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# A Phenomenological Case Study of Pakistani Science Teachers' Experiences of Professional Development

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**ACCEPTANCE**

This dissertation, A PHENOMENOLOGICAL CASE STUDY OF PAKISTANI SCIENCE TEACHERS' EXPERIENCES OF PROFESSIONAL DEVELOPMENT, by AZHAR MAJEED QURESHI, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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# A PHENOMENOLOGICAL CASE STUDY OF PAKISTANI SCIENCE TEACHERS' EXPERIENCES OF PROFESSIONAL DEVELOPMENT

by

AZHAR QURESHI

Under the Direction of Dr. Kadir Demir, Ph.D.

## ABSTRACT

Effective teacher development is significant for any educational system to remain competitive in the global arena (Bayar, 2014). However, science teachers' professional development activities have often been found to be ineffective (Opfer & Pedder, 2011). Science teachers also minimally participate in such activities due to their ineffective experiences (Chval, Abell, Pareja, Musikul & Ritzka, 2007). Understanding how science teachers' experiences are constructed is also crucial to create programs to meet their needs (Schneider & Plasman, 2011). It is essential in the construction of professional development experiences to recognize who is being served in professional development

(Saka, 2013). But rigorous methods are required to understand the outcomes of professional development (Koomen, Blair, Young-Isebrand & Oberhauser, 2014).

The purpose of this phenomenological case study was to study how secondary school science teachers describe their lived experiences of professional development in Punjab (Pakistan). How do these teachers understand, make sense, and use of those intended goals of professional development opportunities and change their practices through the implementation of learned knowledge of professional development? This study used purposive sampling to collect the qualitative data from fifteen secondary school science teachers of Punjab (Pakistan). The data collection was done through conducting semi-structured in-depth phenomenological interviews with these science teachers (Seidman, 2013). The data were analyzed using three-stage coding methods, and thematic analysis.

Three main themes emerged from the analysis of data. The first theme of sense making is about their understanding and description of intended meaning of professional development activities. The second theme of meaningful experiences captured the participants perceived benefits from the PD activities. The third theme of contextual and cultural factors is focused on the understanding the impact of these factors in imparting of professional development experiences. The findings of the study communicate the significance of science teachers' role in professional development activities. Science teachers' voices, needs and active involvement must be taken into consideration in the designing and implementation of such activities.

INDEX WORDS: Professional development, Lived experiences, Pakistani science teachers, Professional learning and change, Science teachers' learning needs, Active learning, Reflective practices.

# A PHENOMENOLOGICAL CASE STUDY OF PAKISTANI SCIENCE TEACHERS' EXPERIENCES OF PROFESSIONAL DEVELOPMENT

by

AZHAR QURESHI

A Dissertation

Presented in Partial Fulfillment of Requirements for the

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in

Middle and Secondary Education

in

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Georgia State University

Atlanta, GA
2016

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## DEDICATION

This dissertation is dedicated to my family;

To my parents, *Abdul Majeed Qureshi* and *Abida Khanum*, who were always with me. My father who believed that I would get there and died without seeing me. I will always feel the guilt of not serving him in his last times. I am here just because of my parents' prayers and blessings that enlightened the path on this long journey.

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# 1 A COMPARATIVE REVIEW OF THE LITERATURE ON PAKISTANI SCIENCE TEACHERS' PROFESSIONAL DEVELOPMENT

The global education scenario is largely characterized by the evident trend of an ever-increasing focus on science subjects and consequently, science teaching. Teacher professional development (PD) refer to those PD programs that planned to prepare teachers for better performance by improving their knowledge, skills, and motivation to increase learning for all students (Melville & Yaxley, 2008). In science education, PD aims to support science teacher learning with the goal of improving student achievements (Whitworth & Chiu, 2015). Teachers' roles in the inception, implementation, and evaluation of PD is central to successful and sustained PD (Luneta, 2012). Different aspects of PD can be well understood through an evaluation of the relationship between PD and science teacher learning and experiences.

Science teachers' PD learning is defined as the active involvement of science teachers in learning activities provided by school authorities to improve their performances. It can happen in a range of situations both within and outside of schools, through a variety of structures (Council, 2016). According to Hargreaves and Shirley (2012), meaningful professional learning relies on the individual teacher realizing a need to think and work differently. It can be implemented through participation in formal PD programs or by becoming a member of professional learning communities. For in-service science teachers, PD learning offers varied opportunities to build capacity for informed decision making, transformation in their instructional practices and ultimately, student outcomes (Smith & Lindsay, 2016).

It has been generally known, on the international level, that PD for science teachers is very critical for the success of science education. The science teachers' PD activities are under constant criticism by researchers, as science teachers largely fail to apply these activities in their real classrooms, resulting in little or no improvement in the students' learning outcomes (Buczynski & Hansen, 2010). Similarly, despite this recognized significance, PD programs have been blamed for not having significant promising effects on teachers' practices in both Eastern and Western worlds. For example, in the US, most of the PD opportunities that are accessible to science teachers are detached from the real-world aspects of teaching (Loucks-Horsley, Stiles, Mundry, Love & Hewson, 2009). The findings from Programme for International Student Assessment (PISA), the Trends in International Mathematics and Science Study (TIMSS), and in Eurydice studies of European countries (2007-09) disclosed that regardless of the PD programs, traditional science teaching approaches are still dominant in schools in the European region (Scheerens, 2010). The situation is even worse in the countries of Africa and Asia, where science teachers lack sufficient resources, as well as the research culture, and are characterized by a reluctance to accept change.

Pakistan, like several other countries of the world, has continually been criticized for its unproductive PD policies and practices for teachers due to low student achievement. The mean achievement scores of students in science subjects at national achievement tests were 483 below than the mean achievement scores of 500 (National Education Assessment System [NEAS], 2014). Most the science teachers could not get a chance for

attending various science content courses. Different PD programs had minimal contribution to the training of teachers for ground-teaching realities (United Nation Education Scientific & Cultural Organization [UNESCO], 2003).

Many science teachers (62%) in Pakistan were found uncomfortable in teaching the scientific concepts properly (NEAS, 2014). The teachers have complicated the pedagogy of science as carried out in the conventional approach to science education. Whereas, in Europe and the USA, there are some strategic frameworks for the promotion of science education. In these countries, teachers have more positive views about scientific indigenous knowledge and practices than Asian teachers in PD learning (Chinn, 2006). There is a requirement to construct the operationalized knowledge of PD for Pakistan to expand the ways of knowledge creation, examination, authentication, and distribution. This also implies the need to review the current Western literature[1] on PD designs and practices to explore the ways of fixing the issues of Pakistani PD.

With this purpose in mind, the current study set out to search the comparative understanding of science teachers' PD learning and experiences in Pakistan. The study was carried out to review the literature on science teachers' PD learning and experiences in the Western context (The US and European countries) while comparing it with the situation of Pakistani science teachers' PD practices. Reviewing literature in comparative context will bring critical questions of how to increase effectiveness in Pakistani PD practices. The discussion draws comparative view and important lessons for the Pakistani science teachers' future design of PD learning and experiences.

[1] The literature written in the context of Western culture.

## Method of the Literature Review

A literature review was conducted to collect relevant information on science teachers' PD learning and experiences at the school level in both Western and Pakistani contexts. Science Direct and EBSCO hosts were the main search engines. Also, a rigorous document search was conducted on google and google scholars. The term PD was held constant due to its centrality to the review. Different terms like science teacher learning, learning effectiveness, science teacher practices, science teachers' needs, science teachers' experiential challenges, learning challenges and issues, and science teachers' strategies, with both British and American spellings were used to search the databases.

Two lines of inquiries were adopted for this review of science teachers' PD learning and experiences for comparison of Pakistan with the Western context. Firstly, for understanding PD learning and experiences in the Western contexts, research articles published in peer-reviewed journals for the period, 2001-2016 were included. However, conference proceedings, books, book chapters, and non-reviewed publications were excluded for this section. For Pakistani context, the literature selection included only those research articles, reports and official documents published in English and containing information on Pakistani science education. Only the literature which included science teachers' PD programs at school level (K-12) were included for both sections.

The following research questions were addressed:

1. What is the focus of the literature review on science teachers' PD learning and experiences in the Western context? How do the different features of PD learning and experiences support or impede PD effectiveness?

2. What is the focus of the literature review on science teachers' PD learning and experiences in the Pakistani context? How do the different features of PD learning and experiences support or impede PD effectiveness?

3. What implications does the information gathered from the literature review have for Pakistani policy makers and researchers for developing research programs in studying PD programs and designing effective PD programs?

The first part of the review considers the science teachers' PD learning and experiences in the Western context. What features of PD learning and experiences are reported in the literature that supports or impede PD effectiveness? The second part of the literature review concentrates on Pakistani science teachers' PD learning and experiences that support or impede PD effectiveness. It also entailed the implications for Pakistani stakeholders on an improvement of science teachers' future PD learning and experiences. The third part, Discussion and Conclusions compiled the comparisons of Pakistani science teachers' PD learning and experiences with that of the Western context.

## Science Teachers' PD Learning and Experiences in Western Context

In the Western Context, science teachers' PD in an academic setting which is viewed as an ongoing learning experience that begins with the teachers' entrance into the classroom teaching experience and career continues until the end of their final years of career (Desimone, 2009; Guskey, 2002). It includes formal, structured topic-specific seminars provided on PD days, to everyday informal staffroom discussions among science teachers about instructional techniques, embedded in science teachers' everyday lives. Likewise, PD is the only approach that schools practice to ensure that the teachers are continually strengthening their practices with new research aimed at nurturing

knowledge, critical thinking, and problem-solving among students (Desimone, Porter, Garet, Yoon & Birman, 2002). The purpose of effective PD programs is to bring about positive changes in the participants' professional life so that they can interact with their social and cultural realities (Buczynski & Hensen, 2010).

The most effective PD practices are those that focus on science teachers as individuals and results in sustainable changes in teachers' learning (Desimone, 2009). These PD practices regard science teachers as participants in the identification of their learning needs. Effective PD can result in changing science teachers' practices by enhancing professional experiences, personal epistemologies, openness, and willingness for change (Asghar, Ellington, Rice, Johnson & Prime, 2012; El-Hani & Greca, 2013; Guskey & Yoon, 2009; Lee & Buxton, 2013; Santos & Oliveira, 2006).

Teacher learning outcomes were shaped through PD structure, design, and objectives (Zientek, 2014). An extensive body of the literature was reviewed to determine the following: impacts of PD on science teacher learning and experiences (Bell & Odom, 2012; Eilks & Markic, 2011; Opfer & Pedder, 2011; Posnanski, 2010); Science teachers' growth and change (Akiba,2012; Banilower, Heck & Weiss, 2007; Duzor, 2012; Goodnough, 2010; Melville & Yaxley, 2009; Ramlo, 2012; Tan & Nashon, 2013); positive relationship with instructional practices (Beamer, Sickle, Harrison, Temple, 2008; Desimone et al., 2002; El-Hani & Greca, 2013; Kazempour,2009; Lee & Buxton, 2013; Smith, 2015); reflective practices (Capobianco & Feldman, 2006; Mamlok-Naaman & Eilks, 2012; McNicholl, 2013; Saylor & Johnson, 2014; Tang & Shao, 2013); and Science teachers' self-perception (Allen & Penuel, 2015; Lusticks, 2011; Mikelskis-Seifert & Duit, 2013;Mokhele & Jita, 2010; Torff & Byrnes, 2010).

Several researchers have measured the impact of PD learning on instructional effectiveness through measuring student outcomes. For instance, in the studies focused on student learning outcomes, the students' classroom achievements were evaluated by assessing their positive attitudes towards science learning (Adamson, Santau & Lee, 2012; Diamond, Maerten-Rivera, Rohrer, & Lee, 2014; Foster, Toma & Troske, 2013; Herman, Clough, & Olson, 2013; McNeill & Knight, 2013; Oliveira, Wilcox, Angelis, Applebee, Amodeo, & Snyder, 2012; Santos & Oliveira, 2006; Sinclair, Naizer, & Ledbetter, 2010; Sullivan-Watts, Nowicki, Shim, & Young, 2013).

In order to make PD practice relevant, useful, and meaningful, it is essential to consider the positive experiences of teachers (Bayar, 2014; Guskey, 2002; Sexton, Atkinson & Goodson, 2013). Presently, Western literature focuses on the specific ways in which science teachers learn and experience during PD activities, and the ways in which PD programs support their changing attitudes and beliefs towards science teaching (Heni, Mansour, Aldahmash, & Alshamrani, 2014; Imant, 2002; Park, Martin, & Chu, 2015; Visser, Coenders, Pieters, & Terlouw, 2013).

In summary, science teachers' PD learning and experiences studied the PD impact on science teachers' experiences, instructional practices, and student outcomes. Recent trends focus on how these PD learning and experiences are utilized, supported, and made useful for practices.

