701 Saudi science teachers and 66 science teacher supervisors located in four educational districts in different parts of Saudi Arabia (Jeddah, Alkarj, Alzulfi, and Almeqwah districts). These districts were chosen because they were part of the partnership programme with the Centre of Science and Mathematics Education, which is the sponsor for this study. All science teachers in these districts were considered to be the population and the sample of this study; a contact person was hired in each educational district to distribute the questionnaires to all science teachers and supervisors in each educational district.

Science teachers: A total of 499 out of a possible 2701 Saudi science teachers and 61 out of 66 science teacher supervisors responded to the questionnaire. For science teachers, the respondents included both genders: 209 (42%) were women and 290 (58%) were men. However, this does not mean that this is the case throughout all the schools in Saudi Arabia. The majority of the questionnaire sample, 411 (82%), held qualifications in education, and the other 88 (18%) held qualifications in pure science but not in education. Respondents were divided into five groups according to their years of experience, as follows: less than 5 years' experience, 31.7%; 6 – 10 years' experience, 21.6%; 11–15 years, 21.6%; 16–20 years, 12.8%; and more than 21 years, 9%. Concerning subject specialism, it was found that the respondents were drawn from the following disciplines: biology 33.3%, physics 16.6%, chemistry 16.4%, earth sciences 2.0, and other subjects (those who teach science for elementary students, but are not specialized in science) 27.1%. In terms of qualifications, the majority of the sample had a bachelor's degree (89.2 %), 8.0% had a diploma in education, and 1.0% had a master's degree in education.

Science supervisors: In the context of Saudi Arabia, each teacher is assigned a science supervisor; however, each supervisor is in charge of tens of science teachers based on the number of science teachers in the educational administration. The role of the supervisor is to monitor the teacher through regular visits, evaluate teacher performance, and provide feedback. The supervisor is also responsible for organizing seminars and peer observations among the teachers whom he or she supervises.

In the study, 61 science teacher supervisors included both genders: 48 (78.7%) were female and 13 (21.3%) were male. The majority of the science teacher supervisors, 54 (88%), were certified in education, but 7 (12%) were not. In terms of teaching experience, science teacher supervisors were divided into five experience groupings: less than five years experience, 8.2%; 6–10 years experience, 15.5%; 11–15 years, 16.4%; 16–20 years, 26.2%; and more than 21 years, 34.4%. Concerning their content discipline, they were specialized as follows: biology 41%, physics 26.2%, chemistry 29.5%, and other subjects 3.3 %. In terms of qualifications, the majority of science teacher supervisors had a diploma in education (96.7%).

Research instrument and procedure

To collect the data, the researchers developed a questionnaire based both on their experiences and on a review of a related study (Chval, Abell, Pareje, Musikul, & Ritzka, 2008). The initial version consisted of 39 items related to two domains: (1)

science content knowledge needs and (2) pedagogical knowledge and skills needs. To validate the survey, ten science educators reviewed the initial version and provided their comments and suggestions, and then the survey was modified according to their feedback. Their feedback included linguistic suggestions, deleting two items and adding three items. The final version of the survey includes 40 items (21 items in the science content knowledge domain and 19 items in the pedagogical knowledge and skills domain).

Validity and reliability

A pilot study with 50 science teachers was used to determine the reliability of the questionnaire. Cronbach's coefficient alpha was used to calculate the internal consistency coefficients of the questionnaire. Results of the reliability analysis showed that the items in the instrument had a satisfactory discriminating power. The reliability coefficient alpha obtained for the whole instrument was 0.97; however, the coefficient alpha for its two domains were 0.98 and 0.97, respectively, for the science content knowledge domain and the pedagogical knowledge and skill domain.

