Effectiveness of a Proposed Training Programme for Chemistry Teachers in Light of the Requirements of the Developed Chemistry Curricula at Secondary Schools in Saudi Arabia

By:

Dr. Fayadh Hamed Fayadh Alanazi
Assistant Professor, Aljouf University
Saudi Arabia

Effectiveness of a Proposed Training Programme for Chemistry Teachers in Light of the Requirements of the Developed Chemistry Curricula at Secondary Schools in Saudi Arabia

* Dr. Fayadh Hamed Fayadh Alanazi

1. Introduction:

A number of countries in the world are applying changes to their educational curricula (Ha et al., 2008). Gulf Arab states are no exception in the need to make amendments to their science curriculum across all schooling stages, whether primary, intermediate or secondary. As of 2008, the KSA's Ministry of Education has presented a completely different science and math curriculum in line with the work completed by the Obeikan Research Development Company. To some extent, this new curriculum may be recognised as having a foundation centred on science textbooks and the translation of such, as presented by McGraw-Hill, a known publishing organisation based in the USA. The agreement of Obeikan Education in line with McGraw-Hill facilitates the former in translating, localising and accordingly selling the curricula in the science and math fields of McGraw-Hill, spanning "grades K–12, to the Ministries of Education across the Arabic Region" (Obeikan, 2012, cited by Alghamdi & Al-Salouli, 2013, p.504). Interest in the development of science and math curricula is recognised as predominantly owing to the importance of significant articles printed in relation to the creation and development of modern societies and the need of Saudi Arabia to assist in completing a transition from an oil economy to a

* **Dr. Fayadh Hamed Fayadh Alanazi:** Assistant Professor, Aljouf University, Saudi Arabia.

knowledge economy. Moreover, this development is centred on the view that dependence on translation, specifically in regard to math and science in the KSA, is fundamental across all stages of public education so as to ensure the global expertise of excellence in this area is exploited and utilised. This provides improvements in education overall.

In collaboration with Obeikan, the Ministry of Saudi Education has made plans in mind of placing greater emphasis on teacher training and their overall dedication to the most appropriate application through science teaching in schools (Shaya & Abdulrahman, 2012). Accordingly, in the KSA, development in the professional domain has only recently become recognised as a fundamental consideration on a national scale, as well as a study concern in the science education arena (Almazroa & Al-shamarni 2015). It may be stated that development in this area is recognised as a critical requirement when seeking to establish and maintain the most valuable degrees of science teaching. Importantly, the most fundamental of justifications in professional development is centred on aiding teaching staff in recognising the special expertise associated with their work. Moreover, development in the professional arena is recognised as pivotal for teaching in acquiring and mastering the skills and knowledge required as service prior to actually teaching is neither in-depth nor for an adequate period of time.

Furthermore, teachers need to be aided in professionally developing and growing in an effort to improve quality. In this vein, it is stated by Mizell (2010) that development in the professional sphere is able to garner three different degrees of results: firstly, teachers are positioned to learn new skills and build up a new

knowledge base owing to their involvement; secondly, teachers may be able to utilise what they have learnt in an effort to enhance their overall leadership and teaching; and thirdly, achievements and learning amongst students are seen to improve as a result of educators using what they have learnt in professional development. Teachers are viewed by Almazroa & Al-shamarni (2015) as the fundamental actors underpinning the application of the curriculum, with development in the professional field viewed as a fundamental aspect should changes to the curriculum be expanded into the classroom setting. Almazroa and his colleague further recognise that teachers in the science subject area need to be positioned so as to outline objectives and accordingly ensure they take on the role required to achieve development from a professional standpoint. Accordingly, the present work suggests that the new curriculum should be applied by teachers who are recognised as active players in development initiatives and their overall creation.

The view is emphasised by Handal & Herrington (2003) that the central role of teachers in curriculum application should be taken into consideration owing to the fact that it is teachers who determine the outcome of educational pursuits, with the same applying in regard to policy makers in relation to the attitudes and perceptions of teachers. The differences between the ideas and opinions of teachers underpinning a curriculum-related initiative should be established, examined and actively managed (ibid). In line with the above, the present work establishes the key requirements of the science curricula, devised as the secondary stage, as based on the needs of chemistry teachers, with a training programme constructed in mind of secondary teachers' professional development in

consideration to the development of science curricula requirements.

1.1. Problem Statement:

A wealth of research has been carried out by Nelson (2011) on the various ways in which teachers are experiencing problems pertaining to the curriculum-either at a conceptual level, such as in the negotiation of curriculum-related frameworks, district guidelines and pre-packed programmes, or otherwise at a basic level, such as in terms of establishing how and what to teach. The newly presented curriculum in the science subject area highlights different trends and patterns in the learning and teaching arenas, and objectives in mind of adopting a student-focused method alongside inquiry-centred instruction (Almazroa & Al-shamarni 2015). Nonetheless, a wealth of professional development proffered to teachers is inadequate and falls short of new curriculum demands (Almazroa et al., 2014). Furthermore, there is the widely held concern in regards the application of the curriculum, suggesting that teaching staff will direct their efforts towards modern-day conventional teaching methods, albeit with minor changes, to emphasise their own modifications to teaching in a specific way (ibid).

The study by BouJaoude & Gholam (2014) indicates a number of different factors behind the failure of reforms, including the fact that quality and content are not usually based on practitioners' and societal needs, but rather on the needs recognised by those at the higher levels of government ministry; as an example, in the KSA, the decision to implement the aforementioned American book series as opposed to devising and developing one in unison with local science teachers (ibid). The new science curriculum, devised at the central level and adopted by

Ministry of Education's bureaucrats, has been witnessed, with very little input from teachers. Such a situation is especially pertinent with regard to secondary teachers, who consider themselves subject matter specialists and therefore deserving their opinions being heart in regards what needs to be learnt and the methods that should be applied to facilitate this (ibid).

In this vein, a study carried out by Mansour et al. (2012) identified a lack of alignment between science teachers' viewpoints and those held by supervisors in regards PD requirements, with the argument posed that other Ministry of Education authorities are known to afford different values to their concerns. Furthermore, it was identified by Mansour et al. (2014) that teachers are not involved in communicating their received programmes' goals. Such a lack of communication and input from science teachers, PD providers, supervisors and other professionals of relevance, can prove useful in minimising the expected outcomes of such PD initiatives.

In line with the above, it has been established by the study that there are various issues identifiable between the training needs of science teachers and curriculum developers, where such entities need to establish training needs without a direct party, namely a teacher; without this, it becomes a training programme that lacks real value, with focus directed away from teachers' views.

1.2. Research Importance:

One key aspect of the educational process is teachers, who are recognised as adopting a key role in educational development; therefore, it is imperative that teacher preparation is improved in delivering efficient and valuable education amongst teachers and effective and appropriate development initiatives in the professional field, with the capacity to facilitate the growth of teaching staff so as to

enable further development (AL-Qahtani, 2015). Education reforms will not be successful unless teachers are well informed and involved in their subject, and also able to apply the most relevant and suitable teaching practices (Almazroa & Al-shamarni, 2015).

This study is valuable for various reasons. First and foremost, an educational literature review has highlighted the fact that, thus far, a training programme for chemistry teachers at secondary level has not been attempted in light of the developed science curricula requirements, which is critical: the Excellence Research Centre of Science and Mathematics Education (ECSME) at King Saud University carried out a research centred on establishing the study considerations in the field of education in the science subject area in the KSA, and subsequently identified that studies in the development initiatives of professionals are of key importance in the specific setting that is the KSA (ibid).

As a second factor, across the world, science teachers' professional development has been afforded much attention amongst policy makers (ibid). Moreover, research is necessary so as to analyse various types of development in the professional field, and the support these offer concerning new curriculum (ibid). Accordingly, the study is advantageous to the science department of the Ministry of Education, as well as to science teachers' supervisors, science teachers, science and math development projects, and science teacher researchers. This can be achieved only by providing science teachers with the opportunity to communicate their perspectives concerning professional development requirements, as well as the various challenges encountered during the professional development process.

2. Literature Review:

The review will begin by providing a selection of key studies that have sought to explore Saudi science teachers' needs in a training programme, and then will discuss studies focused in the arena of the effect of development amongst professionals on teachers' performance.

2.1. Studies on the Needs in Training Programme, as Perceived by Saudi Science Teachers:

The concept of need has diverse interpretations (Mansour et al., 2013). In the literature, 'need' is used variously to infer inconsistency, a recognised issue, the criteria surrounding a larger number of services, in line with the requirements of the target population (ibid). For this study, need is defined as the wants or preferences of an individual or a group of people (ibid). Flimban (2003) conducted a study aiming to recognise training needs amongst Saudi biology teachers throughout the course of their career. The study sample comprised 191 female Saudi teachers from different secondary schools. The research tool was a questionnaire. The conclusions suggested that all training needs were in behavioural objectives, instruction technology and assessment fields.