## A Brief Literature Review on Learning and Experiences of Science Teachers in the Western Context through PD

Numerous researchers have asserted that evaluating the effects of PD programs on science teachers' learning is a complex process (Allen & Penuel, 2015), which varies

across the context of the school environment to national policies (Luft & Hewson, 2014). According to Garet et al. (2001), a majority of the researchers agreed as to what establishes effective PD activities. Despite this, there is only limited literature available on the issue as to how these activities are translated into teachers' professional learning ( Loughran, 2013; Opfer & Pedder, 2011; Smith & Lindsay, 2016). Further, the literature showed that there is no single model of PD to demonstrate the top-rated PD activities that can affect teachers' learning experiences (Lustick, 2011). However, in order to understand how science teachers learn, it is essential to investigate the multiple contexts and factors in and with which they work (Borko, 2004).

Existing literature categorized the core features or characteristics of effective PD activities into structural and process features of PD learning. Structural features define the characteristics of the design of PD activities. For instance, activity format (that is, reform types such as, collaborative study or networking, or traditional types like, conferences or workshops), activity duration, and the degree to which the activity engages the shared contribution of teachers from the same school/grade. On the other hand, process features define the types of learning and experiences that PD activities provide to the teachers. For instance, the PD activities which are content-focused, offering active learning opportunities to evaluate teaching and learning, and determining the degree to which these actions are coherent with the teachers' goals and state standards.

The identification of fundamental features requires a systematic review of each of these core features in programmatic research to measure their individual effect on the teachers' instruction and student performance (Desimone, 2009; Supovitz & Turner,

2000). However, the literature has also identified certain common features which are found to be associated with effective PD learning. For instance, five common features of effective PD learning and experiences which have been commonly identified by different research studies include, focus on content, active learning, coherence, sufficient duration for practice and reflection on PD experiences (Bayar, 2014; Desimone, 2009; Guskey, 2002, Hynds et al., 2011; Tytler, Symington, Darby, Malcolm & Kirkwood, 2001; Zientek, 2014). Similarly, several other researchers have also added additional features of PD learning experience to the list. A synthesized view of different features of science teachers' PD learning and experiences along with an operational definition of each feature and scholars involved in the Western context are given in Table-1

**Active Learning Experiences**

The literature on effective PD learning and experiences gave special emphasis to 'active learning' which was based on the view of describing learning in which the learner interacts with the information and experiences (Garet et al., 2001). According to Desimone et al. (2002) and Saylor & Johnson (2014), effective PD learning and experiences entails active participation of science teachers in the PD process. Active learning experiences have been appreciated to have a positive impact on teachers' practices through building their motivation, reflective thinking, personal epistemologies, attitude change, openness and willingness to change (Akiba, 2012; Santos & Oliveira, 2006). Further, it was also asserted that active learning has the potential to result in more sustained change compared to other forms of learning (Borko, Davinroy, Blien & Cumbo, 2000).

Table 1.

A Synthesized Review of the Literature on Science Teachers' PD Learning and Experiences in the Western Context

| Features | Key Findings(s) | Contributed Scholar (s) |
|---|---|---|
| Active Learning Experiences | PD experiences provided to science teachers have an impact on science teachers' instruction approaches. | Akiba, 2012; Bergh, Ros & Beijaard, 2015; Desimone et al., 2002; Garet et al., 2001; Grady, Simmie & Kennedy, 2014; Greene, Lubin, Slater & Walden, 2013; Saylor & Johson, 2014; Smith & Lindsay, 2016 |
| Knowledge and Beliefs Construction | Science teachers' PD knowledge construction depend on their existing knowledge and beliefs. | Allen & Penuel, 2015; Banilower, Heck & Weiss, 2007; Berry, Loughran, Smith & Lindsay, 2009; Crippen, 2012; Heck, Rosenberg & Crawford, 2006; Lotter, Rushton & Singer, 2013; Torff & Byrne, 2010; Zwiep & Benken, 2013 |
| Learning Needs | What they already know and what they need to learn should be emphasized and improved on. | Armour & Makopoulou, 2012; Bayar, 2014; Bernhardt, 2015; Chval et al., 2007; Nir & Bogler, 2008; Petrie & McGee, 2012; Ramlo, 2012; Miles, 2002; Roseler & Dentzau, 2013 |
| Follow-up Experiences | Effective PD programs contain follow-up experiences with multiple interactions. | Antoniou &Kyriakides, 2013; Coenders, Terlouw, Dijkstra & Pieters, 2010; Eilks & Markic, 2011 |
| Teacher Research | Teachers learn through their action research opportunities to make an informed decision about instruction. | Baumfield, 2007; Bissonnette & Caprino, 2014; Cabaroglu, 2014; Capobianco & Feldman, 2006; Corte, Brok, Kamp & Bergen, 2013; Harnett, 2012; Mamlok-Naaman & Eilks, 2012; Rathgen, 2006 |
| Reflective Practices | Examining of current and past professional practices and improving future practices through problem-solving strategies. | Beamer, Sickle, Harrison & Temple, 2008; Bocala, 2015; Faber, Hardin, Klein-Gardner & Benson, 2014; Henze, van Driel & Verloop, 2009; Mamlok-Naaman & Eilks, 2012; McCullagh, 2012; Muir, Beswick & Williamson, 2010; Van Driel, Deijaard & Verloop, 2001 |
| Communities of Practice | The activities of professionals such as, coaching, teaming, partnerships, and other collective efforts have positive impacts on both instructional practices and student achievements. | Akiba, 2012; Aydin et al., 2013; Barr & Nieuwerburgh,2015; Boyle, While & Boyle, 2004; Cox-Petersen, Spencer & Crawford, 2005; Duzor, 2012; El-Hani & Greca, 2012; Eilks & Markic, 2011; Goodnough, 2010; Howe & Stubbs, 2003; Ngcoza & Southwood, 2015; Owston, Wideman, Murphy & Lupshenyuk, 2008; Patton, Parker & Pratt, 2013; Pareja Roblin & Margalef, 2012 |
| Leadership and organizational Support | School principals, through their deliberate actions, identify, allocate, and support resources for teachers' professional learning. | Buczynski & Hansen, 2009; Fitzgerald & Theilheimer, 2012; Hobbs, 2012; Imants, 2002; Jacobs, 2012; Lovett & Cameron, 2010; Masuda, Ebersole & Barrett, 2012; Oliveria et al., 2013; Opfer & Pedder, 2011; Rhodes & Beneicke, 2002; Sandholz & Ringstaff, 2016; Whitworth & Chiu, 2015 |
| Participation Experience | Positive teachers' experiences of participation make PD learning relevant, useful, and meaningful. | Bayar, 2014; Guskey, 2002; Kazempour & Amirshokoohi, 2014; Kwakman, 2002; Lalor & Abawi, 2014; Lustick,2011; Mikelskis-Seifert & Duit, 2013; Nielsen, 2012; Sexton, Atkinson & Goodson, 2013; Roux,2013; Saka, 2013; Saunders, 2012; Seidel et al., 2010; White, Bloomfield & Cornu, 2010 |

**Knowledge and Belief Construction**

The evaluation of changes in science teachers' beliefs as a result of their participation in PD is a complex process and consists of interactions between PD learning, school contexts, and teachers' beliefs of science (Deniz & Akerson, 2013; Gao & Wang, 2014; Kazempour & Amirshokoohi,2014; Posnanski, 2010). Research studies suggested that science teachers' existing ideas, beliefs, experiences, concerns, interest and feelings towards PD programs are criteria to consider in developing effective PD activity (Aflalo, 2012; Dare, Ellis & Roehrig, 2014; Lotter, Rushton & Singer, 2013).

There is growing consensus among Western researchers that Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) must be the emphasis of PD programs due to its effectiveness in PD learning and experience. Most research studies also investigated the Pedagogical Content Knowledge (PCK) as an indicator of science teachers' learning (Akerson & Hanuscin, 2007; Banilower, Heck & Weiss, 2007; Garet et al., 2001; Lehiste, 2015; van Driel & Berry, 2012; Zwiep & Benken, 2013 ).

**Learning Needs**

Another crucial element to be considered regarding PD learning and experience is to match the PD programs with the science teachers' learning needs ( Bayar, 2014; Miles, 2002). Science teachers' learning needs can be explored by placing focus on needs during the PD design and implementation. A major shortcoming noted by researchers who have studied PD programs for science teachers is that many PD programs fail to consider factors such as teachers' views, perceptions, and needs (Capobiano, Lincoln & Canual-Browne, Trimarchi, 2006; Duzor, 2012; Hermann, 2013; Kazempour & Amirshokoohi, 2014).

**Follow-up Experiences**

The amount of feedback and continued support offered to science teachers is also critical in the effectiveness of PD programs (Bernhardt, 2015). For ensuring effective PD learning and experiences, PD developers must set explicit teacher learning goals. There is a need to support science teachers' implementation of PD learning and assess them in follow-up activities to ensure that science teachers apply their PD learning and experiences (e.g., Antoniou & Kyriakides, 2013; Boyle, While & Boyle, 2004). By engaging in such follow-ups, a coherence between the PD designs, instructional practices, and learning environment is established. (Coenders, Terlouw, Dijkstra &Pieters, 2010; Eilks & Markic, 2011).

**Teacher Research**

Teacher research or action research is conducted by teachers to inform and improve upon their practices. It is predominantly considered to be a Western concept, which has been regarded as a means to empower the science teachers' knowledge and practices (Baumfield, 2007; Capobianco & Feldman, 2006; Harnett, 2012). Literature has indicated that the core conceptions of science teachers significantly change when they engage in action-related research activities. According to Kazempour (2009) and Rathgen (2006), these changes have translated into their classroom practices. This job-embedded approach engages teachers in meaningful and purposeful ways during and after PD and brings about effective professional learning in teachers (Bissonnette & Caprino, 2014; Corte, Brok, Kamp & Bergen, 2013). Different studies have emphasized that research-based PD experiences can influence the motivation of science teachers. Likewise, their action-related research or participatory experiences can help them in their transition from

a guided experience to freedom, making them feel useful and motivated (Faber, Hardin, Klein-Garden, & Benson, 2014). Their voices, viewpoints, and experiences as researchers empower them to play active roles in PD learning (Capobianco, Lincoln, Canuel-Browne, & Trimarchi, 2006).

**Reflective Practices**

Reflective practices involve the mental process of reflection and are considered to be a strong critical feature of PD learning and experiences. Through reflective practices, science teachers can effectively increase their competence to critically reflect upon both the curriculum framework and the circumstances in which they have to work (Mamlok-Naaman & Eilks, 2011). These positive outcomes of reflection and reflective practices can be in the form of increased quality of teaching and learning. Teachers can personalize their professional learning and experiences through reflective research practices (Corte, Brok, Kamp, & Bergen, 2013; Cimer & Palic, 2012). Further, reflective practices have been recognized as a popular feature that aids the understanding of PD, empowerment, and decision making, as well as students'outcomes (Bocala, 2015; McCullagh, 2012; van Driel, Deijaard & Verloop, 2001).

**Communities of Practices**

According to the claims put forward by Western literature, when science teachers work as members of the professional learning communities, their PD learning and experiences may not be confined to a formal participation in a PD program. It can be shaped in the form of social interactions ( Boyle, While, & Boyle, 2004; Eilks & Markic, 2011). Similarly, Vazquez-Bernal, Mellado, Jimenez-Perez, and Lenero (2012) mentioned that "teachers do not easily change their conceptions, and even less so, their

educational practices" (p. 338).Teachers need to continue to learn through the emotional support of the community of practice to gain a solid knowledge of the content (McNicholl & Black, 2013).

Professional learning community as a professional capacity established clear goals, measure student learning regularly, and work collaboratively to support their professional learning ( Ngcoza & Southwood, 2015; Patton, Parker & Part, 2013). PD learning through the community of practices have been found to result in positive practice outcomes among science teachers ( Howe & Stubbs, 2001; Kazempour & Amirshokoohi, 2014; Saka, 2013; Sexton, Atkinson &Goodson, 2013; Tang & Shao, 2014). When teachers were provided opportunities to grow, they took up responsibilities that positively affected their instructional practices. Likewise, teachers, based on their research outcomes, studied the preferred situation for instruction and tried to influence students' outcomes (Corte, Brok, Kamp, & Bergen, 2013).

**Leadership and Organizational Support**

During the few decades of research on teacher PD learning in the West, a specific emphasis was placed on the role of leadership and organization support in building the capacity of the science teacher workforce (Buczynski & Hansen, 2009; Imant, 2002; Opfer & Pedder, 2011; Sandholz & Ringstaff, 2016; Whitworth & Chiu, 2015). In line with this, it is believed that school principals have a central role to play in support of PD learning and experiences, through developing teacher leadership, and cultivating the learning communities. Different organizational conditions and availability of resources can also produce contexts that allow teachers to benefit more from PD learning opportunities. Likewise, research studies specified the obstacles of teachers' learning to

be: limited school resources, teachers' time constraint, and classroom management issues (Buczynski & Hansen, 2009; Hobbs, 2012).