Data Analysis

Statistical data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS15.0). Descriptive statistics (frequencies, means, and standard deviations) were used to analyze data. For data analysis of the need items, mean values of the responses for 40 items were calculated. Ranking of means were used to determine the most and least pressing of the perceived needs of teachers. Before carrying out the parametric statistical tests, preliminary analyses were conducted in several steps, including missing data analysis and the identification of outliers. Also, a normality test was carried out to decide on the type of statistical analysis that fits the data, 'parametric' or 'non-parametric'.

Results

Perceived Professional Development Needs

The teachers were asked about their professional development needs concerning "needs in science content knowledge" and "needs in pedagogical knowledge and skills".

The needs in science content knowledge perceived by teachers

The level of needs for each science domain as perceived by the 499 Saudi Arabian science teachers who participated in this study was studied. More than 40% of the science teachers marked 'needed' and 'greatly needed' in all 19 items that were included in the science domain dimension.

The highest percentages of the 'needed' and 'greatly needed' scales are seen in the following domains: nature of science and scientific inquiry and modern physics (each 52%). These are followed by genetics and evolution (51%); chemical reactions (50%); Earth properties and physical processes, energy and chemical changes, and electricity and magnetism (each at 49%); energy, forces and motion, and structure and function of human systems (each at 48%). In climate and weather, only 17% of the science teachers expressed a great need for this discipline, while 26% of them expressed a moderate need.

The science teachers who participated in this study perceived that their needs in science subjects were mainly related to physics topics (e.g., modern physics, electricity and magnetism). This result might be explained by the fact that one-third of the participants in this study are specialists in biology.

The results indicate that the highest percentages of the 'needed' and 'greatly needed' scales are found in the following categories: teaching science through field trips and scientific visits (57%). These are followed by teaching science for gifted students (56%); teaching science for special needs students (56%); developing creative thinking among students (55%); using labs in teaching science, developing science concepts among students, and using technology in the science classrooms (each at 53%); the use of scientific inquiry (52%); problem solving in science (50%); teaching theory based on constructivism (49%); using concept mapping (48%); and assessment skills, e.g., assessing students' learning, (44%). Finally, the least needed skills are in classroom management (43%), connecting science to students' real lives (43%), and questioning and classroom discussion techniques (43%). Even though these last skills are perceived as the least needed, a very high percentage of respondents expressed a strong need for them.

The Needs In Science Domains Perceived By Teachers And Supervisors

Regarding the comparisons between the needs perceived by science teachers and those perceived by their supervisors, Tables 1 and 2 clearly show that there was a great gap and inconsistency between teachers and their supervisors.

Comparisons between teachers' and their supervisors' perceptions of needs in the science domains

Table 1 summarizes the perceived needs of science teachers and their supervisors for professional development in various science subjects. As shown in Table 1, the ten top-ranked needs perceived by teachers were the following, in order according to their means: nature of science and scientific inquiry (3.53), modern physics and structure and function of human systems (3.46), genetics and evolution (3.45), electricity and magnetism (3.43), earth properties and physical processes (3.42), chemical reactions (3.41), forces and motion (3.41), energy (3.40), and energy and chemical changes (3.39). In contrast, the ten top needs perceived by science supervisors were the following; the solar system and the universe (4.51), nature of science and scientific inquiry (4.41), forces and motion (4.25), plants (4.15), climate and weather (4.02), structure and properties of matter (3.98), genetics and evolution (3.94), chemical reactions (3.89), earth properties and physical processes in modern physics (3.80), and energy and chemical changes (3.78).

Six out of the top ten perceived needs were the same for both science teachers and their supervisors. These six needs are genetics and evolution, energy, forces and motion, energy and chemical changes, chemical reactions, Earth properties and physical processes, and the nature of science and scientific inquiry. However, as shown in Table 1, the priority among these six perceived needs was different for science teachers and science supervisors, except for energy and chemical changes, which was ranked 10th by both science teachers and science supervisors.