Abu-Alhamail (2005) carried out a research concerned with recognising Saudi biology teachers' training needs, as based on their own views, in relation to the in-service training programme. The sample comprised 87 teachers; the questionnaire approach was adopted by the researcher. The most important results showed Saudi teachers as acknowledging many issues they thought training programmes should tackle, including knowledge related to curricula, educational technology in laboratories, content, teaching students, and strategies in assessment. Alshihri (2011) conducted a study aimed at recognising the training needs of science teachers at middle school, with the

questionnaire completed by 34 Saudi teachers. The most important conclusion emphasised science teachers as being unable to use new teaching technology. Hence, Saudi teachers in this study required a training programme to be focused on instruction technology.

Mansour et al. (2013) applied a questionnaire amongst 499 Saudi science teachers in different disciplines, i.e. biology physics, chemistry, earth science, and other subjects (those who teach since for elementary students). The top needs perceived by teachers or professional development on pedagogical knowledge and skills were as follows: teaching science through field trips and scientific visits, developing creative thinking amongst students, teaching science for gifted students, developing the science concept amongst students, associating technology with teaching, planning for teaching, scientific inquiry instruction based in science, teaching science for special needs students, solving problems in instruction-based science, and applying concept-mapping.

EL-Deghaidy et al. (2015) applied qualitative approaches, comprising questionnaires with open-ended questions, as well as interviews of a semi-structured nature, amongst science teachers in the KSA. The open-ended questionnaires targeted a sample of 304science teachers, and were open-ended in nature. The questionnaire reaped a response rate of 29%. Furthermore, an interview approach was used amongst nine science teachers. The findings indicate that teaching staff emphasised that they did not play an active role in choosing those subjects for inclusion in the CPD schemes; their answers, when examined, emphasised the view that the common activity of completing ‘pre-planned’ programmes poorly aligned with teachers’ professional needs (ibid). The answers given by

teachers in regards activities and their content were broken down into different categories, in line with their different responses, and accordingly arranged in "descending order", spanning "pedagogical, scientific, personal skills and ICT" (ibid, p.1552).

With respect to pedagogical, Saudi teachers require more in-depth knowledge concerning pedagogical content, newly updated curricula, and the management of the classroom, complete with assessment. In relation to content knowledge, teachers require more in-depth subject content knowledge, skills applicable in the practical domain, and cultural considerations in regards science education. With respect to skills in the professional domain, it was recognised by the teachers that there is a requirement of a CPD programme focused on developing their "professional autonomy, e.g. action research, leadership and self-development" (ibid, p.1557).. Furthermore, regarding ICT, teachers need to have programme that trains them in the use of general technological tools, including virtual laboratories and the internet (ibid).

2.2. Studies carried out Concerning the Effect of Development in the Professional Domain on Teachers' Performance:

Adams & Krockover (1997) completed a work aimed at identifying first, the key principles underpinning pre-service science education at secondary level, as recognised by the teaching staff of the science subject, second to establish structures of knowledge that early career teachers in secondary science assembled in regards science-learning and -teaching, as well as establishing any links between the first two of these aspects. The faculty's syllabi and interview data emphasised that the initiative focused on teachers of pre-service secondary science emphasise different elements of the teacher knowledge framework in

terms of general pedagogical knowledge, pedagogical knowledge in regards content, and a constructivist, learner-focused standpoint in relation to learning, which is known to encompass different aspects not only of knowledge of self but also pedagogical knowledge overall. The construction of aspects of teacher knowledge (classroom discipline, student-centred learning and instructional strategies) was endorsed by the four new science teachers in the study for their teacher education programme. Only one of the four subjects failed to connect their knowledge of science instructional strategies to their experiences in subject-specific methods courses where three subjects were successfully connected at advanced level. One of the science teachers, Bill, related the development of his science instructional strategies to his experience as a high school student, using observational data, the researchers noted that teacher education made more of an impact on Bill's teaching knowledge than Bill acknowledged to himself which indicates that the teachers did not always comprehend the influence of their subject-specific methods course to their construction of pedagogical content knowledge. Bill's own experiences as a student gained him strategies which overlapped with his usage of science instructional strategies modelled by his methods instructor. This study shows that an aspect of knowledge of content from a pedagogical perspective, namely instructional approaches in the science arena, is developed in teacher education.

Four individuals who have graduated a science teachers' education programme assimilated their knowledge constructed during the programme into their science teaching practices in varying degrees, as suggested in Adams & Krockover (1997). Based on the revealed data,

Laura shifted the way in which she viewed teaching, notably from teaching geared towards the achievement of a skill to being more concerned with developing understanding in the science classroom environment. Her understanding of instruction was shaped by her university experience as she explained. Programme experiences might have guided her to implement a change in the structure of her teaching construct. The programme perhaps provides an outline concerning early career teaching staff and how their own science classroom cognition was developed. Notably, however, it is recognised that the learning experience and the context of their teaching situation modulate the extent to which there is translation from the programme to the teacher's own insight into their teaching environment.

In the work carried out by Van Driel et al. (1998), reference was made to the challenge associated with the relationship between knowing (knowledge and doing, teaching practice) is key in supporting student understanding. Shifts in regards the views of the subjects in relation to learning and teaching science were led by not only in-service training initiatives but also those of a pre-service nature. Conceptual change strategies are intelligible or attractive, thus they are adopted. Problems occur due to the adoption of various approaches in classroom teaching. The mismatch that could exist between teacher knowledge and teacher practices causes the problem of implementation as reported by van Driel et al. (1998).

Van Driel et al. (2001) concluded that through professional development and collaborative action research, teachers can become aware of their own learning and incorporate it into their teaching. Teachers depend on practical knowledge (ibid), which the authors describe as having a focus of action, people and context, and as being integrated, centred on beliefs, and tacit in their planning and

teaching practices. Practical knowledge is very different from the categorized, codified, verified knowledge that we normally put into textbooks. The difficulties of putting and acquiring practical knowledge into textbooks are equal. Learning from experience provides practical knowledge to teacher candidates which also can seem an overwhelming challenge for those who are just starting their programmes. Initially, most candidates find the experience of teaching science to be full of difficulty and confusion, posing a bewildering array of demands and difficulties (ibid).

Luft, et al. (2003) point out that the experiences and beliefs that teacher candidates bring with them to their programmes and that they perfect during the overall training required to learn how to teach are critical enabling or constraining factors. Garnering insight and understanding into both knowledge and experiences in the teacher preparation programme leads to the paradoxical function of the teacher candidate's prior beliefs as reported by Feiman-Nemser (2001). She reported many research results illustrating the need for teaching staff to show persistence in entering beliefs, which are described by Lotie (1975) as insights into learning, teaching, students and subject matter, all of which are established throughout teacher candidates' K-12 schooling experience. Such viewpoints deliver a key foundation for the comprehension and evaluation of ideas and practices.

Based on the overall concept pertaining to the reflection of teaching staff, as well as in consideration to the topology of teacher research presented by Lytle &Cochran-Smith (1990),Sweeney et al. (2001) completed an analysis pertaining to the links between the articulated personal practices theories held by a new high school chemistry teacher and his actions, as emphasised by the choices made

in regards his curricular and instructional approaches. It is recognised that there is a need for reflective and practical reasoning if teaching is to be of quality. Küçük & Çepni (2005) suggested that if teachers pay attention to the approaches they utilise when teaching, they will develop greater understanding of their own practices. Prior experience influences a new teacher's personal practical theory as exemplified in Sweeney et al's. (2001) case study of a first year chemistry teacher. Their definition of personal practical theory is the different systematic beliefs of the teacher, which are recognised as centred on previous experiences, including those that may arise stemming from instructional practices (Cornett, 1990; Cornett, Yeotis, & Terwilliger, 1990 cited in Sweeney et al., 2001). The work implemented a methodological approach that was naturalistic and interpretive in nature.

Specific actions are summarized as follows, based on Sweeney et al. (2001). Teachers are able to maintain lesson journals, write essays, and create different media recordings concerning classroom activities, all of which enable them to reflecting on the way in which they teach and how their learners learn. Sharing experiences in small group meetings with peers by discussing their documents and records and, finally, teachers are able to devise their own short articles relating to their studies, which can be used in journals for chemistry faculty. The findings specify that the four key personal practice theories were shown by teacher researcher Student scientists (practising research and the scientific method). The teacher is positioned to establish a productive and positive learning setting. It is important that learners feel challenged and that science is recognised as an aspect of day-to-day life. Furthermore, the university researcher indicated initial parallel theories which were Science is a highly valued aspect of knowledge, which warrants specific

approaches and skills in thinking amongst learners. The science teacher‘s main goal is to enhance specific skills and methods of thinking in the students, such as in terms of formal experimentation, mathematical reasoning, understanding, and the use of the correct scientific terminology.