**Participation Experiences**

Teacher's participation in PD and experiences is considered to be a critical feature of teacher's learning and change. A successful PD program helps teachers acquire meaningful experiences and enables them to implement new ideas in schools (Banilower, Heck, & Weiss, 2007; Kazempour, 2009). However, participation in different PD experiences is embedded in temporal flows and sometimes standout as disruptive or unmotivated actions (Daugbjerg, Freitas, Valero, 2015). Studies have also shown that science teachers' learning and experiences are evolving in specific PD situations (Lehman, Goerge, Rush, Buchanan, & Averill,2000). These meaningful experiences are, mostly, based on teachers' attitudes towards PD, those who are intensely motivated to attend the PD programs are likely to learn and change after participation ( Smith et al., 2003). Teachers' motivation are linked with the perceptions emerging from the interactions within PD program, associated curriculum materials, and professional activities of their colleagues and leaders in their schools (Allen & Penuel, 2015).

**Issues Observed in the Effectiveness of PD Programs in the Western Context**

Research studies have identified the ineffective features of PD programs for science teachers' learning and experiences. These included fragmentation, lack of implementation, and lack of teacher-centeredness ( Bissonnette & Caprino, 2014; Lusticks, 2011). For some, teachers' learning was a general activity instead of a concept or a discipline-specific activity (Zhang, Parker, Koehlar & Eberhardt, 2015). The sustainability of PD learning and experiences were challenging in these countries. Most

PD programs used traditional approaches that were not helping teachers to revise what to teach and how to teach (Borko, 2004; Wallace, 2013).

Loucks-Horsley et al. (2009) stated that most PD programs did not feature a well-designed and continuous support system. Most of them were incapable of effectively addressing science teachers' learning needs (Bergh, Ros & Beijaard, 2015). Mostly, their racial, historical, and curricular perceptions and challenges of participation in PD learning were not taken into account in the design, implementation or improvement of the programs (Atwater, Butler, Freeman & Parsons, 2013). Similarly, some programs did not take the attitudes of science teachers into consideration due to which teachers refused to participate (Boyle, While & Boyle, 2004; Maskit, 2013; Torff & Byrness, 2011).

Science teachers also perceived PD as fragmented, incoherent, and unrelated to the problems of instructional practices (Lieberman & Macece, 2008). Current PD practices weaken the professionalism of teachers, as understanding and preparations that reduce teachers' power to choose on objectives and methods are externally imposed. Teachers just act like specialists, ensuring somebody else's design (McCullough et al., 2000). Most of the time, feedback provided on teachers' PD learning by school leaders are not consistent (Bernhardt, 2015; Rhoton & McLean, 2008).

This last section reviews the Western literature on PD learning and experiences of science teachers in two areas: the fundamental features of science teachers' PD learning and experiences, which includes experiences of active learning, participation, followup, collaboration, teacher research and reflective practices. The organizational features of leadership, a community of practices, and support, and follow-up experiences were identified as essential. Most of the features are interwoven with PD effectiveness. The

collegial culture in schools and collaboration between science teachers were determined to be key determinants in nuturing science teachers' PD learning and experiences. The second area of this section addresses the challenges and issues of science teachers PD learning and experiences. These issues and challenges indicated the contextual and cultural nature of PD learning and are required to enhance teachers' learning needs as well as beliefs and expectations.

## Science Teachers' PD Learning and Experiences in Pakistani Context

The current practices of science teachers' PD in Pakistan are provided through a single workshop or at best, a series of sessions. The teachers in public sectors utilize the traditional Cascade model to instigate PD learning. Most PD programs emphasize on the effectiveness of teachers by stimulating stress on the technical aspects of their profession (Ali, 2011).

This section of the review explores the PD learning and experiences of science teachers in Pakistan, which is further segregated into two subsections. The first section focuses on providing a brief background of the Pakistani PD structures and reform efforts for enhancing science teachers' learning while exploring the effectiveness of PD. The second section concentrates on the exploration of relevant literature that focuses on different facets of science teachers' learning and experience, and the challenges encountered pertaining to PD effectiveness.

### Background and Structure

Pakistan's independence in 1947 initiated various reform efforts to bring about quantitative and qualitative changes in science teachers' learning and experiences. In 1950 in Pakistan, science as a subject was offered in primary and middle schools. In

1959, the Pakistani Government started focusing on science teaching and recommended science as a compulsory subject for Grade Levels 6 to 8 (Iqbal & Mahmood, 2000). Several past educational policies (1959-2009) have shifted the emphasis put on the teaching of science at the school level to uplift the status of science and technology education in the country (Government of Pakistan, 2009).

One of the significant efforts for promoting the quality of science teaching at the national level came in 1984 with the help of the Asian Development Bank and Organization of Petroleum Exporting Countries (OPEC) with the start of Science Education Projects. The Government initiated this unique instituionalized effort to improve PD strategies for science teachers' professional learning. Through this effort, institutions' basic capacities were raised through providing laboratory resources, school equipments, revising the science curricula, and providing PD to science teachers (Shaheen, Rehman, Gujjar, Bajwa, & Ramzan, 2010).

The National Institute of Science and Technical Education (NISTE) was established in 2004 with the purpose of creating awareness among stakeholders for the development of science teaching skills. NISTE organized more than 500 PD programs between 2005-2008 on the discipline of science, mathematics, computer, and technologies for technical training. The institute trained 2,603 science and technical teachers during the first four years of establishment. These PD programs provided an opportunity for science teachers to learn and share their knowledge, expertise and experiences (Government of Pakistan, 2009). NISTE between the years 2009-2012 implemented the Project for Promotion of student-centered and inquiry-based Science Education. Underneath this project, different revision of the national curriculum for science was introduced and new PD

models based on student- centered and inquiry-based (SCIB) science lessons were included.

In the Punjab province of Pakistan, significant changes took place regarding science teachers' PD under the Science Education Project (SEP-1) and Science Education Project Phase-II (1999-2007). Because of these initiatives, the emergence of 71 Regional Training Centre (RTCs), 302 multi-purpose laboratories and 298 Mathematics Resource Room (MRR) were provided at the secondary level. To improve capacity, around 28,000+ heads of schools and science teachers' PD trainings in the subject of physics, chemistry, biology, mathematics, general science, and computers were implemented. Also, 43 science teachers received foreign training in Australia and Malaysia for five weeks (Government of the Punjab, 2008).

In 2004, the Directorate of Staff Development (DSDs) was established as an apex organization to monitor the public-sector education scheme through a framework of continuous professional development (CPD) to ensure quality learning among science teachers. Along with the DSDs, different public sector institutions like the University of Education, Institutes of Education, and Research (IERs), Provincial and Regional Institutes of Teacher Education and Universities' Departments of Education provided different types of science teacher in-service PD training at elementary and secondary levels.

## A Brief Literature Review on Learning and Experiences of Science Teachers in Pakistani Context through PD

Studies conducted in Pakistan revealed that professional learning outcomes are produced through several effects such as socio-economic, spiritual, and collective struc-

tures of individuals (Halai, 2001; Pardhan, 2005; Rizvi, 2004). According to these researchers, becoming an effective science teacher in Pakistan depends on the acquisition of reflecting skills and pedagogical knowledge through a personal learning experience, support and training received from other professionals. Similarly, the professional learning of science teachers can be explored through identifying its key features. A synthesis of key features and major findings of research on Pakistani science teachers' learning experiences through PD is presented in Table-2. Following, a brief description of each of those PD's key features and major findings, summarized in Table-2 are presented.

**Knowledge and Beliefs Construction**

Ahmad (2000) found that beliefs as teachers' personal knowledge together with professional pedagogical knowledge can influence PD practices. The beliefs about learning and teaching of science are developed through different sources like teachers' personal experiences as students and professional experiences as science teachers (Begum, 2012; Mahmood, 2013). Different researchers in Pakistan recommended that for adequate development of PD programs, the science teachers' existing ideas, beliefs, experiences, concerns, interest and feelings towards their learners, instruction, and organizations must be comprehended and inculcated in the structure of such programs (Iqbal, Azam & Rana, 2009; Pardhan, 2003; Perveen & Bhutta, 2012; Saeed & Mahmood, 2015; Shah, 2009; Tajuddin, 2014).

Asghar (2013) mentioned that dynamic interactions between their religious, cultural, and scientific sphere of learning come into play and due to this, their instructional practices are influenced. Research studies conducted in Pakistan recognized the contextualized and personalized nature of science teachers' knowledge construction during PD

Table 2.

A Synthesized Review of the Literature on Science Teachers' PD Learning and Experiences in the Pakistani Context

| Features | Major Findings | Researcher(s) |
|---|---|---|
| Knowledge and Beliefs Construction | Science teachers' PD knowledge construction are influenced by their personal knowledge as well as professional experiences | Ahmad, 2000; Ali, 2011; Asghar, 2013; Begum, 2012; Halai, 2006; Halai &Khan, 2011; Halai & McNicholl, 2004; Iqbal, Azam, Rana, 2009; Pardhan, 2005; Perveen & Bhutta, 2012; Mahmood, 2013; Shah, 2009; Tahir, 2010; Tajuddin, 2014; Thomas, 2013 |
| Learning Needs | What they already know and what they need to learn are not considered in PD | Akhtar, Shah & Naseer-ud-Din, 2011; Haider & Ali, 2012; Imran & Chaudary, 2012; Iqbal & Mahmood, 2000; Tajuddin & Khan, 2014; Vazir, 2003 |
| Teacher Research | Teachers learn through their action research opportunities to improve their practices. | Anwar & Bhutta, 2012; Goderya-Sheikh,2012; Halai, 2011; Halai & McNicholl, 2004; Khan & Begum, 2012; Mahmood,2013; Meher, 2014; Pardhan,2005; Penny, Ali, Farah, Ostberg, & Smith, 2000; Retallick & Mithani, 2003; Zareen, Kayani, & Kayani, 2014 |
| Reflective Practices | Investigation of implemented knowledge should be carried out to identify reflective practices. These reflective practices are influence by several factors. | Alam, 2012; Halai, 2011; Halai & Khan, 2011; Khan & Begum, 2012; Mahmood, 2013; Meher, 2014; Pardhan, 2003; Khan &Begum, 2012; Shamim & Halai, 2006; Uddin & Khan, 2014; Westbrook, Shah, Durrani & Tikly, 2009 |
| Communities of Practice | Communities of professional impacted the creation and management of PD knowledge. | Ali, 2011; Hashmi, 2011; Shah, 2012; Westbrook, Shah, Durrani & Tikly, 2009 |
| Attitudes for PD Learning and Experience | Teachers' attitudes can change PD learning and experiences and participation | Aslam, 2013; Halai, 2005; Iqbal & Shayar,2000; Meher, 2014; Nadeem, Chairman, Lone & Maqbool, 2013; Tahir, 2010; Tajuddin & Khan, 2014 |

programs. (Halai & McNicholl, 2004). Many PD programs served to reconstruct science teachers' knowledge like learning about ideas of science from a collection of fact to an inquiry-based subject. Science teachers could bridge the gaps between the theory and practice of science teaching (Halai, 2006). The most appropriate PD learning experiences for science teachers in knowledge construction were working on inquiry tasks during PD (Halai, 2011).

**Learning Needs**

The learning needs of Pakistani science teachers are shaped through their command on knowledge and the context in which they are working. Those PD programs in Pakistan that are efficient in meeting the distinct learning needs of teachers are the most effective types of programs. The majority of the literature on science teachers' learning and experiences in Pakistan indicated that science teachers' PD courses were highly inflexible and not designed according to the requirements of science teachers (Akhtar, Shah, & Naseer-ud-din, 2011; Tajuddin & Khan, 2014). However, effective PD programs that meet their learning needs enabled them in building high efficacy and skills to meet instructional challenges (Vazir, 2003). The research likewise found that for any PD program to be effective in Pakistan, there is a need to focus on the teachers' needs (Akhtar, Shah, & Naseer-ud-Din, 2011; Chaudary & Imran, 2012).

**Reflective Practices**

The reflective practices in Pakistan are built through deepening the understanding of PD knowledge and context of working. The positive features of reflective practices in Pakistan were determined through the perception of improvement activities, equality of treatment, learning culture and effectiveness of school leadership (Alam, 2012; Meher,

2014; Shamim & Halai, 2006; Westbrook, Shah, Durrani & Tikly, 2009). Halai (2011) found that the knowledge science teachers bring to the classroom in Pakistan could not adequately assist them in teaching and completing their tasks. To be effective science teachers, they need a deep understanding of the content they teach. A science teacher can learn and change his/her practices through continuous efforts of reflection on his or her learned knowledge (Halai, 2005; Khan & Begum, 2012). Mahmood (2013) found that the improvement of PD practices in Pakistan is significantly dependent on the development of reflective practices. PD learning of science teachers was found to be facilitated through the implementation of their knowledge on reflective practices (Uddin & Khan, 2014).