Table 1
Comparison of The Needs for Science Subject Knowledge Perceived by Science Teachers and by Supervisors

No	Items	Science teachers		Science supervisors		t	df	Sig. (2-tailed)
		M	SD	M	SD			
1	Structure and function of human systems (biology)	3.46 (3)	1.088	3.75	1.004	1.673	546	.095
2	Epidemics: Causes and ways of prevention (biology)	3.38	1.115	3.48	1.047	.476	548	.634
3	Living things (biology)	3.33	1.103	3.49	.984	.772	545	.440
4	Plants (biology)	3.32	1.145	4.15 (4)	.951	4.954	541	.000
5	Genetics and evolution (biology)	3.45 (4)	1.159	3.94 (7)	.826	3.188	551	.002
6	Electricity and magnetism (physics)	3.44 (5)	1.102	3.73	1.056	1.910	545	.057
7	Energy (physics)	3.40 (9)	1.088	3.47	1.112	1.081	549	.280
8	Structure and properties of matter (chemistry)	3.32	1.101	3.98 (6)	.975	4.130	549	.000
9	Forces and motion (physics)	3.41 (8)	1.098	4.25(3)	.888	5.571	549	.000
10	Modern physics (physics)	3.47 (2)	1.149	3.77	.890	1.945	547	.052
11	Light and sound (physics)	3.40	1.137	3.72	.951	2.043	549	.042
12	Energy and chemical changes (chemistry)	3.39 (10)	1.120	3.78(10)	.937	2.359	550	.019
13	Chemical reactions (chemistry)	3.41 (7)	1.165	3.89 (8)	.958	-2.959	551	.003
14	Structure of matter and chemical bonding (chemistry)	3.36	1.125	3.46	1.104	.562	545	.574
15	Environment and the effect of environmental pollution (biology)	3.36	1.127	3.75	.943	2.483	548	.013
16	Climate and weather (Earth science)	3.30	1.132	4.02 (5)	.956	4.514	541	.000
17	Earth properties and physical processes (Earth science)	3.42 (6)	1.115	3.80 (9)	.953	2.423	544	.016
18	The solar system and the universe (Earth science)	3.37	1.141	4.51 (1)	.698	7.468	547	.000
19	Nature of science and scientific enquiry	3.53 (1)	1.138	4.41 (2)	.761	5.732	550	.000

Note. Note. M= means, SD=Standard Deviation, t=T-test, df=degree of freedom; The number in parentheses represents the priority of the perceived needs

These findings may raise important questions about the validity of the science supervisors' voice regarding the CPD required for teachers. They may also raise a question about the science supervisors' awareness of the science teachers' needs.

An independent sample t-test was conducted to see whether there was a difference between teachers and supervisors in their perceptions of teachers' CPD needs in science domains. As shown in Table 1, there was only a statistically significant difference on three subject knowledge questions: living things, energy and structure of matter, and chemical bonding. The means of supervisors' responses in these three domains (3.33, 3.47, and 3.46, respectively) were higher than those of teachers' perceived needs in the same topics (3.33, 3.40, and 3.36, respectively). This might be attributed to the fact that the supervisors do not hold sufficient knowledge about teachers' needs concerning the science domains

Comparisons of responses of teachers and their supervisors to pedagogical knowledge and skills

Table 2 summarizes the perceived needs of science teachers and science supervisors for professional development on pedagogical knowledge and skills. As shown in Table 2, the ten top-ranked needs perceived by teachers were the following: teaching science through field trips and scientific visits (3.68), developing creative thinking among students(3.66), teaching science for gifted students (3.64), developing the science concept among students (3.60), associating technology with teaching (3.57), planning for teaching (3.55), scientific enquiry instruction based in science (3.54), teaching science for special needs students (3.52), instruction based problem solving in science (3.51), and using concept mapping (3.50). Alternately, the ten top needs perceived by science supervisors were the following: teaching science through field trips and scientific visits (4.74), connecting science to students' real life (4.70), scientific enquiry instruction based in science (4.69), developing the science concept among students (4.68), content analysis (4.60), teaching science for gifted students (4.56), developing creative thinking among students (4.52), using labs in teaching science (4.46), questioning and classroom discussion technique (4.42), and classroom management skills (4.38).