University research showed the modifications in the parallel theories which have been led by the modifications in the personal practice theories of teacher-researchers, as well as the instructional practice that follows. Preliminary PPT 2 is seen to be prioritised ahead of preliminary PPT 1 when considered in terms of pedagogical importance. Enhance learners’ way of thinking to preform science-like thinking, e.g., improve their observation. Make science relevant to the experiences and conceptual understanding of learners. High school science teachers need to enhance the scientific habits of students and help them to attain a valuable degree of scientific literacy; this helps to ensure learners are well-prepared for education at the college/university level study (ibid).

Modified parallel theories (university researcher), the science teacher uses the present linguistic and cultural cognitive/capital resources amongst learners as a way of ensuring access to discourse conventions and the understanding of such is bridged in canonical science. High school science teachers need to enhance the scientific habits of students and help them to attain good understanding in scientific literacy. There is the potential to achieve a symmetrical link should trust be built and maintained between both researchers, prioritising comprehension in regards the different individual drivers for completing a research study (ibid). The strong points inherent in the design of the research can be seen when considering the

researcher established and conceptualised fundamental theoretical teaching issues that otherwise may not have been clear to the teacher-researcher.

In a comparable vein, the teacher-researcher has established a number of fundamental teaching considerations, notably of a practical nature, that were not immediately clearly to the university researcher. In both cases, both of the scholars applied their own expertise in an effort to develop their own understanding of personal practice theories amongst faculty, as well as the way in which instructional practice is implemented, and the various factors contributing to the degree of researcher professionalism owing to the way in which these aspects are understood and examined. Symmetrical relationship is exceedingly suitable for educator scientist/college analyst community oriented work, while likewise discerning that any representation of an instructor's reasoning ought to sensibly be seen as inadequate, and to a limited extent an ancient rarity of the exploration strategy (ibid).

Luft, et al. (2003) mentioned comprehending that new secondary science teachers could be affected by various induction programmes. A diverse methodology that occurred in two stages was used by the researchers. Through the pilot, a university-based, science-specific induction programme was shared by five secondary science teachers, and official or unofficial backing was got by five other teachers from the school district induction programme. Throughout the secondary phase, 18 school teachers, notably all of whom were new and of middle and secondary school level, were assigned into three distinct categories, which were seen to include six teachers in the case of “the university-based, science-specific support programme (Alternative Support for Induction Science Teachers, ASIST) ” (Wilson, 2015, p.8), six teachers for

overall support programmes, and six teachers were not participating in any induction programme. Data included observations, interviews and documents that were gathered (Luft, et al., 2003).

Through the pilot study, the researchers discovered that the university-based, science-specific programme was shared by the early career teachers who created investigation lessons which were more expanded than those that their peers created in the other groups. The new teachers who are in public and unofficial backing groups stated that they were disappointed due to their teaching and losing their support, and their thinking about teaching moved to instructional teaching (ibid). In the second stage, the Contrasting Landscapes Study, many styles and substances were used by all members during teaching, and "the beginning teachers in ASIST wanted to utilize laboratories and student work groups" (Wilson, 2015, p.8) whereas those without induction or in the public sought to utilize more static work. Even though ASIST stressed the requirements of using greater examination-centred inquiries, the new teachers in ASIST wanted to utilize extra laboratories more so than those of the no induction and public groups (Luft, et al., 2003). ASIST members utilized more didactic, technology-focused equipment and a larger number of supplies in their laboratories. Also, the researchers observed that problems were debated by the ASIST teachers in their schools; for example, laboratory experiments were difficult to perform in their schools; implementing those laboratories that were regulated by the ASIST teachers. Teachers' capacities to concentrate on "science content and inquiry-oriented instructions were related to their induction programmes" (Wilson, 2015, p.8). In the general induction initiative, beginning teachers

stressed that achieving the job requirements in advertisements could be by the curriculum, and teachers without induction backing could struggle and feel isolated. Also, they could have many administration problems and teach in old ways (Luft, et al., 2003).

Villegas-Reimers (2003) indicated that, based on an international literature review, the professional development of teachers could be basic components of the educational repairs actually in improvements in the world. Also, Villegas-Reimers (2003) highlighted an apparent connection in regards educational repairs and the development of teachers in a professional capacity, alongside most communities participated in these repairs. This relation could be in two directions or mutual. The relationship can be ineffective when educational repairs do not consist of teachers and their professional development. Also, development initiatives in the professional domain that cannot adopt a form of design or policy cannot be effective. Villegas-Reimers (2003) mentioned that constructivism could establish a new aspect of professional development, and it considers it as a lasting process which occurs in a specific context and connects with school repairs, which is cooperative process in diverse contexts.

A study was carried out by Al-Ghamidi (2012), which sought to suggest various criteria for the development of intermediate stage science teachers, in a professional capacity, in consideration to various international requirements, whilst also establishing the requirements underpinning the developed science curricula (McGraw-Hill) in the intermediate level. Moreover, Al-Ghamidi, in his work, devised a training initiative (Evaluation in the Developed Science Curricula), which is recognised as able to provide the professional development of intermediate stage science teachers. Both experimental and descriptive

approaches were applied by the researcher with one group. The sample of the study comprised 27 intermediate stage science teachers, all of whom were purposefully selected from the Makkah educational region in Saudi Arabia. The results of the study emphasised the overall efficiency of the training package in terms of enhancing immediate stage science teachers' professional development in evaluation with a large effect size (0.82). The research presented various suggestions, including the necessity to ensure training programmes are offered in mind of improving science teachers' professional development whilst also taking into consideration their needs for this type of training in the presence of sophisticated and modern curricula (ibid).

2.3. Theoretical Framework:

Other Ministry of Education authorities have different priorities according to a mismatch between Saudi science teachers' perceptions and those of their supervisors in regards to PD requirements (Mansour et al., 2012). Therefore, Saudi teacher education uses the technical reasoning approach. Teachers perform essential in the role of technicians who adhere to what is required by outside parties, including school administrators, central governments and teacher educators. In this vein, Sweeney, et al. (2001) and Van Driel, et al. (2001) recognise that a number of valuable and efficient approaches to be taken into account by other professionals, including policy makers, colleagues and teacher educators, may be devised by teaching staff throughout the process of reflective reasoning. In their own classrooms, teaching staff should be able to act as researchers whilst also in the role of reflective practitioner. It is stated that reflective teaching requires that ideas are shared, colleagues are listened and responded to,

and the ideas of all are considered and implemented in their own thought process.

In this work, the theoretical model is centred on the Socio-Constructivist Theory of Learning, which may be outlined as a choice rationalised by considering the fact that, through this theory, teachers are able to communicate how they would like to learn and what they would like to learn; emphasis is placed on learning as the underpinning to professional development programmes (EL-Deghaidy et al., 2015). Importantly, the Socio-Constructivist Theory was devised in line with the view that the social arena is the setting for the creation of knowledge, where learning is witnessed as a result of interaction and discourse with others (Vygotsky, 1978). Accordingly, knowledge is recognised by El-Deghaidy et al. (2015) as being a social construct, enabled as a result of cooperation, evaluation and interaction amongst peers. In specific consideration to professional development, teachers may be positioned as learners, with emphasis placed on their prior beliefs, knowledge and skills, potential to garner feedback, complete revision and accordingly garner success, and the opportunity to interact with others (ibid).

3. Research Methodology:

3.1. Research Questions:

The key aim of this study centres on establishing the issues associated with identifying the formulation of questions, as follows:

- What are chemistry teachers' training requirements in regards the needs of the chemistry curricula developed at the secondary stage of Saudi schools?
- What is the proposed training programme, based on the training requirements of chemistry faculty in consideration to the requirements of chemistry curricula developed at the secondary stage?

- What is the impact of the proposed training programme, based on the training requirements of chemistry faculty in consideration to the requirements of chemistry curricula developed at the secondary stage in the development of teaching performance?

3.2. Study Participants:

The present researcher's sample was made up of chemistry teachers in one educational administration in the KSA (Aljouf); the total number of teachers in this administration totalled 112. The administration was selected as it would be easier to conduct the study as the researcher both lives and works in the region. However, the researchers targeted half of the sample owing to the fact that the key objective was centred on exploring PD experiences and needs as opposed to generalising the findings; accordingly, there was not the selection of all educational regions, with teachers' responses, in relation to their involvement in the work, recognised as giving a potential insight into their experiences through PD attendance. The administration department of the Saudi of Ministry of Education was asked for a list of e-mails for all chemistry teachers in Aljouf City—the city in which the research was carried out. Subsequently, an email was distributed amongst all teachers (112);this focused on the completion of an open-ended questionnaire survey. Three weeks later, 70 teachers provided a response to the questionnaires, therefore achieving a response rate of 78%.The researcher then sent a further e-mail to all 70 teachers, providing a more in-depth explanation as to the researcher's purpose and the other process of investigation (interview and observation) in the current study. All teachers replied by email; only 30 teachers were interested in taking part in this study.