**Teacher Research**

Studies pertaining to teacher research or action research in Pakistan indicated that through PD practices science teachers were to encourage deeper, reflective, and reflexive understanding of their classroom teaching. Those science teachers who used action-related research changed their reflective and institutional practices (Anwar & Bhutta, 2012; Halai, 2011; Halai & Khan, 2011; Khan & Begum, 2012; Mahmood, 2013; Pardhan, 2005; Penny, Ali, Farah, Ostberg, & Smith, 2000; Zareen, Kayani, & Kayani, 2014). Halai (2011) found that action research assisted teachers in learning all three domains of knowledge of content knowledge, pedagogical knowledge, and pedagogical content knowledge. Pakistani science teachers had applied action-research related activities in improving their learning capabilities towards resolving general problems. Most of the teachers used action-research approaches, inside or outside of school, to reflect on their learning and experiences (Goderya- Sheikh, 2012; Halai, 2011; Halai & McNicholl, 2004; Khan & Begum, 2012; Meher, 2014; Retallick & Mithani, 2003).

## Communities of Practice

In Pakistan, the organizational structures such as communities of practice are shaped informally and through social interactions among science teachers. These practices assist science teachers in creating and managing PD knowledge and enhancing their learning abilities. It had a positive impact on students' achievement and organizational commitments (Ali, 2011; Shah, 2012). Hashmi (2011) carried out research on professional learning communities in Pakistan and revealed that working in such communities was perceived as a positive experience among science teachers. Research suggested that PD learning and experiences of teachers in Pakistan should focus on promoting group work and activity-based learning initiatives (Westbrook, Shah, Durrani, Tikly, Khan, & Dunne, 2009).

## Attitudes for PD Learning

In Pakistan, science teachers' PD learning is dependent on their positive and meaningful learning experiences, as well as how they position themselves as learners during PD (Halai, 2005; Meher, 2014; Nadeem, Chairman, Lone & Maqbool, 2013). Similarly, PD programs in Pakistan were found to shift the non-reflective attitudes to more reflective attitudes (Tajuddin & Khan, 2014). In a study conducted by Iqbal and Shayer (2000), it was found that a favorable teaching environment with proper support of material resources is connected to the motivation of science teachers and their show willingness to improve their professional skills. Aslam (2013) concluded that there was a lack of teachers' involvement in PD planning and training process, which contributed to the lack of interest among teachers to learn in the PD programs. Similarly, Tahir (2010) mentioned that the success of PD learning depends on the participants' attitudes towards PD

and active participation experiences. He observed that those PD activities, developed from study materials which involved developing, practicing, and critiquing such materials for field experiences were valued more than the provision of ordinary supply materials.

**Issues observed in the Effectiveness of PD Programs in Pakistani Context**

Several studies revealed that the nature of most of the PD programs in the public sector was more theoretical than practical and failed to address real-life scenarios of the teaching environment. A key challenge faced by Pakistani science teachers is the lack of relevance of PD programs to their learning needs (UNESCO, 2015). Mostly, PD programs are characterized by the inflexible curriculum, which ignores the needs and working conditions of teachers (Akhtar, Shah & Naseer-ud-Din, 2011; Aslam, 2013; Haider & Ali, 2012; Iqbal & Mahmood, 2000; Vazir, 2003).

It is a fact that most public-sector school teachers have poor subject matter knowledge (Government of Pakistan, 2008). Most times, science teachers' PD programs consist of several short courses or workshops in which insufficient pedagogical knowledge is provided to the teachers. Levine (2006) reported that PD learning and experiences lack consistency with their school curriculum, with inadequate practice opportunities, and poor-quality teaching (Levine, 2006). Also, most of the literature emphasized the structural and organizational issues in PD learning and experiences, while ignoring the philosophical, conceptual, and pedagogical underpinnings to PD practices (Ali, 2011).

Different PD opportunities helped teachers to critically reflect on their practice, knowledge, and beliefs about content, pedagogy, and learners. But most PD practices in Pakistan indicated less opportunities to reflect on learning, due to which the learning and experiences of science teachers remained less productive (Mahmood, 2013; Rizvi, 2007;

Shah, 2009).Thomas (2013) mentioned that both professionally qualified and professionally unqualified teachers in Pakistan were not significantly different in their beliefs regarding pedagogical content knowledge and utilization of constructivist approaches like student-centered approaches because of their beliefs system. Likewise, studies in Pakistan indicated that the changes in reflective practices were technical in nature and still require more content-specific PD structure (Hashmi, 2011; Pardhan, 2003; Meher, Ummulbanin & Mursaleen, 2007).

The studies conducted on PD in Pakistan reflected the struggle of science teachers in changing their instructional practices due to contextual and cultural factors, which play a negative role in strengthening their PD learning. The instructional policies, resources, structures can make PD learning experience a central activity instead of a marginal activity. Unfortunately, in Pakistan, due to improper follow-up, most of the PD learnings and experiences were not transferred to the classroom (Aslam, 2013). Halai (2005) emphasized the need for monitoring teachers' performance and suggested that timely feedback should be provided to them on their teaching styles and techniques.

Science teachers in Pakistan stated that it is essential to have social and professional support systems for effective practices (Ali, 2011). However, teachers are unaware of the role of the professional learning community and were found to be reluctant in accepting feedback from their colleagues. Most teachers preferred to work in isolation rather than sharing their knowledge among others. Due to the lack of communication between teachers and authorities, they regard themselves as consumers of PD programs rather than contributors (Haider & Ali, 2012; Halai, 2011; Nadeem, Ali, Lone & Maqbool, 2013; Rizvi & Elliott, 2005).

To summarize, much of the literature on PD studies in Pakistan laid emphasis on the centrality of science teachers in the PD process. However, there was a strong tendency to overlook the conceptual and pedagogical supporting factors such as active learning, teachers' research, and follow-up strategies. The results and methodologies used were in conformity with the international narrative of PD learning and experiences. The next discussion section debates the research questions in light of the current findings.

## Discussion and Conclusions

The research questions that guided this literature review are: 1) what is the focus of the literature review on science teachers' PD learning and experiences in the Western context? How do the different features of PD learning and experiences support or impede PD effectiveness? 2) What is the focus of the literature review on science teachers' PD learning and experiences in the Pakistani context? How do the different features of PD learning and experiences support or impede PD effectiveness? And 3) What implications does the information gathered from the literature review have for Pakistani policy makers and researchers for developing research programs in studying PD programs and designing effective PD programs? This literature review was compiled from 200 peer-reviewed research articles, with more than 75% belonging to the Western context (USA & European countries). The Literature Review for Pakistan included research articles and a few policy documents on science teachers. This literature was analyzed to understand the comparative features. Findings are briefly presented in Tables 1 and 2.

Overall, the literature review highlights the impacts of PD programs on teacher learning and experiences in both Western and Pakistani contexts. However, researchers in the West focused more on PD features like active involvement of teachers, learning

needs, knowledge construction through research and reflective practices, a coherence of PD with standards, PD practices and leadership roles and so on. (Buczynski, 2009; Corte, 2013; Desimone, 2002; Lotter, 2013; Luneta, 2012; Posnanski, 2010; Saylor, 2014; Towndrow, 2010). Whereas in Pakistan, significant features were belief impacts, knowledge construction and PD implementation issues (Ali, 2012; Begum, 2012; Halai, 2006; Pardhan, 2005). A comparative review of the research findings in both contexts on science teachers' PD learning and experiences are presented in Table.3. This table is constructed based on the similarities and differences found in both types of literature on the features of PD learning.

The literature both in Pakistani and Western contexts emphasized that the active role of a science teacher, his/her personal circumstances, learning needs, and so one must be considered while designing and implementing PD activities (Begum, 2012; Borko, 2004; Darling-Hammond & Bransford, 2005; El-Deghaidy et al., 2014; Jita & Mokhele, 2014; Luneta, 2012; Rizvi & Elliot, 2007). However, in countries like Pakistan, PD models like, the 'Cascade Model' or 'Deficit Model' are planned in the formal setting by keeping the perceived deficit in teacher performance in view and without giving any autonomy. The disparities between science teachers' needs and governmental priorities for PD learning are not considered. So, science teachers' PD practices are unable to respond to PD implementation requirement. Similarly, PD practices were very much irrelevant to classroom and school realities (Davis & Iqbal, 1997) and the focus less on practical work, due to which most of the science teachers become less motivated and become passive participants within the programs (Mahmood, 2010).

Table 3.

A Comparative View of Research Findings on Pakistani Science Teachers' PD Learning and Experiences

| PD Learning Features | Pakistani Findings like the Western Context | Differences/ Issues in Pakistani Context | Implications for Pakistan |
|---|---|---|---|
| Active Learning Experiences | Researchers emphasize the active participation of science teachers. | • No differences were observed. | Effective PD learning can be achieved through active learning strategies in designing and implementation |
| Learning Needs | Meeting learning needs can impact on teachers' efficacy to meet teaching challenges. | • PD curriculum are not flexible and relevant to science teachers' needs and ignored their working conditions. | PD should be focused, cohesive and aligned with teachers' needs and working conditions. |
| Beliefs and Knowledge Constructions | Beliefs and knowledge construction of science teachers must be comprehended and inculcated in PD programs to increase its effectiveness. | • PD programs ignored the philosophical, conceptual, and pedagogical underpinning of science teacher beliefs and knowledge.<br>• Teachers' attitudes are less favorable for learning<br>• The duration of PD is not enough for knowledge construction nor consistent with the practices. | Beliefs change must be evaluated and considered in PD learning and experiences. Changes in Teacher Content knowledge and PCK must be assessed as indicators of PD learning. |
| Reflective Practices | Reflective practices serve as positive features in learning and improvement of science teachers. | • Opportunities for reflective for science teachers' practices are less available.<br>• Reflective practices are only technical in nature. | More emphasis should be put on science teachers' opportunities to learn and reflect on their PD practices. |
| Teacher Research | Helping in learning of all knowledge domains and in changing practices. | • Teacher research is a neglected area among science teachers for PD learning and change. | An active research culture should be promoted among science teachers to promote flexible learning and change. |
| Communities of Practices | It assists in creating and managing PD knowledge for teachers | • Teachers are unaware of their role in communities of practices and its significance<br>• Most science teachers prefer to work in isolation. | Communication between science teachers and authorities must be promoted to build a professional learning community. |
| Leadership and Organizational Support/Follow-up | No literature was encountered in the Pakistani Context | | Effective leadership roles are required among science teachers and principals to support PD learning. |
| Participation Experiences | PD Learning is dependent on positive and meaningful participation experiences | • Traditional models of PD viewed science teachers as deficits of knowledge, hence discouraging their participation. | Teacher-centered models of PD learning are needed for effective practices among science teachers. |
| Attitudes towards PD learning | PD learning plays a significant role in changing teachers' attitudes | • PD is less supported by policies and resources, and non-involvement in PD activities also impact on their learning | PD must be designed according to improve teachers' attitudes towards learning. |

Another significant similarity of the literature in both Pakistani and Western context is recognizing the complexities of the belief system and knowledge construction as a challenge for effective PD learning and experiences. Recent works in the Western world revealed the complexity of teachers' beliefs systems and the relationship with instructional practices (Fletcher & Luft, 2011; Smith & Lindsay, 2016). But in Pakistan, like other non-Western countries, construction and internalization of scientific knowledge are different due to science teachers' perceptions about scientific knowledge. Most of them labeled this knowledge as 'Western Science' and resist to learn. Due to this, their learning attitudes become more problematic (Ali, 2011; Aslam, 2013; Halai, 2005). Similarly, Pakistani PD practices were provided through a single workshop or best, a series of sessions that have very limited impact in changing their beliefs and knowledge construction. Mostly, their contextual and societal factors have overriding influences on their teaching and learning experiences (Halai, 2011).

Another conformity of Pakistani literature with that of the Western countries' literature was an emphasis on new PD learning pedagogies like action research, inquiry-based learning and collaborative or participatory activities. The literature in both contexts recommended an active linkage between science PD training bodies and the schools where trainees are employed to strengthen and support the PD learning and experiences, and transforming science teachers as reflective practitioners. Emphasis was built on creating common knowledge, common practices, and relevant pedagogies to achieve better PD learning and experience for science teachers. The difference in Pakistani PD practices is that science teachers have no such opportunities available to build their reflective

practices, limiting their opportunities to become a part of the professional learning community (Ali, 2011; Hashmi, 2011; Pardhan, 2005).

A distinctive feature of the literature in the Western context points to the fact that PD learning and experiences would have a positive effect on teachers' learning and supported by features like school leadership, organizational support, and follow-up activities (Coenders & Terlouw, 2015; Delvaux et al., 2013; Opfer & Pedder, 2011; Rhoton & McLean, 2008). But, the literature in Pakistani context was found to be non-focused on this significant feature of leadership. Mostly, they thought that the roles of school leadership are ineffective due to limited resource issues but can create challenges for their effective practices in school.