Six of the top ten perceived needs were the same for both science teachers and supervisors. The six needs are the following: using labs in teaching science, scientific enquiry instruction based in science, teaching science through field trips and scientific visits, developing creative thinking among students, developing science concepts among students, and teaching science for gifted students. However, as shown in Table 2, the priority among these six perceived needs by both science teachers and science supervisors was different except for teaching science through field trips and scientific visits, which was ranked 1st by both science teachers and science supervisors.

Table 2

The needs for professional development of pedagogical knowledge and skills as perceived by in-service science teachers and supervisors

No	Items	Science teachers		Science supervisors		t	df	Sig. (2-tailed)
		M	SD	M	SD			
1	Teaching theory, such as constructivism, behaviourism	3.50 (10)	1.038	4.28	.878	5.756	549	.000
2	Classroom management skills	3.28	1.155	4.38 (10)	.840	7.271	554	.000
3	Associating technology with teaching	3.57 (5)	1.122	4.36	.817	5.497	547	.000
4	Using labs in teaching science	3.55 (6)	1.189	4.46 (8)	.773	5.823	549	.000
5	Assessing students' learning	3.33	1.127	4.16	.970	5.520	548	.000
6	Planning for teaching	3.28	1.148	4.13	.903	5.748	551	.000
7	Connecting science to students' real lives	3.32	1.207	4.70 (2)	.691	8.688	550	.000
8	Scientific enquiry instruction based in science	3.54 (7)	1.113	4.69 (3)	.564	7.794	547	.000
9	Instruction based on problem solving in science	3.51 (9)	1.091	4.05	.884	3.894	549	.000
10	Using concept mapping	3.45	1.102	4.16	.840	5.072	544	.000
11	How to teach specific science topics, such as magnetism or writing chemistry equations	3.38	1.099	4.30	.955	6.138	554	.000
12	Questioning and classroom discussion techniques	3.32	1.176	4.42 (9)	.747	6.968	553	.000
13	Teaching science through field trips and scientific visits	3.68 (1)	1.111	4.74 (1)	.480	7.230	547	.000
14	Developing creative thinking among students	3.66 (2)	1.041	4.52 (7)	.748	6.066	546	.000
15	Developing science concepts among students	3.60 (4)	1.018	4.68 (4)	.596	7.873	541	.000
16	Teaching science for gifted students	3.64 (3)	1.074	4.56(6)	.643	6.771	540	.000
17	Teaching science for special needs students	3.52 (8)	1.183	3.98	.904	2.904	545	.004
18	Content analysis	3.42	1.040	4.60 (5)	.588	8.634	544	.000
19	Teaching science using learning cycles	3.49	1.052	3.95	.825	3.256	542	.001
20	Connecting science to other courses	3.41	1.093	4.00	.876	3.968	540	.000
21	Connecting science topics to each other	3.44	1.110	4.28	.878	389	484	.697

Note. M= means, SD=Standard Deviation, t=T-test, df=degree of freedom; The number in parentheses represents the priority of the perceived need

An independent sample t-test was conducted to see whether there was a difference between teachers and the supervisors in terms of teachers' CPD needs for pedagogical knowledge and skills. As shown in Table 5 there was a statistically significant difference between teachers' and supervisors responses, except that there was no significant difference on one item - connecting science topics to each other. The mean of supervisors' responses in these three domains (M = 4.28) was higher than that of teachers' perceived needs for this skill (M = 3.44). This can be explained by the possibility that the supervisors may not have sufficient knowledge about teachers' needs concerning science topics.

Teachers' needs compared with their backgrounds

The teacher independent variables selected in this study were teaching experience, school level, gender, and specialism. The results indicated that there were no statistically significant differences among teachers. This means that teachers' developmental needs are the same regardless of their teaching experience, school level, gender, and specialism. Also, this reflects the significance of the need for developing CPD for teachers.