Hence, self-selected sampling was used with chemistry teachers as they came forward on their own to act as the sample for the current study; none were chosen by the researcher. However, the self-selecting sample had a criteria of including only teachers who were interested; therefore, this was likely to affect the overall representativeness of the sample. This is not the case in this study, however, due to the fact that teachers choosing themselves—even through the use of a self-selecting sample method—would not be expected to affect the representation of the sample as all chemistry teachers in Saudi Arabia dealt with the same in-service programmes, as introduced by the Ministry of Saudi Education.

3.3. Data Collection:

In mind of providing answers to the questions, the current work is to be completed by implementing a methodological triangulation approach, with the application of interview and questionnaire research methods. The work of Scott & Morrison (2006) involved the cross-checking of evidence, completed by gathering a number of different types of data pertaining to the same phenomenon; this will be useful in achieving validation and accordingly ensuring the accuracy of data.

Triangulation in this study was implemented with the use of different approaches in mind of completing a cross-referencing process in regards the gathered data, thus enriching the overall validity (Silverman, 2000). Accordingly, although all methods are regarded as offering their own strengths and weaknesses, through the application of different strategies aimed at investigating the same phenome, a more in-depth and comprehensive insight will be achieved in relation to reality.

3.3.1. Qualitative Method (Open-Ended Questionnaires and Interviews):

Two phases will be adopted in the current work in order to explore the teachers' needs in relation to PD programmes in light of the Saudi science curriculum requirements. The first will involve an open-ended questionnaire (N=70) with the objective to gather information from chemistry teachers in the KSA. The second phase will involve the conduction of semi-structured interviews (N=30) with faculty and educators at Al-Jouf university. It is noteworthy to highlight that interviews are recognised as a fundamental data collection tool for the current work, providing detailed, rich and in-depth data (Cohen & Manion, 1994), not only because they facilitate in-depth probing and expand the interviewees' responses, but also owing to the fact that general questions can be posed. Semi-structured interviews will be used owing to the various benefits that can be seen to emerge, including a greater duration to allow for the completion of interviews as a result of a greater degree of interaction, the ability to garner insight into the participants' views as opposed to those of the researcher being imposed, and the respondents being afforded equal status to the researcher during the course of the conversation/discussion (Burns, 2000). Across both stages (the completion of the open-ended questionnaire and semi-structured interviews), teachers were asked a range of questions about their needs of PD programmes in light of the current Saudi scenic curricula.

3.3.2. Experimental Methods:

Constructivist teaching approaches have been recognised as the most important amongst Saudi teacher needs in light of the current Saudi scenic curricula. This exploration was based on the early stages open-ended questionnaires and interviews. Hence, the researcher created a training programme based on constructivist

teaching approaches (see Appendix 1).The programme adopted in the current research was a 15-training session course, with a duration of one month. The researcher adopted the experimental method based on the design of the control and experimental groups so as to determine the overall effectiveness of the proposed training programme, based on the teachers' needs, particularly constructivist teaching approaches. The sample consisted of 30 science teachers (the same teachers as those included in the interview stage), with some randomly assigned to an experimental group (15 teachers), with others assigned to a control group (15 teachers).The researchers observed all teachers in both groups (control and experimental) both prior to and following the training programme. The researcher used an observation checklist (see Appendix 1) to record what was witnessed and heard during the class session of different subjects (lasting 45 minutes). The checklist was adopted from So's study (2002). Teachers' teaching performance in their observed lessons was scored in line with the individual 22 aspects explaining active teaching, utilising a rating scale comprising 4 points, "ranging strongly agree (3), agree (2), slightly agree (1) to not observed (0) " (ibid, p,10).

3.4. Data Analysis:

This section discusses the process of analysis as implemented in this study. Two types of analysis were used, namely thematic analysis and statistical analysis.

3.4.1. Thematic Analysis:

The researcher analysed by hand the data from the open-end questions and semi-structured interviews using thematic analysis, which is considered useful when arranging and describing the data set in greater detail (Braun & Clarke, 2006). The texts were printed out in double-spacing to allow for notes and comments to be

written, and different coloured pens were used to help make sense of the data. The data then were analysed inductively (bottom-up) so that codes emerged from the data; this was a conscious choice as opposed to applying pre-existing coding. Hence, the data were assigned into chunks of consistent content. Subsequently, consistent text developed as an emerging theme (Ezzy, 2002), with the themes used to create super themes, which then were labelled as different themes. This method was chosen as being more appropriate owing to the present work's theoretical nature, which aimed at exploring new and unexpected themes. At the end of each quote, notably, abbreviations were used: opened-ended data were referred to as QE, whilst interview quotes were afforded the label IQ.

3.4.2. Statistical Analysis:

Due to this study aiming at identifying the effects of the proposed training initiative in relation to the experimental group alongside those of the control group, a comparison was carried out in regards the experimental group and the control group, in addition to a comparison between the tribal and dimensional measurement, using T-test in an effort to signify the differences identifiable when comparing the two groups by SPSS (Ver programme. 20.0).

3.5. Study Trustworthiness:

In the present work, validity can be ensured through the completion of triangulation, which is achieved with the use of open-ended questionnaires and interviews (Silverman, 1993). Cross-checking the evidence through gathering different types of data pertaining to the same phenomenon is valuable in terms of facilitating the validation and accuracy of the data (Scott & Morrison, 2007), thus overcoming the issue of the inclusion of bias

(Blaikie, 2000). Accordingly, triangulation was applied in order to establish overall validity and reliability.

One further approach utilised was that of member check, which is centred on ensuring the rigour of findings (Glesne, 1999). In an effort to satisfy this objective, the questions were posed through the application of interviews and open-ended questions, with the sample made of up professors specialised in teaching methods and curriculum, as well as Science Department supervisors. The tentative data analysis findings were verified and confirmed by various authorised faculty members so as to ensure the correct analysis of the data. Moreover, the member check approach was implemented with the use of card observation. After making the amendments suggested by the specialised professors, the card, in its final form, ultimately consisted of three basic skills, under each of which a group of sub-skills was found to fall. In order to assess the card's overall stability, the researcher observed a number of eight science teachers in the secondary stage (First Application). Six months later, the card was reapplied on the same sample (Second Application). With the adoption of the Cooper equation, the card's stability ratio was 94.0, thus indicating stability of the observation card.

4. Presenting the Findings based on the Questionnaires and Interviews:

The current section presents, first and foremost, the findings in relation to Saudi chemistry teachers' needs, and then accordingly presents the Programme Sessions Description, as based on Saudi chemistry teachers' needs.

4.1. Saudi Chemistry Teachers' Needs:

Five key themes emerged in relation to Saudi chemistry teachers' needs. These are teachers' experience with the current Saudi training programme, teachers' needs of learning and teaching strategies, teachers' needs

according to content knowledge, teachers needs' according to assessment, and teachers' needs according to technology.

The Teachers' Experience with the Current Training Programmes in Light of the Developed Chemistry Curricula

Five main themes(see table below) were established in line with the experiences of the teaching staff in regards the current training programmes in light of the developed chemistry curricula. The minority of the responses mentioned that the training programme was satisfactory. In contrast, the majority of the responses highlighted a mismatch between what we need in the curricle and what training was provided.

The analysis indicated that the most significant problem with the current training programme was based on Saudi teachers' experience. Moreover, the second most notable issue was no special course for chemistry teachers, as the different responses considered valuable in relation to theme were 15 from the questionnaire. Data analysis from the interviews explained the same problems, but in-depth.

> *'The training programmes that provide by the ministry of Saudi education focused on other issues that are not linked to the current curricula, as a teacher for more than 6 years. I did not know what the ministry want from me and the ministry did not know what my needs in the current curriculum.'*(9 years' experience, IQ).
>
> *'There are no special courses for chemistry teachers, apart from other science teachers, since the training courses guided by stage rather than specialization.'* (6 years' experience, IQ).

Table 1: Analysis of teachers' responses of the current training programmes in light of the developed chemistry curricula (N=100, 70 from the questionnaires and 30 teachers from the interviews)

Teachers' experience of the current training programmes	Frequency of responses
Satisfactory	5
No special course for chemistry teachers	15
Very few training programmes	18
Mismatch between what we need in the curricle and what training provided	52
Not take training programme	10

Teachers' Needs of Learning and Teaching Strategies in Light of the Developed Chemistry Curricula

Seventy-two (72) constructivist teaching responses were given when teachers were asked about their needs in terms of learning and teaching strategies in light of the developed chemistry curricula. Moreover, only eighteen (18) responses were given for the active learning strategy. In contrast, by examining the table's different responses, other strategies, such as concept maps, were found to focus on learning by inquiry, and learning-based problems were few. When considering the entire interview data, it seemed that much agreement could be seen amongst teachers, with the most popular needs identified as constructivist teaching.