Both kinds of literature in Pakistani and Western contexts described the significance of PD learning in changing the attitudes of teachers. However, this attitude change is a complex process and depend upon policies and resources. Teachers' approaches to learning appear to be subject to individual experience within the context of cultural norms (Demir & Ellett, 2014). Teachers in Pakistan need to motivated for learning through effective practices. Their experiences must be recognized as being relevant or valuable through PD structure, designs, and objectives. Effective PD may involve opportunities to reflect on their pedagogical beliefs and practices.

## Implications for Future Research

According to Table-3, a significant finding of these comparative literature review is that PD learning and experiences in Pakistan need to be built around the science teachers' needs and practices. It can be concluded through comparison that PD policy makers and developers that there is a need to adopt such learning models or strategies that could

be teacher centered and actively involve them in designing and implementation of PD processes. Similarly, they must be provided with incentives for participate in such activities. The beliefs and knowledge construction processes in Pakistan may be studied more in-depth. The efforts make to understand how science teachers' beliefs and attitudes towards PD learning and experiences change could be explored.

The comparisons of two kinds of literature in Table-3 indicated the need for sincere and focused dialogue in Pakistan, on what PD learning and experience depend on, and what need to be done to promote science teachers' research culture, reflective practices, and communities of practices. There is a need of effective leadership for PD programs in Pakistan, who are flexible, visionary, resourceful both in content and pedagogical content knowledge and able to interact with science teachers and considering individual differences. That leadership required establishing such environment in which science teachers feel empowered and motivated to learn.

A significant finding from the review of the Pakistani literature was that there is a shortage of published empirical research studies on the science teachers' learning and experiences especially on those teachers who are working in public sector schools. There is a need by stakeholders of PD in Pakistan to pay more attention and investment in building research and development culture that focused on exploring PD policies and designs. For future research in Pakistan, focuses on the key future questions could include: Can PD learning and experiences be generalized across the disciplines? How science teachers' working and development as professionals could be effective for increasing student achievements? How to ensure the effectiveness of PD learning in changing science teachers' beliefs and views about NOS? How science teachers' PD learning and experiences

can be different in different PD programs in different regions of Pakistan? How PD trainers' role can impact on the PD learning and experiences of their trainee? What models of PD learning could be suitable for Pakistani context?

While the literature in the Western context is useful, further investigations can be done on the effectiveness of PD learning and experiences in Pakistan through understanding the enactment and implementation of PD policies. The importance of cultural and contextual factors drawn the attention of researchers around the world (Demir & Ellett, 2014). The future studies in Pakistan could extensively explore the relationship between the science teachers' learning activities, outcomes, and regulation of learning so that improved system for science teachers' PD learning and experiences could be design and implemented.

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# 2 A PHENOMENOLOGICAL CASE STUDY OF PAKISTANI SCIENCE TEACHERS' EXPERIENCES OF PROFESSIONAL DEVELOPMENT

For science teachers, the professional development (PD) process is both an intellectual and a personal endeavor, and its outcomes are affected by many factors (Girvan, Conneely & Tangney, 2016). When science teachers participate in PD programs and actively engage within their professional context, they gain more out of the process than when they passively attend (Desimone, 2011). Understanding how science teachers' experiences are constructed is crucial for the creation of programs that meet their needs (Schneider & Plasman, 2011). Bryan and Abell (1999) described

> The heart of knowing how to teach cannot be learned from coursework alone. The construction of professional knowledge requires experience…. Experience influences the frames that teachers employ in identifying problems of practice, in approaching those problems and implementation solution, and in making sense of the outcomes of their actions. (pp. 121-122)

Experiential learning in teachers' PD is not an innovative concept and has been covered in the existing literature on the subject. For example, the relationship between stages of effective teaching, the teaching experience, working conditions, and teachers' PD approaches have been explored (Antoniou, 2013; Anthony, Haigh & Kane, 2011; Goh, 2013; Hacieminoglu, 2014; Kazu & Eroglu, 2013; Peters-Burton & Hiller, 2013; Yilmaz & Altinkurt, 2011). Likewise, different studies have measured the relationship between teachers' effectiveness, identity construction, and experiences with the PD activities in an international context (Grant, Stronge & Xu, 2013; Kabilan, 2013; Pipere & Micule, 2014; Sharma, Rahatzad & Phillion, 2013).

Different organizational and institutional contexts play critical roles in influencing the experiences of science teachers. However, understanding how these contexts influence experiences required rigorous studies. It is a hard truth that most of the PD literature paid little attention to the impact these contexts have on teachers' learning outcomes and their practices in the classroom (Cobb, McClain, Lamberg & Dean, 2003; Guskey, 2002). The PD programs appeared to underestimate the contextual, relevant, and ongoing, needs-based learning opportunities of teachers when they are participating in such programs (Lieberman & Miller, 2008).

Some researchers asserted that PD programs need to adapt their activities according to the different level of teachers' experiences and that these experiences should be an integral part of the PD design (e.g., Smith & Ingersoll, 2004). One such study, conducted by Chaudhary and Imran (2012) on Pakistani teachers' PD practices, recommended that a PD activity should be "based on common principles of socio-cultural learning, reflection, metacognition, prior experience, authentic experience, and generative learning strategies" (p. 16).

Insufficient attention is usually given to science teachers' experiences during the PD process where they often participate as passive learners. Unfortunately, "the typical experiences for science and mathematics teachers are not aligned with teachers' expectations or essential characteristics of effective PD identified in the literature" (Chval, Abell, Pareja, Musikul & Ritzke, 2007, p. 31). When teachers feel ignored, they do not develop the motivation to keep on learning (Fullan, 2007; Maskit, 2013). By exploring the science teachers' PD experiences, Kazempour and Amirshokoohi (2014), identified that "there continue[s] to be a need for further understanding and implementing of effective PD and

further research should examine how teachers' thoughts and experiences, upon return to the classroom, correlate to their thoughts and experiences during workshops" (p. 305).

In short, understanding science teachers' experiences can increase the success of PD programs. In the next section, a brief description of Pakistani science teachers' PD experiences is given as a backdrop for understanding the problem this study aimed to address.

## Science Teachers' Experiences of Professional Development in Pakistan

PD programs in Pakistan are mainly conducted for short durations or on a project-by-project basis; PD trainers are not fully trained or prepared for the job and mismatches among the training courses and school curriculum are common practice (Mahmood, 2010). The environment of these programs is carefully controlled, structured, and built on the assumption of mistrust of teachers, ignoring the unlimited potential for growth and development amongst participants (Chaudary & Imran, 2012).

Program designs are based on deficit-oriented approaches and are usually conducted in the form of formally scheduled events, which ignore teachers' personal and professional contexts. One such study that reviewed the relationship between PD experiences and classroom practices of teachers in Pakistan concluded that social and professional contexts of schooling must be reflected in the planning of these programs (Westbrook, Shah, Durrani, Tikly, Khan, & Dunne, 2009).

Teachers' involvement in the planning and training process is a crucial factor. Mostly, teachers are not interested in such programs either because of time constraints or having the perception that their contextual needs will not be considered (Aslam, 2013). Ali (2011), for example, writes that "teachers are influenced by the evolving realities and

social experiences they undergo in different times and contexts" (p. 217). The serious gaps in understanding these interacting factors that influence both students and teachers, at multiple levels and different times, are underlying fundamental issues facing PD in Pakistan.

Akthar, Shah, and Naseer-Ud-Din (2011), in their critical analysis of the PD of science teachers at the secondary level in Pakistan, found that in-service training curriculum was not aligned with the needs and demands of the teachers. They found that PD programs were mostly theory oriented. Notably, Halai (2005) exposed that the greatest challenge of PD programs for science teachers lies not in developing curricula and new ideas, but in supporting teachers in executing their learning and refining their needs and the needs of their students.

Aslam (2013) described another weakness of PD activities that "there is no proper follow-up and transferred activities to classroom practices" (p. 311). Likewise, it was observed that if teachers were able to take their learning into their practice, they had a far deeper, reflective, and conscious understanding of their teaching as compared to others (Halai & Khan, 2011). Thus, such PD approaches are needed which could enhance teachers' instructional realities.

It is, thus, need to address the trivialization and devaluation of traditional PD practices in Pakistan. There is a need that educational researchers explore the lived experiences of science teachers in Pakistan by listening to their experiences and understanding. They can investigate how PD policies and structures helped, or hindered, their instructional and reflective practices in schools. Such explorations could clarify the context characteristics that facilitate or restrain the science teachers' professional growth. This

study can also inform about the linkage between the PD experiences and science teachers' teaching and learning practices. This study can also be informative for stakeholders of science education to improve the PD activities in the public sector of Pakistan.

## Theoretical Framework

Phenomenology was selected as a theoretical framework to understand science teachers experience of professional development in greater depth. Grbich (2013) defined phenomenology as "an approach that attempts to understand the hidden meaning and essence of an experience together with how participant make sense of these experiences" (p. 92). Phenomenology as a theoretical framework specifically used to study lived experiences of the phenomenon from the perspectives of those who experience them (Giorgi, 1985; Moustakas, 1994). It analyzes the phenomenon of subjective consciousness and comprehends reality through embodied experiences (Starks & Trinidad, 2007).

Van Manen, (1990) described "A good phenomenological description is collected by lived experience and recollects lived experience- is validated by lived experience and it validates lived experience" (p. 27). This approach can capture lived experiences in all their ambiguity, urgency, and immediacy (Finlay, 2009). The phenomenologist not concerned with simple facts, singular facts, but in the essence of the thoughts may ask, "How?" and "Why?" questions. Moustakas (1994) mentioned five key processes (Epoche, Transcendental-phenomenological reduction, Imaginative variation, Inter-subjectivity, Essences) that researcher can use to develop knowledge.

King and Horrocks (2010) described, "phenomenology has played an important role in many practice-oriented disciplines such as education…. its emphasis is on looking

closely at lived experiences in a specific setting, rather than abstract theorizing about 'human nature,' appeals to academics and practitioners" (p. 181). It has helped in ascertaining, or uncovering, the lived juxtaposition of human action and interactions (Papadimitriou, 2012). This framework was beneficial in exploring how science teachers' unconscious filter/frame of mind works in accepting change. Understanding through a phenomenological perspective helped in connecting with the 'lifeworld' of science teachers, uncover and describe their direct and subjective professional development experiences.

This study was interpretative in nature, and this framework was ideally appropriate for revealing the rich, complex realities of science teachers' learning because of PD experiences. This framework also facilitated in understanding that there is a multitude of ways of interpreting science teachers' PD experiences. These teachers as subjects construct the meaning of their experiences and not involved as objects of the investigation. By using this framework, researcher got help in maintaining the epistemological position regarding the study and build the interpretation that is created by the meaning attached to science teachers' experiences of PD programs.

The data analysis of the study was contained within the perspectives of the science teachers that are involved with PD programs. By maintaining a phenomenological attitude in this study the researcher focused on those views reported by the participants. This framework also refrains researcher from making judgments and reducing bias associated with the prior knowledge and preconceptions. This study also assisted in capturing subjective experiences by capturing ambiguity, poignancy, complexity, and richness of science teachers lived experiences in deeper ways.

## Method and Methodological Framework

The purpose of this study was to understand the Pakistani public secondary school science teachers lived experiences of PD using an interpretative phenomenological approach within an embedded case study design. The nature of the study was an "embedded" case study bounded by the PD experiences that research participants had attended during their career time. The unit of analysis was the secondary school science teachers. A phenomenological case study approach attempted to shed light on individual human activity while not making a generalization about such phenomenon (Hickman & Kiss, 2010). Manen (1990) argued that "the tendency to generalize may prevent us from developing an understanding that remains focused on the uniqueness of human experience" (p. 31). The phenomenological case study allows and encourages researchers and practitioners to understand and appreciate both similarities of learning experiences as well as the unique experiences of individual ones (Hickman & Kiss, 2010). Similarly, another advantage of using this approach is described as:

> It can use several participants to come up with a better single finding concerning the phenomenon or several incidences to understand the individual's way of experiencing the phenomenon. In each case, multiple instances lead to a single finding. (Giorgi, 2008, p. 37)

In that sense, this methodology was supported in understanding how science teachers construct their retrospective viewpoints about PD activities with a much fuller description of lived experiences. By gaining detailed verbal accounts of science teachers lived experiences, we can ascertain, or uncover, their lived juxtaposition of human action and interactions through an interpretative, naturalistic approach.

## Research Question and Design

The research question was: how do Pakistani secondary school science teachers describe their experiences of PD? To answer this research question, the following subset of questions were used: (a) how do science teachers understand, make sense of, and use intended goals of PD opportunities? And (b) what contextual factors either promote or hinder science teachers' implementation of learned knowledge from PD?