Discussion and Conclusion

The findings of the study indicate that there was no significant difference among primary, middle and secondary science teachers. All of the groups expressed a strong need for PD in both science content knowledge needs and pedagogical knowledge and skills needs. This finding concurs with the findings of a number of researchers who have examined the perceived needs of secondary level science teachers (e.g., Chval et al., 2008; Osman, 2006; Rubba1981; Stronck, 1974).

The majority of the teachers in the current study expressed a great need for academic and pedagogical training. The findings reflected the teachers' perception that they lack some basic knowledge (e.g., chemical bonding, structure and properties of matter, forces and motion, and the structure and function of human systems) and skills (e.g., planning for teaching, using labs in teaching science, and scientific enquiry instruction in science) to best teach science. These findings have raised questions regarding the roles of teacher educators (those who train teachers) in developing teachers' CPD, as well as questions about teacher educators' roles in meeting teachers' professional needs over many years.

The results from this study indicate that there is a mismatch between teachers' perceptions of their own CPD needs and their supervisors' perceptions. While teachers are particularly concerned with the quality of science education, other stakeholders may have different priorities, such as science supervisors, as revealed in this study. These findings have raised questions regarding the roles of teacher educators (those who train teachers) in developing teachers' CPD, as well as questions about teacher educators' roles in meeting teachers' professional needs over many years. In this sense, the findings of the current study concur with Park Rogers et al.'s (2006) study that it is the difference in beliefs among the stakeholders of professional development (PD) that has contributed to the gap between ideal and actual PD practice. A balance is required that addresses the concerns of everyone involved by reconciling competing interests. In this sense, these findings raise concerns over the different views about PD among both teachers on one hand and their supervisors on the other hand. These findings may also raise questions about the science supervisors' awareness of the science teachers' needs or the communication between the teachers and supervisors about the professional needs. Additionally, teachers' voices should be heard and taken into account concerning their perceived professional needs and the practical problems they face when implementing new ideas in the classrooms. Therefore science teachers, supervisors, policy makers, and in-service and pre-service training planners need to work together to consider the recommendations that have been identified in the teachers' PD research (Hewson, 2007; Mansour, 2008; Van Driel, 2001).

The findings from this study could have implications for science teachers' CPD. When planning in-service programmes, consideration should be given to the areas where needs are the greatest. Attention should be given to ensure that individual teachers' differing needs are met because providing the same programme for all teachers may not meet the needs of them all. Often CPD initiatives for the PD of science teachers appear to treat teachers as a homogeneous group rather than as diverse individuals. In the end, CPD is all about people, and it's as simple and as complex as that. Therefore, when planning CPD for teachers, we need to consider teachers' beliefs, experiences, and expectations about their CPD. Teachers do not enter into CPD as empty vessels. They bring existing experiences, practices, perspectives, insights and, most usually, anxieties about the highly complex nature of their work (Mansour, 2013). They come with differences, disagreements, preconceptions, uncertainties, and missions. It is necessary to repeat the needs assessment from time to time so as to modify and adapt the existing design of the CPD programmes to meet the emerging and changing needs of teachers. The findings of this study also provide directions for further research related to the perceived needs of science teachers. Qualitative research into needs should also be conducted for all pre-service and in-service science teachers. Also, further research is needed into the role, views, and practice of supervisors and their epistemological and pedagogical views of science and science education.

Conclusion

The findings from this study elucidate a significant characteristic of Saudi Arabian science teachers' needs. While science teachers may share a number of perceived needs with science supervisors, they also have distinct pedagogical needs (e.g. teaching science for special needs students and instruction based on problem-solving in science) that possibly vary according to individual interests. That difference reinforces the necessity for those who direct science teacher in-service programmes to attend to the primary axiom of in-service education: the needs of every science teacher who will participate in an in-service programme must be assessed prior to planning and instituting the activities (Rubba, 1981).

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