> *'Unfortunately the basics and theories used in the Mc Graw Hill series are unknown to many teachers because the modern curriculum is based on constructivism theory while teachers adopt the behavioural theory.'*(15 years' experience, OE)

The analysis from the interview data explored the reason behind the selection of constructivist teaching strategy as the Saudi teachers have not had any training programmes that provided knowledge or skills in relation to the constructivism theory.

> *'Despite of the importance of constructivism theory, no special training courses are given in the modern theories of learning. I had more than 8 training programmes in the light of the developed science curricula, I never received any training on theories'.* (10 years' experience, IQ)

Furthermore, during the interview, many Saudi chemistry teachers stated that they develop their knowledge regarding learning and teaching strategy through the use of different approaches, such as modern technology.

> '*Training courses failed to provide me with anything that worth mentioning in relation to the collaborative and active learning. I worked personally on developing myself in these strategies through modern technology resources such as YouTube and the internet.'*(12 years' experience, IQ)

Table 2: The learning requirements of teachers and the different teaching strategies in regards the developed chemistry curricula, N=100

Teachers' experience of the current training programmes	Frequency of responses
Constructivist teaching	72
Active learning	18
Concept maps	5
Focus on learning by inquiry	3
Learning based on problems	2

Teachers' Needs according to Content Knowledge in Light of the Developed Chemistry Curricula

This section considers all of the elements inherent in the scientific knowledge content, as well as its more practical aspects in relation to the management and completion of experiments or making use of equipment and instruments. It notably consists of four themes(see the table blew). The majority of responses were afforded to practical

skills. Similarly, in the interview data, the teacher focused on the way in which science works and how this may be linked to the skills required in the application of equipment and instruments.

> *'There is a need for the content to involve practical experiences in regards all the practical experiments detailed in the newer version of the curriculum. This provides a rationale as to why the practical skills of teachers should be aided and expanded upon through the programmes.'*(5 years' experience, IQ)

In the interviews, one of the subjects made reference to how the teachers need to undergo training through completing experiments.

> *'Holding workshops, as well as conducting experiments at one of the schools in the presence of a number of teachers to exchange experiences.'*(8 years' experience, IQ)

However, only five teachers experienced problems with the current content in regards the developed chemistry curricula. The types of problem were based on the sequences of some topics in the same grads and rearranging the content in different years.

> *'Re-arranging the curriculum in a better way. It is unreasonable that the organic chemistry curriculum is divided on two separate years, unlike the physical chemistry curriculum that is linked, and contains organised lessons. the biochemistry curriculum has to be expanded, even at the expense of biology topics that are considered boringly repeated.'* (9 years' experience, QE).

Table 3: The teachers needs according to the content knowledge in the light of the developed chemistry curricula, N=100

Teachers' experience of the current training programmes	Frequency of responses
practical skills	60
deepening subject content knowledge	24
Values	11
Problems with the current content	5

Teachers' Needs According to Assessment in Light of the Developed Chemistry Curricula

Three main themes (see table below) were established in line with teachers' needs in regards assessment in light of the developed chemistry curricula. The majority of the responses mentioned teachers as needing a greater number of training programmes to apply effective assessment, such as alternative assessment and formative assessment.

In contrast, very few teachers require programmes based on summative assessment. This analysis indicates that Saudi teachers were only familiar with the assessment of learning; this appears to provide some kind of insight into the belief that teaching staff are not well experienced in how different forms of evaluation can be devised and carried out.

The interview data were considered in line with the data from the questionnaires. An example of a point made by one of the subjects is detailed as follows:

> *'I am very interest in applying different tools of alternative assessment, I do not have any problem to use traditional assessment such as test or what it is called summative assessment. So I hope in the future, I will training programme to have different types of assessment. I have only few details the difference between formative assessment and summative*

assessment. I think the formative assessment is very important.' (11 years' experience, IQ)

However, during the interview, one teacher indicated a lack of alignment between the theory emphasised in the new curricula and assessment type adopted by teaching staff in their classrooms, as outlined by the policy of the Ministry of Education in Saudi Arabia.

'Teachers have no faith in the constructivism theory. When the final tests are used, there is a contradiction and conflict with the principles of the constructivism theory.' (9 years' experience, IQ)

Table 4: The teachers needs according to assessment in the light of the developed chemistry curricula, N=100

Teachers' experience of the current training programmes	Frequency of responses
Alternative assessment	49
Formative assessment	45
Summative assessment	6

Teachers Needs According to Technology in Light of the Developed Chemistry Curricula

Three key themes could be seen, in line with the needs of teachers, in regards technology in light of the developed chemistry curricula; these are virtual laps, mobile learning and computers. Forty-eight (48) responses garnered from the completion of the questionnaires determined that CPD programmes aimed at developing technological understanding in relation to virtual labs should be offered. The main reason for Saudi teachers to select virtual laps, as highlighted in the interview data, was owing to the fact that many schools were lacking in laps and equipment.

'I was a teachers in two different secondary schools, the both schools did not have any laps so I always explain the experiments without doing it, I only asked students to read the process of the experiments in their

books. I have many colleagues that have the same problems so we need the training programme that help us to conduct alternative experiments and using the virtual laboratories programmes.' (13 years' experience, QE)

Further, Saudi science teachers wanted to use also general technological tools, such as mobile learning and computers, which would benefit from the internet. The main concern amongst Saudi teachers, as demonstrated in the data garnered from the interviews, was how educational technology could be used in their classrooms.

'Every teacher in the universe knows the advantages of using the new digital technology such as iPad but they are struggling to use it as an educational with their students.'(7 years' experience, IQ)

Table 5: The teachers needs according to technology in the light of the developed chemistry curricula, N=100

Teachers' experience of the current training programmes	Frequency of responses
virtual labs	48
Using mobile learning such as ipad and tabet	29
Using computers	23

4.2. Programme proposed Sessions Description:

In the previous section, the findings were presented, linked to Saudi chemistry teachers' needs, based on the open-ended questions and semi-structured interviews methods. Initiatives focused on preparing science teachers needs to focus on delivering a background in relation to educational research and the nature of such. Educational research warrants a process of ongoing observation, continuous questioning, and the completion of various analysis concerning a teacher's own teaching methods and the ways in which students learn—and the results of such. Hence, this current section will present the Programme

Sessions Description based on Saudi chemistry teachers' needs. It should be stated that the researcher designed the following proposed training programme based on only the most important needs (according to the frequency of responses garnered in this study).

Proposed General Framework of the Programme:

The proposed general programme was based, in its structure, on the following basis:

- Requirements of the proposed developed chemistry curricula in consideration to chemistry teachers' needs in secondary schools through the use of existing research tools, namely open-ended questions and interview questions.
- The proposed general programme was presented in the form of training schemes viewed as consistent with the requirements of chemistry faculty in secondary schools.

General Objective of the Programme:

Development of the knowledge and skills of chemistry teachers in the secondary stage in light of the requirements of developed chemistry curricula according to the following general objectives:

- To ensure familiarity with the learning theories currently used in the developed chemistry curricula.
- To ensure familiarity with the methods and strategies of the developed chemistry curricula.
- To ensure teachers are afforded all of the necessary skills underpinning the practical teaching of the chemistry curricula content.
- To ensure the ability to use evaluation in the developed chemistry curricula.
- To ensure the ability to integrate technology in teaching and learning of chemistry.
-

Programme Approaches:

The researcher applied several approaches in mind of training on the proposed programme, taking into consideration their overall suitability to the needs of chemistry teachers being trained, available resources, duration of the programme, and sample size. These approaches are lecturing, discussions, cooperative learning and workshops.

Programme Content:

The proposed training programme consists of three parts, all of which are based on four axis: learning theories, content, evaluation, and use of technology; all were devised in light of the most important training requirements of chemistry teaching staff, as revealed through the study instruments utilised in the present research, as focused on open-ended questions and interview questions.

First: Learning Theories: Constructivist Theory—Theoretical

- Definition and background of the Constructivist Theory from philosophical and psychological angles.
- The foundations of the Constructivist Theory.
- The most important principles and assumptions of the Constructivist Theory.
- The constructivist classroom environment.
- The learner's role in regards constructivist learning.
- The teacher's role in regards constructivist learning.
- Evaluation when utilised as per the Constructivist Theory.
- Teaching strategies emanating from constructivist thought (Cooperative Learning Strategy)

First: Learning Theories: Constructivist Theory—Practical

- The discussion and identification of successful teaching standards.
- Trainees' reading of a series of articles on Constructivist Teaching Theories and the discussion of such articles therewith.
- Teachers' exploration of students' understanding of a subject they taught or are currently teaching.
- Exploration of the change in the necessary teaching skills when applying constructivist theories through workshops.