## Research Context

In Pakistan, the federal government is responsible for policymaking and setting the strategic directions for the secondary education level, but the provincial government is responsible for carrying out the implementation. This phenomenological case study was conducted with those secondary science teachers who were working in public schools. Which were under direct control of Government of the Punjab. Two types of science teachers with job designations of a secondary school teacher (Science) who taught $9^{th}$ and $10^{th}$ grade students and subject specialists (science subjects) who taught higher secondary or $11^{th}$ or $12^{th}$ level grades participated in the study.

All of the public secondary schools are segregated into single-sex educational institutions, where only one gender teaches and learns. However, most of the PD training is provided in a co-education style by the Government of Punjab through its Directorate of staff development (DSD). Different PD programs provided by DSD are based on the "cascade model of training," in which different types of specialists or trainers are involved in providing PD to the science teachers. There are disadvantages to this model. It is very structured, knowledge is only transmitted rather than co-constructed, it is inflexible to the needs of teachers, and it is conducted as a formally scheduled event.

**Participants**

The participants in this study were fifteen science teachers working in public schools in Punjab. These participants included five female and ten male science teachers with different disciplinary and professional backgrounds. As phenomenologists are interested in common features of the lived experiences so instead of largely distributed diverse samples only those who experience the phenomenon were selected for the study. The purposive sampling method based on the convenience (Groenewald, 2004) was employed for this study as this unique sampling method has exceptional, or atypical, attributes to identify those participants of the study who experienced the PD phenomenon that was being probed.

The unique purposive criteria for the selection of the fifteen participants included: (a) Science teachers who were working as a school science teacher (SST) or subject specialist (SS) under the School Education Department of the Government of Punjab at the time of the study; (b) those who had at least five years of PD experience and participated in more than three PD activities; and (c) those who were willing to participate in the study on a voluntary basis. The participants from five major districts (Lahore, Gujranwala, Sheikhupura, Faisalabad, & Multan) were telephonically invited to participate in the study. The district school authorities were approached and requested to identify five science teachers that fulfill that criterion of inclusion. Through their help, the contact information of twenty-five participants was obtained. The data was collected from those fifteen science teachers of three districts who were available and gave their written consent (See Appendix C for participants' demographic information). To ensure rigor and trustworthiness, the researcher included those participants who were neither the

researcher's colleagues nor students nor in any dependent relationship with the researcher.

**Data Collection**

The goals of this type of qualitative study are to understand the meaning of the participants' experiences; how they construct their worlds, and what meaning they attribute to their experiences (Merriam, 2009). Thus, semi-structured in-depth phenomenological interviews were conducted with research participants. The phenomenological interviews were conceived as a 'conversation' or an interpersonal engagement between subject and researcher. Subjects were encouraged to share the details of their experiences with the researcher (Bevan, 2014; Giorgi 1997). The researcher accepted the natural attitudes of the participants and adopted active listening approach during the interview. Both descriptive and structural questions along with the novel use of imaginative variations for descriptive adequacy was used.

Phenomenological interviews were used in this study because the use of broad and open-ended questions allowed participants opportunities to extensively express their viewpoints. This type of interview provided the researcher a chance to actively study participants' experiences without having any obstructive structures. An interview protocol was developed to address the research questions and to outline the key questions that were asked of each participant. The interview protocol was based on Seidman's (2013) framework, which was divided into three sections. The first section focused on the participants' academic life histories and early school experiences. The second dealt with the details of present lived experiences of PD, while the third examined their reflection on the meaning of the phenomenon (See Appendix A for sample interview questions).

The duration of data collection was over three months. In the first month, interview protocol had been piloted, and changes were incorporated to ensure effectiveness before data collection. In the second and third month of data collection, fifteen participants were interviewed face-to-face. Each interview lasted between 55-90 minutes. Participants could choose the place and timing for interviews to ensure their levels of comfort during the interviews. Participants were requested to express their opinions in English, but they were equally allowed to communicate in indigenous languages, such as Punjabi or Urdu, to freely express themselves.

To minimize the effect of bias in data collection, the researcher analyzed the subjective consciousness of self through reflexivity and through writing research journal and reflective notes. Finlay (2008) described reflexivity as the ability to be open to hearing experiences in a new way and examining the phenomenon in a fresh way, thus enabling new understandings to emerge. These writing exercises helped the researcher in decontextualizing and then re-contextualizing science teachers lived experiences. The reflexive critical dialogue with the self in shape of field notes and memos help researchers to convert the cluster of descriptions into discrete categories. This also helps in building the bracket views of the phenomenon under investigation.

**Explication of Interview Data**

Explication infers a study of the components of the phenomenon while keeping the context of the whole (Grant, 2008). The explication of interview data was done through understanding and clarifying the meaning, structure, and essence of the lived experience of their PD experiences, as a phenomenon, and through identifying general themes within each interview, without generalizing the findings.

Before analyzing data, pre-data analysis measures were taken: all audio recorded interview data was transcribed through the verbatim method. Each participant was assigned a pseudonym to protect his or her identity. The interviews or parts of interviews that were not conducted in English were translated into English by researchers along with the transcribing process. The translation of data was confirmed and reviewed by two lecturers of English in Pakistan who edited these translated transcripts for its accuracy, as well as for the meaning behind spoken sentences. The complete edited transcripts were read at least twice to seek an intimate familiarity with the data. All the data were kept in separate, password protected computer files that were accessible only to the researcher and his research advisor.

In this study, interpretive phenomenological analysis of the participants' experiences of the phenomenon was a first-order perspective, so the focus was on the understanding and interpretation of participants lived (personal) experiences. The interviewee and their experience under study were the unit of analysis. The data were analyzed for significant statements, invariant horizons, and recurring themes. The data analysis began early, through the epoche process of bracketing. The researcher obtained the data on how the interviewees think and feel about their lived experiences in the most direct way. Similarly, researcher bracket his preconceptions by analyzed his subjective consciousness through reflexivity and through writing the analytical memos (reflective notes and research journal, etc.).

All the interview transcripts were reviewed for identification of categories of meaning from experiences by constructing open coding through the qualitative software MAXQDA 12. The special attention was given to descriptions of what was experienced

as well as how it was experienced. This software helped with generating data separate from the original context of individual cases to units of meaning in the texts. Before finalizing themes, peer debriefing was done to ensure the consistency and accuracy of the coding and categorization process. The generated code book along with the interview transcripts was discussed with a doctoral student colleague in the USA. Attempts also made to get member check but no responses from participants. Several emerging themes and process memos through open, axial, and selective coding were discussed, and a consensus was built based on interrater agreement on categories and themes (See Appendix D for example of interview transcription to theme construction).

Thematic analysis was the primary method of data analysis, which was conducted using the two analysis techniques of phenomenological reduction and imaginative variation. The phenomenological reduction process was done through deliberate and purposeful opening towards phenomenon without taking any stance on their statements. Through delineating, the units of meaning a different cluster of meaning were obtained to form themes. The imaginative variations were done through consideration for possible experience variations. Textual-structural descriptions were created to clarifying the phenomena. Different similarities and differences of participants' world experiences were undertaken through reflecting on context and experience descriptions. By collapsing different categories and themes, three primary themes emerged. The data analysis provided more meaningful and convincing expressions of how science teachers reflect on these experiences. All the pseudonyms were used in finding section with original transcripts evidences.

## Findings of the Study

The section that follows is organized around the three main themes which emerged from the data: a) the participants' sense-making experiences of PD and how they understood and described the different intended meanings of PD activities; b) the participants' meaningful experiences of PD and how their participation in different learning opportunities helped them to process and implement the professional knowledge; and c) the contextual and cultural factors of PD, as well as the degree to which their professional learning was promoted or hindered by these factors.

### Theme 1: Sense Making Experiences

This theme refers to how the participants resolved ambiguity and doubts with their PD environment and interpreted policies and structures in relation to their PD experiences. Based on their description, the following subthemes emerged: a) PD Structure and Policies; b) Program Designs and Contents; c) Effectiveness of PD Trainers; d) as well as Problems of PD Feedback Mechanism.

#### PD Structure and Policies

Research participants' experiences of PD were shaped through the opportunities that had been provided to them directly or indirectly by the School Education Department of the Government of the Punjab (Pakistan). These experiences largely depended on the length of their job and the chances to be nominated for PD. While all research participants had gone through multiple types of PD training opportunities at different stages of their career, most of them engaged in PD activities at the district or provincial level. Only a few of them had opportunities to participate in PD outside of the province, and only two participants participated in PD experiences at the international level.

Most participants thought that Government objectives for conducting such PD activities were not aligned with their needs and based on their administrative agenda. For example, if the government changed the science curriculum, then they would conduct new PD with the purpose of refreshing or update participants' content knowledge according to the new curriculum. However, participants felt that PD policies should have been based on their present or future learning needs. One participant, Mr. Alvi, told that none of his PD was special and that it added nothing to his existing knowledge. Another participant, Ms. Bano, stated that both teachers and their students' needs were not considered in PD planning.

Participants thought that PD should preferably be conducted in school laboratories to use more real contexts. Many participants shared that these activities must be cost-effective and adequately organized around the availability of local resources. These participants shared that the institutional capacity of Government training institutions must be amplified to address the increasing requirements of the PD training. Mr. Zafar's response is an illustrative example. He said:

> When the syllabus was changed, it was felt that some refresher course should be arranged for science teachers, but that training was given only to 1% or 2% of the science teachers of the schools and remaining staff did not participate because [the teachers] were busy conducting classes.

Participants shared that existing PD practices were much structured and not helped them learn relevant content or pedagogies. All research participants agreed that PD programs were largely structured and centralized as they observed issues with planning, design, and delivery of the PD programs. Indeed, they all agreed that they had no

voice or input at any stage of the PD programs. Mr. Sharif, for example, described the effect of such structured PD experiences as follows:

> Usually, when Directorate of Staff Development [PD provider] decides and arranges such training by themselves like what they will do in this PD programs and what after that, sequentially they have to focus on it. It had a harmful effect on teachers that they already assumed that nobody would understand their needs and already knew what type of training is expected to be given to them, and they have already made their mind before starting of such training.

**Program Designs and Contents**

The majority of participants mentioned that they received PD training in the form of workshops, seminars, or refresher courses. A wide range of topics was introduced to them in these PD trainings, e.g., computer and language literacy to awareness seminars on the dengue virus, whereas in content-based PD, they engaged with those subject area training that focused on teaching these subjects in a classroom context. The medium of instruction in all the PD training was English, and it was delivered through lecture, group work, and project methods.

More than half of the participants seemed to be satisfied with the duration of these PD programs, ranging from 3-4 days to one month. Likewise, most of the PD activities were conducted during summer time, when the schools were not in session. They shared their overall satisfaction with how PD providers ensured regularity and punctuality during PD activities. The attendance policy was very strict and separate staff was allocated

to monitoring teachers' punctuality. However, the participants shared that the time duration of daily PD sessions (8-10 hours) was a bit long, not suitable for women and senior science teachers. Ms. Samrana, for example, stated that:

> Daily duration must be shortened because women have to suffer regarding their family responsibilities. Nowadays, they are giving promotion training, and most of the teachers are at the age of 50 or above, they must see that how much stamina they [senior teachers] have to sit and learn. There are a lot of people who are facing issues like Blood pressure or Sugar diseases etc. and need regular medicine or food. All these things matter in PD.

While most of the participants acknowledged that their PD sessions were diversified, there were some who criticized the format and content of the PD activities. Participants stated that PD programs were missing a discipline-based emphasis, as they were broad in their focus. Thus, they suggested that PD programs for science teachers should be arranged separately from other subject teachers because the PD activities for science teachers required special activities, e.g., pedagogical content knowledge, and space. Those participants who seemed to be satisfied felt they learned new knowledge and skills from the PD activities. Mr. Rafay said, "it's not only helpful in science teaching, but it is helpful in overall school responsibilities ... like management, registrations, and duties of teachers and the handling of student behavior". Those who criticized the format of the delivery and content stated that PD programs were lacking creative approaches and relevance. Mr. Yawar, for instance, stated that PD methods lacked creative approaches and did not make the most of the participants' high cognitive skills. According to him, most

of the contents and materials were loaded with theories and lacked relevance to the school curriculum. Mr. Malik had brought up similar concerns and stated that:

> Yes, I think mostly, it was a waste of time of teachers and their students' in schools … when someone plans to provide teachers PD training than they should provide them with such material or resources that when teachers go back to school than they can able to use them. Similarly, the schools must have provisions that ensure the implementation of PD learned knowledge by the teacher who got that training.

However, Mr. Malik suggested that to increase the relevance of PD programs both participant teachers and trainers should work together on PD contents. Both could design PD activities in such a way that meet both the school and professional standards requirements. In the same way, he recommended that in designing PD structures, the PD providers must create alignment with the international training models.

**Effectiveness of PD Trainers**

Participants talked about the quality as well as the variety of PD trainers. Nine out of fifteen participants acknowledged that most trainers were well experienced. However, they all agreed that they did not have the same abilities and levels of motivation to train teachers. According to the participants, some of the trainers were truly brilliant, but there were some who just taught to pass the time. Mr. Saleem, said:

> No! I don't think, so all of them were equally motivated. A man is an audit officer, but he is not a professional PD trainer and comes to teach auditing. He had

> no experience to handle the class of 50 to 100 people, so there will be a great difference in the teaching of professional and unprofessional, and this difference changes their motivational level.

Participants identified that these PD trainers were mostly outsiders in their institution's network who had less practical knowledge about their current working issues. Likewise, participants understood that, although those PD trainers who had effective knowledge to offer, they did not operate to the best of their abilities. These trainers did not try to understand participants' needs and mostly did not deliver the instructions with enthusiasm. Mr. Bhatti recounted that "Those [trainers] who are not familiar with the use of modern technology, they use the same old methodology, like lecture method, etc.". Additionally, the participants shared that, normally, their discussions were "not at that level" in which they would otherwise felt that they were receiving innovative training. Research participants stated that PD trainers' behaviors were not good in handling participants' questions. To illustrate, Mr. Sharif reflected:

> There [in materials] was guidance, but that was mostly based on bookish knowledge… They [PD trainers] do not get out of the syllabus because there were not enough models and not any struggle to take children [trainees] to the field to tell them that this is that topic you were learning.

Lastly, research participants believed that the PD trainers were not effective because they were selected or nominated by personnel from the public sector, which lacked accountability mechanisms. Mr. Zahid shared his voiced that:

> They were teaching some theories of biology. The trainer had come from Multan, and he had MPhil or had Ph.D. in physics, but it was not his strength… he came

there for earning money, but it was not his fault. The government is responsible for this. A teacher of mathematics should teach mathematics as likely a teacher of physics should teach physics.

When comparing the effectiveness of local or government trainers to their foreign or private sector counterparts, participants stated that foreign or private sector trainers were much better and effective in delivering PD training. The reason they described was that most of them had advanced knowledge and professional attitudes of working. These trainers used modern teaching methods like interactive lectures, syndicate work, etc.

**Problems of PD Feedback Mechanism**

Another aspect that participants mentioned was their experiences of different PD activities like pre-test, post-test, feedback session, or follow-up activities, etc. These participants pointed out that the feedback practices were conducted either in the form of classroom discussion or the form of sessions for informal suggestions. Occasionally, the administrative staff of an institution collected feedback during training sessions, while on other occasions, PD trainers inquired as to participants' opinions. All participants stated that these activities were structured as regular features of every PD program in the Punjab. The PD providers established mechanisms for monitoring and evaluating PD programs. Most of the testing was conducted through the questionnaire built on Likert scales.

However, participants were not fully aware of the purpose of these testing practices. Mr. Zahid thought that the purpose of the testing was to improve participants' knowledge, while others thought that the purpose was to provide feedback. Mr. Malik stated that "these tests are just a routine and the purpose was not the improvement of the

teacher or the PD training. I have never seen any application of these things in my career life". Similarly, many the participants did not believe that PD trainers or institutions ever used their suggestions for the future designing or implementation of PD activities. In this vein, Mr. Yawar described that, "Yeah! At the end of PD training they ask us for suggestions, but I think those suggestions are never considered because there is no feedback from the department, no letter, and zero contact regarding my suggestions". Equally, other participants revealed that, because most PDs were funded or arranged by other agencies, no one followed up with PD participants after the PD sessions because they thought that was not their obligation to check their post-PD experiences. Ms. Samrana shared:

> No! I don't remember that after I've sent those reports or contents, they ever asked about my experience. I don't think so…. There should be a feedback system after training and in that they must ask what the purpose of PD was and how much that purpose was fulfilled. They should come to my class too and must know the response of student about my application of that knowledge.

Most the participants thought that follow-up activities should be implemented with the purpose of determining whether their PD training was effective. Mr. Bhatti, for example, stated that "Yes, this [follow-up] contact may prove to be fruitful because they are well trained and if you have contact with them [PD providers] then it would be easy for a teacher to deal with different problematic situations." Likewise, Ms. Khalida added, "I think if they have given PD training then they should follow-up a bit. Teachers use it for a short time, and later they forget it, too".

## Theme 2: Meaningful Experiences

The theme captures perceived benefits from the experiences of PD activities. Research participants shared their experiences of learning and change in different types of activities during PD programs that helped them in becoming better science teachers. They described how they applied the learned knowledge within their classroom settings and promoted student learning. They shared their active role experiences in making these activities more meaningful and relevant to their teaching. The main subthemes arose from the data were: a) Group Work Experiences; and b) Learning and Change Experiences.

### Group Work Experiences

Almost all participants described that most of the PD sessions were designed in such a way that provided them opportunities for doing group work. Sometimes, these group work opportunities were provided through formal PD classroom activities, such as group presentations, practicums, and even informal sessions of discussions available during PD sessions, and field trips. Reflecting on the group work, Mr. Rafay stated:

> [The PD Trainers] made our groups of four members and asked us to read one by one and then write individually, and after that, we have to discuss it with other members. Then they provided us a questionnaire, and we had to answer it, and then everyone shared their personal analysis of their learning. They changed members in next session. It [PD experience] was quite a task, and there was learning too.

Participants valued the collaborative work opportunities wherein they were exposed to a variety of new instructional material as well as academic issues. Participants had the opportunity to participate in a dialogic learning with their PD trainers or with

each other. They stated that they could discuss real life teaching situations and problems. Participants' purged their frustration or demotivation around issues by telling short stories about their experiences in the classrooms. Moreover, by participating in PD activities and by listening and giving some constructive feedback on each other's work, the participants believed that they learned and developed professionally.

The participants regarded group work between the colleagues as a valuable mode of collaborative learning, which gave them a sense of mutual growth, trust, and efficacy. The most promising group experiences participants shared was known as "share something new that we have learned during PD training." Participants cited that, even after the PD, they kept building this constructive dialogue with their school colleagues or tried to share their learning with other science teachers and students in nearby schools. Ms. Bano stated that:

> During training, I had learned too much from other teachers about any topic if a teacher illustrated better than me; so, I picked his or her points to implement on my students. Or if another teacher is describing a topic in much easier way than me, I picked that style immediately.

Another participant, Ms. Samrana, indicated that:

> Yes, we collectively gathered information and made assignments… It was a better experience...It was a positive type of experience and it was too good because everyone was from the different area and they told us about their tasks, we collected material by ourselves and shared our up-to-date knowledge. It was a very nice experience.

The participants, further, mentioned that PD group work activities were implemented as a requirement by the DSD, but the quality of that group work was not a concern for PD trainers. For example, if somebody did not play any active role in that group work, then it was not an issue for them. Mr. Bhatti shared:

> If there are some active participants, then they [DSD] should focus on passive participants too. If there is one who is not taking interest and feeling uncomfortable then they should ask his problems. When everyone is working in-group then why someone is sitting aside or keeping silence. Mental capacity should be focused an essential ingredient in these activities.

Many the participants thought that either this collaborative interaction or working, or dialogic learning through conversation, were important sources of their improved sense making about science teaching issues. They informally discussed their teaching or students' management issues with each other and learned from each other shared experiences or success stories.

**Learning and Change Experiences**

Although participants were less satisfied with certain aspects of the PD process, they acknowledged that these programs helped them in fostering their learning. They stated that they "felt too many changes" in their teaching and were able to apply newly learned knowledge for their classroom practices. They revealed that, especially after the first few months of trainings, they tried to be a different type of science teacher who believed in adopting new technology and approaches for science teaching. Mr. Yawar ob-

served that “definitely, after PD, we go back to the classroom and we approach the situation from new angles, and it definitely helps the teaching environment.” Likewise, Mr. Rana stated:

> Yes! I have seen too many changes in myself. As a professional science teacher, I think I am the luckiest person who worked in PEAS [Punjab Education Assessment System]...It was very useful for me...I got much to learn, and I am very thankful to them [PD trainers] that I improved so much.

Because of PD experiences, participants developed better conceptual understandings of scientific concepts and learned about new topics. From a pedagogical perspective, they started looking for alternative ways to facilitate the learning process of their students while keeping in mind the logistical constraints they had. Ms. Bano recounts that:

> In the beginning, it was just routine to teach them because it was my first year. But than in mid of my career when I did refresher courses, I modified myself and started teaching differently. Similarly, PD training gave me strength to motivate my students in a new way and the benefit of becoming a good science teacher.

Mr. Bhatti shared a story that puts the instructional change in perspective. He said:

> There was a topic of photosynthesis during PD training, and they [trainer] told us that rather tell them [students] on board, ask them to bring leaf, water, put it in a room, and put a branch of leaves and pour ink in water. When our students did it individually, they learned it well and probably for a whole life time that what they did it in the classroom.

Participants revealed that they were able to use these PD experiences in the related areas of teaching profession, including chief examiner in Board Examinations or writing textbooks and guiding materials for students like Mr. Rana told:

> Few years back, Punjab text book Boards, invited writers to write on different science curriculum, so they invite us to write, so I did write a text book on physics, I was selected as author through competition with nearly 100 other book writers but all others could not come on top but I was able to wrote it.

Overall, the participants recognized that these types of learning experiences gave them good experiences, as well as the opportunities to learn new techniques. They could work on the latest devices or pedagogies. Ms. Saima shared that she engaged with the latest training apparatus and materials during those PD sessions, which matched her reading skills. After these PD trainings, she used PD material for the training of other science teachers, as well as to her children at home who were studying at the same level. It was evident that PD experiences gave participants confidence and success in teaching. Mr. Sharif established:

> Yes! PD change the teachers, but is not necessary that all PD do such things; it depends upon the nature of PD and nature of PD should be such that to change them or must keep them on track.

### Theme 3: Contextual and Cultural Factors

Contextual and cultural factors appeared to be an important aspect of PD activities that impacted science teachers' PD experiences. These factors not only negatively impacted their participation, but they furthermore created challenges of access, learning, and implementation. This theme is divided into four sub-themes; a) The Selection and Access

experiences; b) Need Assessment Experiences; c) Logistical Constraints, and d) Cultural and Motivational Factors.

**The Selection and Access Experiences**

The majority of the participants did not have good experiences due to the access or selection procedures for their PD training. Rather, they had concerns and reservations about PD selection procedures. All participants shared that attending the PD activities was compulsory for them and they had no voice regarding the decision to participate in such activities. They were mainly nominated for PD training through some departmental procedures, so they had to follow their authorities' recommendations. As Mr. Yawar stated, "science teachers are not at liberty to choose PD training. Such PD training is compulsory for them. [The DSD] nominate[s] us, and we have to be physically present themselves for that training".

Most participants expressed that they had to attend the general, non-specialized types of PD. Most of the teachers and trainers were selected by a routine administrative process. Sometimes, PD had no relevance to the teachers' specific pedagogical and subject needs. They explained that the blind process of selection of participants and trainers for PD created problems for active participation. If they must refuse for any reason, then they must provide a long process of justification through documentary proof. Mr. Bhatti described shared his experiences:

> Once, I was taking PD and my subjects were of BSc like botany, zoology, and chemistry. But PD trainers moved us to mathematics contents, as from the very beginning we hadn't studied mathematics after matriculation. Those days of PD were boring, and we could not understand what was going on and we requested

> them [PD trainers] to teach us our content areas subjects first or teach us according to our level of understanding. It was useless to teach us the subject that is not ours.

Research findings revealed that proximity to the PD sites was the determining factor for many teachers to decide whether participate or not. Those participants who lived near PD training sites had more access to these experiences as compared to those who lived in remote areas of the province. The participants of the Lahore district (e.g. Mr. Rana, Ms. Saima, & Ms. Samrana) declared that they received more exposure to these PD trainings as compared to teachers from other districts, such as Mr. Alvi who lived in the remote city of Haroon Abad. Similarly, they stated when they were nominated for a federal or foreign PD training, they had to decline the offer because it was not feasible to them to leave their home or school for the length of time required. The female science teachers often had limited opportunities to attend such PD trainings due to these constraints. Ms. Samrana shared her concern as follows:

> They arrange training for a whole month. Our families get disturbed by this schedule. Therefore, many females refuse to get training. Duration of job is too much for a lady, especially when someone has to come back to manage a lot of things at home.

**Needs Assessment Experiences**

Participants expressed concerns about how DSD determined their PD needs. They thought that they did not consider the areas in which they needed PD training. In the

same way, there was no mechanism for them to be actively involved in planning and designing of these activities. They struggled to keep their motivation up while feeling that they had no voice for these activities. Mr. Zahid explained that:

> No one has ever asked in the PD training about our PD needs. I tried to tell them like please do the practical work, but I don't know why they escape from it. Perhaps, they don't know how much it is important to considered needs. Moreover, training providers [DSD] never get checked by anyone about their PD activities.

Similarly, the participants were aware that PD activities were highly structured. The schedule of activities and materials were already fixed and nobody, including training staff, PD trainers etc. could make modifications to address the participants needs or things that came up during the PDs. The only flexibility is that they provided some opportunities of collaborative work and syndicate research work done during PD. Such opportunities provided participants some space to work on their needs.