Second: The Content—Theoretical

- Development of the methods for linking theoretical to practical aspects.
- Identification of the modern methods of operation and the use of practical laboratories.
- Discussion of some of the difficulties and challenges potentially faced by male and female teachers when conducting experiments in school laboratories and finding appropriate alternative solutions.
- Promoting and developing skills concerning the application of safety rules and regulations, ensuring high efficiency within chemistry laboratories.

Second: The Content—Practical

- Training teachers conducting practical experiments meticulously within their schools.
- Training teachers conducting experiments in general chemistry.
- Training teachers conducting some experiments in analytical chemistry.

- Training teachers conducting some experiments in physical chemistry.
- Training teachers conducting some experiments in organic chemistry.

Third: The Evaluation: Alternative Evaluation—Theoretical

- The concept of alternative evaluation.
- Comparing methods of modern (alternative) evaluation and methods of traditional evaluation in terms of concept, characteristics and credibility.
- Establishing components of alternative evaluation.
- Considering the foundations of alternative evaluation.
- Establishing the characteristics and objectives of alternative evaluation.
- Implementing the tools of alternative evaluation.

Third: The Evaluation: Alternative Evaluation—Practical

- Training teachers on performance-based evaluation.
- Training teachers on pen-and-paper evaluation.
- Training teachers on evaluation by observation.
- Training teachers on evaluation by communication.

Fourth: Technology: Virtual Laboratories—Theoretical

- A detailed definition of Virtual Laboratories.
- The importance of virtual reality in education.
- Types of Virtual Laboratory.
- The importance of virtual laboratories in chemistry, teaching models of successful global experiments in the use of virtual laboratories (for example: University of Pittsburgh in the United States: virtual laboratory manufactured by Crocodile Clips Inc.)

Fifth: Technology: Virtual Laboratories—Practical

- Training teachers on how to select titles of experiments that can be simulated from the chemistry book according to virtual laboratories.
- Training teachers on the analysis of chemistry content, based on virtual laboratories.
- Training teachers to determine the performance period for the conduction of experiments according to virtual laboratories.
- Training teachers to determine the materials used for the experiments to be conducted according to the virtual laboratories.
- Training teachers to follow the adequate steps to simulate virtual laboratories.
- Training teachers to conduct experiments according to virtual laboratories in classrooms.
- Training teachers on the types of evaluations used for the conduction of experiments according to virtual laboratories.

Programme Evaluation

- Evaluation before training on the proposed programme: Using open-ended questions and interview questions on the study sample so as to identify the most important training requirements of chemistry faculty in consideration to the developed chemistry curricula.
- Evaluation during training on the proposed programme: Evaluating trainees' performance and the orientation thereof at the workshop and through the application of tasks to be implemented in the practical part.
- Evaluation after training on the proposed programme: Application of the observation card on

chemistry teachers who have been trained on the proposed training programme.

5. Presenting Findings-based Experimental Methods:

This section presents the findings based on the T-test in order to discover the various effects associated with the suggested training programme, in line with the training needs of chemistry teachers in light of the requirements of the chemistry curricula developed at the secondary stage in the development of teaching performance. The researcher created a training programme based on constructivist teaching approaches due to such approaches being recognised as the most important of Saudi teachers' needs, in light of the current Saudi scenic curricula. This exploration was based on the early stages of open-ended questionnaires and interviews. The programme used in the current research was a 15-session training course, ongoing for two months. The researcher applied the programme, and data were statistically processed by calculation of arithmetic means, standard deviations and (t) values for the variations recognisable between the mean ratings of members across the different groups.

5.1. Before Applying the Proposed Training Programme:

The researcher analysed the pre-application results so as to ensure the homogeneity of the study groups. The results are illustrated in the following table. The table below indicates the absence of any differences viewed as statistically significant when comparing the mean scores of the case-control group and that of the experimental group in the pre-performance of all skills. This indicates homogeneity of the two study groups before applying the proposed training programme.

Table 6: The differences recognised when comparing the control and experimental groups prior to applying the proposed training programme

Skills	PrCntrl N=15		PoExper N=15		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
1. Consider the knowledge of learners so as to guide teaching	5.47	1.25	5.00	1.00	1.13	non statistical
2. Ensure learners are guided in an effort to devise their own explanations and come up with different interpretations	6.13	0.99	6.27	0.96	- 0.37	non statistical
3. Devise incisive questions	5.07	0.80	5.53	0.64	1.68	non statistical
4. Select the resources and tasks that can allow learners to test their ideas	3.93	0.96	4.27	0.96	- 0.95	non statistical
5. Ensure the presence of a classroom setting that is able to facilitate group discourse	0.80	0.56	0.80	0.41	0.00	non statistical
6. Give learners the change to come up with new ideas	0.27	0.46	0.27	0.46	0.00	non statistical
The total	21.67	2.41	22.13	1.41	0.08	non statistical

5.2. The Impact of the Proposed Training Programme:

The T value was calculated so as to show the significance of the differences when comparing the mean scores in regards the experimental group's performance for the main teaching skills prior to and following the application of the proposed programme.

Table 7: The differences between the averages of the experimental group before and after applying the proposed training programme

Skills	PrExper N=15		PoExper N=15		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
1. Use pupils' existing knowledge to guide teaching	5.00	1.00	11.00	0.93	-25.10	0.01
2. Guide pupils to generate explanations and alternative interpretations	6.27	0.96	13.27	1.34	19.89	0.01
3. Devise incisive questions	5.53	0.64	11.67	0.62	25.95	0.01
4.Choose materials and activities for pupils to test ideas	4.27	0.96	13.00	1.46	22.05	0.01
5. Provide a classroom atmosphere conducive to discussion	0.80	0.41	5.73	0.46	27.15	0.01
6. Provide opportunities for pupils to utilise new ideas	0.27	0.46	5.00	1.31	13.22	0.01
The total	22.13	1.41	59.67	1.80	69.23	0.01

The table above shows the statistically significant differences at 0.01 between the mean scores of the performance of the experimental group, both before and after the application of the proposed programme, with a preference for the post-performance, for the main skills as a whole, where the calculated (t) value was 69.23; this is recognised as a high statistically significant value. This emphasises the suggestion initiative as having a positive effect on the development of the main skills as a whole, based on constructivist teaching approaches and the sub-skills falling under them.

Table 8: The differences between the averages of control group and the experimental group after applying the proposed training programme

Skills	PoCntr N=15		PoExper N=15		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
1. Use pupils' existing knowledge to guide teaching	5.67	1.45	11.00	0.93	-12.02	0.01
2. Guide pupils to generate explanations and alternative interpretations	6.27	1.11	13.27	1.34	-14.71	0.01
3. Devise incisive questions	5.47	0.64	11.67	0.62	–11.04	0.01
4.Choose materials and activities for pupils to test ideas	4.27	1.16	13.00	1.46	-18.09	0.01
5. Provide a classroom atmosphere conducive to discussion	0.80	0.68	5.73	0.46	-23.40	0.01
6. Provide opportunities for pupils to utilise new ideas	0.80	0.68	5.00	1.31	–11.04	0.01
The total	23.67	2.61	59.67	1.80	–43.99	0.01

Moreover, the T value has been calculated to show the significance of the differences between the case-control and experimental groups' mean scores in regards their performance in the post-performance for the main skills as a whole, as based on constructivist teaching approaches. The table shows differences that are statistically significant at 0.01 when comparing the mean scores concerning the performance of the experimental and the case-control study groups in the post-performance in favour of the experimental group for the main skills as a whole, as based

on constructivist teaching approaches, where the calculated (t) value was –43.99, which is a high statistically significant value. This shows the proposed programme as having a positive effect in regards the development of the main teaching skills as a whole and on the sub-skills within them.

6. Discussion and Implications:

The findings reported in this study allow some conclusions to be drawn concerning teacher learning in professional development.

6.1. The Needs in Training Programme, as Perceived by Saudi Science Teachers:

The findings garnered indicate that the teachers were not satisfied with their current training programme. The majority of the responses mentioned that there was a mismatch between what Saudi teachers required and what training was provided. Mansour et al. (2014) state that teachers are not involved in communicating their received programmes' goals. This lack of communication and contribution from the teachers, supervisors, PD providers and other professionals in the field may be valuable in terms of reducing the expected outcomes of such schemes. Should teachers believe the content fails to fulfil their needs, CPD experiences, as a result, could be unsuccessful in attracting teachers to attend (EL-Deghaidy et al., 2015). One considered rationale behind the unsatisfactory results of in-service teacher-training could be that programme aims may not have been well aligned in relation to the classroom and personal requirements of teachers (ibid). In this vein, a number of the teachers articulated their disappointment with the programme and further queried its overall value for staff. With this noted, it is worth recognising that in-service programmes need to offer high levels of quality from which the teachers can benefit (Baird & Rowsey, 1989).

The learning and teaching strategies on which teachers preferred to focus through CPD programmes are constructivist teaching, active learning, concept maps, learning by inquiry, and learning based on problems (in a descending order). Moreover, teachers were found to prefer learning and teaching strategies that are constructivist in nature, thus requiring students' effective participation. This shows that teachers seem to benefit most in learning and teaching strategies where students are positively involved and engaged as opposed to merely being passive recipients of knowledge. This is seen to be inconsistent with the work of Flimban (2003), who recognises science teachers in the KSA as requiring training as falling into the behavioural objectives field. The science curriculum devised emphasises current learning and teachers objectives and patterns, with focus on implementing a learner-focused method to inquiry-centred instruction (Almazroa & Al-shamarni, 2015).

Furthermore, the majority of responses were found to relate to practical skills in relation to teachers' needs according to content knowledge in light of the developed chemistry curricula. This finding runs parallel with those garnered by EL-Deghaidy et al. (2015), who found that Saudi science teachers require a larger number of practical skills, more in-depth subject content knowledge, with cultural issues associated with science education with regards knowledge of content. The implications of these findings reflect the need to have training programmes that encompass the hands-on experiences relating to all practical experiments, which could help Saudi teachers to develop their performance with new curricula.

Saudi teachers require different training programmes in order to develop their knowledge and skills with different types of assessment. As the findings in the current study indicate, Saudi teachers seek alternative assessment and

formative assessment. The teachers' needs, according to assessment in light of the developed chemistry curricula, are consistent with Flimban (2003), who found that assessment was the most important training need amongst Saudi biology teachers when they perform teaching. The findings also are consistent with Abu-Alhamail (2005),who indicates that the most important training needs for Saudi science teachers, as based on their own views, was that the training programme should have such strategies in assessment; however, findings in the present work may be considered inconsistent when compared to the work of EL-Deghaidy et al. (2015), which established that few teachers suggested CPD programmes as focusing on 'assessment'. This seems to give the implication that Saudi science teachers, in the present study, are not experienced when devising and adopting different forms of evaluation. In this regard, it is valuable to state that summative assessments, which highlight the generation of results in consideration to students' performance, are recognised as a key assessment instrument in Saudi schools—which is, in turn, also recognised as being the only educational assessment instrument applied (Al-Sadaawi, 2007).

This finding, in the current study, also indicates that Saudi science teachers need to have training programme in virtual laps according to technology in light of the developed chemistry curricula. This finding runs parallel with those reaped in the work of Alshihri (2011), where the scholar aimed to recognise the training needs for science teachers at middle schools. In the 2011 work, the most important conclusion drawn stated that science teachers are unable to use new teaching technology. Comparably, Saudi teachers in the current work study need training programmes to be focused on instruction technology. The

study draws a conclusion to suggest that the new science curricula appear to present a number of new considerations for science faculty, with teachers in the KSA recognising their need of different areas, including pedagogical, content, assessment and technology.

6.2. The Impact of the Proposed Training Programme based on Training Needs:

Constructivist teaching approaches have been recognised as the most important needs for Saudi science teacher in light of the current Saudi scenic curricula. This exploration was based on the early stages of open-ended questionnaires and interviews. Hence, the researcher created a training programme based on constructivist teaching approaches. Based on the experimental approach, the findings indicate that the proposed programme has various positive effects on the development of main skills as a whole, related to constructivist teaching approaches, such as using the knowledge of students in guiding teaching, encouraging students to come up with their own explanations and making different suggestions, brainstorming their own incisive questions, selecting resources and tasks so as to allow students to test ideas, and providing a classroom setting that can facilitate groups discourse and therefore enable chances for students to come up with new ideas. The finding is consistent with Al-Ghamidi (2012), who implemented the professional development programme in light of new science curricula (McGraw-Hill) in the intermediate stage Saudi science teachers. The study's findings highlight the general efficiency associated with the training package in regards improving immediate stage science teachers' professional development in assessment, subsequently garnering a large effect size of 0.82. Thus, it is apparent that the professional development of teachers, in line with their professional

requirements, is a fundamental consideration in ensuring educational reform is indeed a success.

According to Zhu (2010), because the teachers' view was neglected in planning for repairs and professional development programmes, teachers became disturbed, disappointed and annoyed; they may see the repairs as an obstacle. Studies in many countries showed teachers could have doubts about their content knowledge because of inserting new subjects into the curriculum (Juhler, 2017). Also, this could impact on the application of curriculum reform (Henze, Van Driel & Verloop, 2007; Makgato & Mji, 2006). According to Villegas-Reimers (2003), there are cases that are recorded in Hong Kong, England, Wales Australia and Norway.

In a similar way in Saudi Arabia, BouJaoude & Gholam (2014) explained that quality and content relied on requirements that were admitted by those at the higher levels of government ministry rather than on professionals' and communities' demands. For example, in Saudi Arabia, the decision was made to use the abovementioned American book series as opposed to innovating and evolving one in harmony with local science teachers (BouJaoude & Gholam, 2014). At the central level, the recent science curriculum was designed and approved by the Ministry of Education's bureaucrats with little participation from teachers. As a result, Van Driel et al., (2001) stated that in several countries, the teaching repairs were not successful because teachers' knowledge and comprehension of suggested changes for reformed curriculum were inadequate. There are some methods for reform activities that could lead effective achievements by teachers to fail because the developers presumed to know how classroom behaviours could be changed by teachers

(Van Driel et al., 2001). This way can assist in failure because the curriculum or programme developers have not considered the teachers, students, and the culture as a part of the new curriculum or practices. Hence, the traditional way promotes the teachers to not be active members who have discovered new ideas from learning experts (Van Driel et al., 2001). The traditional way, that is named the technical rationality approach, has three essential hypotheses: first, there are common solutions for realistic problems, and second, these solutions could be outside of workable conditions. Third are the solutions that can be distributed amongst teachers as a result of management orders, publications andon-the-job training initiatives.

Further, Villegas-Reimers, (2003) stated that the success of the reforms in Namibia and South Africa are due to the educational reforms that centre on teachers' professional development. Background relating to educational research background could be provided by science teacher preparation programmes, as claimed by Sweeney et al (2001). The continuity of observation, completing inquiries and carrying out analyses in relation teaching and the subsequent student outcomes results in effective teaching; therefore, examination into prospective science teachers, with the involvement of only college professors would not provide Educational research. Supovitz & Turner (2000) claimed that the best means to change teaching practice is through professional development. Clear benefits between what teachers are learning and their own classroom situations make them more engaged participants. Sweeney et al., (2001) said that informed theory by confident educators results in effective modification. This can be achieved by applying the reflective rationality approach which follows these three assumptions: (1) complicated issues, of a practical nature,

require particular solutions; such solutions may be devised only within the context in which the issue is seen to be relevant; teachers adopt the role of decision-makers and critics; and solutions will not be applied successfully if done so in alternative contexts. Such need to be made accessible to other teaching staff in the form of hypotheses that undergo testing in their own individual context.

In mind of the above, the current study has established various implications for the Ministry of Education in the KSA as ultimately it can be viewed as responsible for the educational system and practices, including the necessity to ensure training programmes are offered in mind of improving science teachers' professional development, whilst also taking into account their needs for such training in the presence of sophisticated and modern curricula. This could be achieved by implementing a socio-constructivist lens in relation to the professional development of science teachers. As per the statement made in the 2015 of EL-Deghaidy et al., science teachers in Saudi Arabia have communicated a need for training programmes that are recognised as fulfilling the differences in the new science curricula, which are viewed as relevant not only to their social but also to their school contexts. Importantly, such changes can be responded to through ensuring teaching staff are provided with the most suitable learning instruments to facilitate constructive interaction with their intended contexts (ibid). Accordingly, the training programme needs to encourage discussion and involvement amongst and between teachers and their colleagues, in their own contexts, and in mind of reflecting their own practices (Mansour et al., 2014; EL-Deghaidy et al., 2015).

References

Adams, P. E., & Krockover, G. H. (1997). Beginning science teacher cognition and its origins in the preservice secondary science teacher program. *Journal of Research in Science Teaching*, *34*(6), 633-653.

Alghamdi, A. K. H.,& Al-Salouli, M. S. (2013). Saudi elementary school teachers' beliefs: teaching science the new millennium. *International Journal of Science and Mathematics Education*, *11*(2), 501-525.

Alghamdi, H. (2012). *Proposed training program for the professional development of intermediate stage science teachers in the light of international standards and the requirements of the developed science curricul*a. Unpublished thesis (PhD),Umm al-Qura University.

Almazroa, H. (2013). Professional development: a vision for Saudi science teachers. *A paper presented in the annual conference of European Science Education Research Association (ESERA),* Nicosia, Cyprus.

Almazroa, H., & Alshamrani, S. (2015). Saudi science teacher professional development: trends, practices, and future directions. In N. Mansour and S. Alshamrani (Eds), *Science education in the Arab Gulf States: Visions, sociocultural contexts and challenges* (pp.3-21). Rotterdam: Sense Publishers.

Alshamrani, S., Aldahmash, A., Alqudah, B., & Alroshood, J. (2012). The current situation for science teacher professional development in Saudi Arabia. *The Letter of Arabic Gulf*, *126* (1), 215–261.

Alqahtani, H.M. (2015) Teachers' voice: a needs analysis of teachers' needs for professional development with the emergence of the current English Textbook, *English Language Teaching*; *8* (8), 128-141.

AryY, D., Jacobs, L.C., Sorensen, C.,& Razavieh, A. (2009). *Introduction to research in education*(8th ed.). Stamford: Wordsworth/Thompson Learning.

Almazroa, H., Aloraini, A., & Alshaye, F. (2015). Science and math teacher's perceptions of professional development within the new science curriculum implementation. *Paper presented at the Annual Conference Of The National Association for Research in Science Teaching (NARST)*, Chicago, IL, USA.

Abu-Alhamail, A.A. (2005).*The effectiveness of the proposed training program for biology teachers in the Kingdom of Saudi Arabia in the light of their professional needs*. Unpublished Thesis (PhD in education). Ain Shams university. Cairo.

Alshihri, A.M. (2011).*The reality of the use of learning technologies in middle school science teachers and their training needs*. Unpublished Thesis (PhD in education). KingAbdulaziz University.

Atweh, W., Bernardo, A. B. I., & Balagtas, M. (2008). Capacity building as a collaborative model in international development projects: lessons for the Philippines. In R. K. Coll &N. Taylor (Eds.), *Science education in context: an international examination of the influence of context on science curricula development and implementation* (pp. 3–15). Rotterdam, The Netherland: Sense Publishers.

Baird, W.,& Rowsey, R. (1989). A survey of secondary science teachers' needs. *School Science and Mathematics*, *89*(4), 272–284.

Blaikie, N. (2010). *Designing social research: the logic of anticipation* (2nd ed.). Cambridge: Polity Press.

BouJaoude, S.,& Gholam,G. (2014). The Middle East: Egypt, Lebanon and Saudi Arabia. IN B. Vlaardingerbroek & N. Taylor (eds.), *Issues in upper secondary science education: comparative perspectives* (pp.243-260). Basingstoke: Palgrave Macmillan.

Braun, V.,& Clarke, E.V. (2006). Using thematic analysis in qualitative research. *Qualitative Research in Psychology*, *3* (2), 77-101.

Burns, R.B. (2000). *Introduction to research methods*(4th ed.). London: Sage Publications.

Cohen, L.,& Manion, L. (1994). *Research methods in education*(4th ed.).London: Routledge.

EL-Deghaidy, H., Mansour, N., & Alshamrani, S. (2015). Science tecahers' typology of CPD activities: a socio-constructivist perspective. *International Journal of Science & Mathematics Education,13*(6), 1539-1566.

Ezzy, D. (2002). *Qualitative analysis: practice and innovation*. London: Routledge.

Feiman-Nemser, S. (2001). From preparation to practice: designing a continuum to strengthen and sustain teaching. *Teachers College Record*, *103* (6), 1013-1055.

Flimban, T.A. (2003) *The training needs of biology Saudi teachers based on their views*. Unpublished Thesis (MA Science education), Umm Al Qura University, Mecca.

Ha, A. S., Wong, A. C., Sum, R. K., & Chan, D. W. (2008). Understanding teachers' will and capacity to accomplish physical education curriculum reform: the implications for teacher development. *Sport, Education and Society, 13*(1), pp.77-95.

Handal, B., & Herrington, A. (2003). Mathematics teachers' beliefs and curriculum reform. *Mathematics Education Research Journal*, *15*(1),59-69.

Hayes, M. (2010). *Why professional development matters, learning forward*.Retrieved fromwww.learningforward.org/advancing/whypdmatters.cfm.

Glesne, C. (1999). *Becoming qualitative researchers: an introduction* (2nd ed.). Don Mills, Canada: Longman.

Graff, N. (2011). An effective and agonizing way to learn: backwards design and new teachers' preparation for planning curriculum. *Teacher Education Quarterly*, *38*(3), 151-168.

Küçük, M., & Çepni, S. (2005). Implementation of an action research course program for science teachers: a case for Turkey. *The Qualitative Report*, *10*(2), 190-207.

Lodico, M.G., Spaulding, D.T., & Voegtle, K.H. (2010). *Methods in educational research : from theory to practice*. Hoboken: John Wiley Sons, Inc.

Lotie, D. (1975). *Schoolteacher: a sociological study*. Chicago: University of Chicago Press.

Luft, J.A., Roehrig, G.H.,& Patterson, N.C. (2003). Contrasting landscapes: a comparison of the impact of different induction programs on beginning secondary science teachers' practices, beliefs, and experiences. *Journal of Research in Science Teaching*, 40 (1), 77- 97.

Mansour, N., & Alshamrani, S. (2015). The context of science education in the Arab Gulf States. In N. Mansour and S. Alshamrani (Eds), *Science education in the Arab Gulf States: Visions, sociocultural*

contexts and challenges (pp. xiii- xxi). Rotterdam: Sense Publishers.

Mansour, N., Alshamrani, S., Aldahmash, A., &Alqudah, B. (2013). Saudi Arabian science teachers and supervisors' views of professional development needs. *Egitim Arastirmalari–Eurasian Journal of Educational Research, 51* (1), 29–44.

Mansour, N., EL-Deghaidy, H., Alshamrani, S., & Aldahmash, A. (2014). Rethinking the theory and practice of continuing professional development: Science teachers' perspectives. *Science Education*, *44*(6), 949–973.

McGraw-Hill. (2010). *Science: A closer look*. Retrieved from http://www.macmillanmh.com/science/2010/student/tn_index.html.

Obeikan Education. (2012). *General information*. Retrieved from http://www.obeikaneducation.com/en/content/k-12-education.

Obikan for Research and Development. (2010). *Project of mathematics and natural sciences*. Retrieved from http://msd-ord.com/project.htm.

National Research Council. (NRC). (1996). *National science education standards*. Washington, DC: The National Academy Press.

Ramnarain, U.,&Fortus, D. (2013). South African physical sciences teachers' perceptions of new content in a revised curriculum. *South African Journal of Education*, *33*(1), 1-15.

Sabah, S., Fayez, M., Alshamrani, S., & Mansour, N. (2013). Continuing professional development (CPD) provision for science and mathematics teachers in Saudi Arabia: Perceptions and experiences of CPD

providers. *Journal of Baltic Science Education*, *13*(3), 91–104.

Scott, D., & Morrison, M. (2007). *Key ideas in educational research*. London: Continuum.

So, W.W. (2002). Constructive teaching in primary science. *Asia-Pacific Forum on Science Learning and Teaching*, *3*(1), 50-70.

Silverman , D. (1993). *Interpreting qualitative data*. London: SAGE.

Supovitz, J.A., Mayers, D.P, & Kahle, J.B. (2000). Promoting inquiry-based instructional practice: the longitudinal impact of professional development in the context of systemic reform. *Educational Policy*, *14*(3), 331-356.

Supovitz, J. A. &Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching*, 37(9), 963-980.

Sweeney, A. E., Bula, O.A., & Cornett, J. W. (2001). The role of personal practice theories in the professional development of a beginning high school chemistry teacher. *Journal of Research in Science Teaching*, 38 (4), 408-441.

The Excellence Research Center of Science and Mathematics Education, (ECSME). (2009). *The report of the workshop Priorities of research in science and mathematics education*. Retrieved from http://ecsme.ksu.edu.sa/myfiles/Result.pdf.

van Driel, J. H., Beijaard, D., &Verloop, N. (2001). Professional development and reform in science education: the role of teachers' practical knowledge. *Journal of Research in Science Teaching*, *38*(2), 137-158.

van Driel, J. H., Verloop, N., & de Vos, W. (1998). Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, *35*(6), 673–695.

Villegas-Reimers, E.(2003). *Teacher professional development: an international review of the literature*. Paris: UNESCO International Institute for Educational Planning.

Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological process*. Harvard University Press.

Zhu, H. (2010). Curriculum reform and professional development: a case study on Chinese teacher educators. *Professional Development in Education*, *36*(1-2), 373-391.