The assessment of PD participants' needs in content or pedagogical areas were a problematic process. Ms. Bano, for instance, revealed that science teachers needed PD training in which they could learn about the use of technology in the classroom. She expressed that the generalized type of PD trainings was not fulfilling their classroom needs. Conversely, content specific and practical activities based PD designs could have fulfilled their needs in better ways.

Different participants suggested that going elsewhere for a PD did not fulfill their specific school or classroom needs. They eschewed participation in these PDs out of concern for an adverse impact on their teaching assignments. Likewise, upon returning, they had to work more to cover their syllabus. They recommended a larger quantity of school-

based PD opportunities that would not have disturbed their routine teaching assignments. These participants thought that PD providers should have taken note of the teachers' high degrees of professional obligations. They should have thought about how these participants were nominated, treated, or evaluated during these PD sessions. These PD providers must have worked on making PDs relevant to their school realities.

**Logistical Constraints**

Most the participants were concerned with the availability and quality of logistic support provided by DSD for their PD programs. They believed that the DSD was responsible for ensuring essential resources, such as quality trainers, equipment or material support, physical facilities etc. The participants acknowledged that it provided them with some basic facilities, including physical space, syllabus books, reading materials, and some travel and daily allowances that helped them to cover their daily training expenses. However, they found this support to be insufficient in bringing positive experiences to their teaching and learning environments.

Research participants mentioned that it was a routine procedure for PD providers to arrange logistical support for them. For example, participants in need of lodging were provided with appropriate facilities. Others who required field trips as well received adequate facilitation. However, they stated that they faced some constraints regarding the efficient availability of these resources. In this regard, Mr. Saleem stated:

> Sometimes it happens in PD when they have made plan 1, 2, 3 and material is not arrived at the time, so their plans failed. For example, if they have to show slides, but light is not coming, then they start generator, but it's not working so these are the routine mistakes.

Another participant, Mr. Farooq, was shocked by PD providers' logistical support style. He stated that, despite direction and availability of resources, materials came late or at the end of the training. He shared an example in which material was delivered on the second-to-last day of a two-week training session. This turn of events lowered his motivation for learning.

Similarly, Mr. Rana shared his experience as:

> They [PD provider] provide us training material … sometimes we [teachers] need multimedia projectors, we have four classes, and we are provided two projectors, they get all funding for material by British Council but sometimes … it happens that when we need material, there is nothing I don't know why they do this.

In contrast to the majority of the participants, a few participants justified the scarcity of resources by stating that PD providers could not supply everything. As they had insufficient or limited resources, only a limited onus can be placed on them. Mostly, they meet the basic learning needs. Mr. Saleem supported these justifications about limitations and said that these institutions only had to provide him and his colleagues with space and look after their basic needs.

**Cultural and Motivational Factors**

These factors could be viewed as those aspects of PD culture that interacted with participants' individual learning experiences which in return affected their instructional practices. The culture of PD providing organization was strongly influenced the success rate of participants as it was the job of PD providers and trainers to optimize motivation and performance of science teachers during PD sessions.

The majority of the participants indicated that whenever they got the chance to attend a PD, they would become excited and motivated to participate in such activities. These participants believed that such exposure itself spurs motivation. Mr. Yawar describes how "in fact, training adds to our experiences, and we have a lot of chances to share and to learn new things." Another participant expressed that "I got very much motivated from these trainings as, I always think that it will provide me with more knowledge. Similarly, Mr. Saleem shared about the positive impacts this motivational factor had on him as follow:

> I am always motivated and willing to go for any PD. I often said to [senior colleagues] if there is training so, please send my [nomination] too. When we [teachers] go for trainings, we found the new environment and met with new people and make new friends. We learn new things, so when we come back from training, we share the knowledge with friends[colleagues] and get refresh for next six months.

The majority of the participants appriciated the role of trainers and designers in providing them opportunities for building good training environment. Most of the trainers motivated them through actively engaging them in activities and building the discussion with them. These trainers did practical activities with them. Sometimes, these trainers tried to address their specific learning needs that share their experiences and knowledge with the participants. These PD trainers tried to build healthy environment through arranging different curricular and cocurricular activities for them and that impacted on participants knowledge, personality or behaviour.

Participants believed that collectively these PD training were beneficial for their professional learning. However, they criticized some of their co-participants who preferred to be passive learners. Mr. Sharif, for example, revealed that participants had little interest in building any argumentation or active involvement in training activities. Mr. Sharif shared that "Mostly, teachers want to wind it up and questions raised equal to none because if someone asks any question, rest of the teachers pull him back and signal him to let it end".

Additionally, the issues of motivation and willingness to learn during PD depended on other cultural factors as well, such as participants' perception toward new PD knowledge. It was evident that if they were not expecting something new, then they would have never found themselves motivated in attending or participating in such PD activities. Also, others affirmed several factors including the incentives attached with getting PD trainings, monitoring and governance issues of PD, etc. All these factors affect participants' motivational levels as well as building the culture of PD activities.

Participants in all these findings recognized the need for PD training in their professional careers and described it as a *necessity* for becoming effective science teachers. Most the participants had a less understanding about the policies and structure of PD. Still participants' experiences of these PD activities were less meaningful for them. For the most part, participants received fewer opportunities for active learning and addressing their needs. Likewise, access, selection and equal opportunity to participate in these activities were problematic for them. They found themselves affected by contextual and cultural factors and faced struggles in applying for these PD experiences.

## Discussion and Implications

The present study addressed the pertinent question, “How do Pakistani secondary schools’ science teachers describe their lived experiences of PD?” A logical extension related to the aforementioned question in the form of a sub-question posed, “How did science teachers implement the learned knowledge from PD and how did it work for them?” It is of immense poignancy to mention at this juncture that the present study predominantly examined the perceptions of teachers from the Punjab province of Pakistan. The present research in its ambit uncovered several poignant aspects of the ongoing PD practices in the Punjab province of Pakistan. One of the primary issues in due course of the present research investigation was that the participants were not fully aware of the importance of PD, its learning objectives or the overall impact of the training acquired through their participation. The findings of the present paper were closely connected to the pre-existing and precedent research findings on PD studies conducted in Pakistan (e.g. Haider & Ali, 2012; Kanu, 2005; Westbrook et al., 2009) or in other countries of Asia and Africa (e.g. El-Hani & Greca,2013; Johnson & Monk, 2000; Kafyulilo,2013; Mukundan, Nimehchisalem & Hajimohammadi, 2011; Perera, 2011; Petras, Jamil & Mohamed, 2012; Widodo & Riandi, 2013).

The primary implication generated by the results of the present study stated that science teachers are the major stakeholders in their PDs, and they may be taken on board before designing any PD program for their grooming. In consonance with the aforementioned argument, it is prudent to be aware of the proposition that there can be numerous deficiencies they (the respondents in question) may be privy to witness by virtue of the

follow-up programs at the district/divisional levels. Finally, such PD programs may essentially complement the needs of the science teachers. The present study is not the only one highlighting the concern above. In the near past, several other reports have been undertaken suggesting that teachers' perspectives should be taken into consideration for developing PD training modules (e.g., Allen & Penuel, 2015; Desimone, 2009; Gao & Wang, 2014; Luneta, 2012; Mokhele & Jita, 2010; Saka, 2013).

However, those PD programs which lack teaching community input and interests obtain relatively scarce attention. An effective participation and interest can be instrumental in leading to beneficial outcomes. Furthermore, a plethora of pre-existing studies (e.g., Aslam, 2013; Corte, Brok, Kamp & Bergen, 2013; Heba, Mansour, Aldahmash, & Alshamrani, 2015) additionally argued that the key focus should rest on the manner in which teachers learn effectively and respective domains of which they need to possess knowledge of . Equally, the abovementioned findings revealed the pertinent research gap that existed between the supportive and less enthusiastic participants. The existence of the antecedent phenomena may be due to the pertinent differences pervading the research participants' personal circumstances and the variety of experiences that they have undergone in due course of their career.

Often, PD providers while designing the needful program or curricula did not consider the reality of the indigenous environment. Whereas indigenous perspectives steeped in culture-specific paradigms can affect the valid ways of knowing. Furthermore, within the purview of most situations, PD programs in Pakistan have been implemented and developed by considering the inimical success of such PD program in different re-

gions of the world. The present study likewise proposes that all PD development programs should be initiated by bearing in mind the participants' contextual and cultural issues which could affect the effectiveness of PD. Conversely, imported PD programs would never gain the interest of teachers. The epistemological development of teachers is usually mediated through the culture specific education environment (Chan & Elliott, 2004). At this juncture, there stands a poignant requirement for a think tank which could evaluate numerous issues such as attitude development, proximity or training site, trainers' effectiveness etc. The aforementioned findings corroborate similar studies from other parts of the world (e.g., Abell et al., 2007; Bayar,2014; Chval et al., 2007; Kennedy,2011; Lalor and Abawi, 2014; Mukeredzi,2013; Roux,2013; Sandholtz & Ringstaff, 2016), which deduce through their pertinent findings that the successful PD could generate a support system for teaching community wherein teachers can work and implement their ideas.

The logical extension of the most pertinent research question posed by the present study relevant to the existing PD programs for a science teacher in Pakistan was how the knowledge/best practices acquired through these programs are translated into their teaching practices, ultimately benefitting the students. Although the main research questions have already identified several loopholes in the ongoing governmental PD programs, the current research evaluated the way the science teachers participating in the existing programs translate the knowledge acquired. It is critical to pose at this juncture that similar hurdles have been reported previously with pertinence to the learning experiences of teachers and subsequently implementing the knowledge acquired (e.g., Buczynski &

Hansen, 2010; Goodnough, 2010; Opfer & Pedder, 2011; Shah;2009; Sinclair, Naizer & Ledbetter, 2010; Towndrow, Tan, Yung & Cohen, 2008).

Data generated in the due course of the present study puts forth another important implication with pertinence to the PD of science teachers. The existing PD programs are either inadequate or fail to provide effective trainers who can address the rudimentary needs of the teaching community. The findings of the present study confirmed the role of several PD trainers hitherto identified through the research reports from Pakistan (e.g. Akhtar, Shah & Naseer-ud-Din,2011; Nadeem, Ali, Lone & Maqbool, 2013). Equally, other research findings for the most effective types of PD activities are those taking into account the teachers' personal and school-based needs (e.g., Guskey, 2002; Matteson, Zientek & Ozel, 2013; Miles, 2002). Furthermore, participants have emphasized upon the learning needs and active involvement of teachers for ensuring effective PD learning experiences. The fore stated results were found to be consistent with the previous studies undertaken with respect to teachers' skills (e.g., Daugbjerg, Freitas & Valero, 2015; Posnanski, 2010; Zhang, Parker, Koehler & Eberhardt, 2015).

## Conclusions

The present study was undertaken to gain insight into the nuances and intricacies of the science teacher's lived experiences about the different PD practices. During the three months of data collection, participants expressed their discontentment of the PD experiences they have in their career. They considered such PD experiences as supportive in meeting some of the challenges of classroom teaching but unable to address their devel-

opment needs and solving their efficacy issues. The barrier to PD learning existed in different forms and mostly commonly related to institutional or administrative procedures of selection and access.

These participants were exposed to a variety of PD programs but still felt that they lacked application of these PD activities in their instructional practices. They thought that PD programs should be designed on long term basis and keeping in view their specific disciplinary needs. They stated need for a school based PD structure wherein they can develop their knowledge, skills, and self-efficacy through stronger PD outcomes. These participants thought that PD learning took place under the influence of certain factors like cultural, contextual, and motivational factors. They discussed the problems of feedback mechanism or logistical constraints, in accessing these PD programs and getting meaningful experiences. Due to these problems, they must go through many types of learning struggle. The study draws the attention of policy makers and PD providers to the fact that science teachers cannot act as expected and they need to consider in different manner. They must take into account by emphasizing those PD programs and contents that address the teachers' needs.

The findings of the present study strongly suggest that PD for science teachers in Punjab (Pakistan) needs reforms. The PD providers may consider the participants' learning needs and contextual realities in which they are working. Likewise, based on the availability of resources and facilities, such PD experiences can be strategically planned and intertwined with the participants' motivational factors. Consistent with the literature review of the present study, all participants found that their sharing of experience and ac-

tive participation were the most meaningful PD experiences in these programs. The present study suggests that, upon identifying the local issues, good practices from other regions can be incorporated into these indigenous programs.

Based on their shared experiences, it can be concluded that the PD practices for science teachers in Punjab need to be reformed. Specifically, they need such PD opportunities which are relevant, continuous, site-based, and which support their learning and change. These participants need to be supported through policies, structures, and resources in the implementation of their learned knowledge of PD. They likewise need more opportunities for active participation, building dialogue, and feedback. The findings of this study can be incorporated with the purpose of PD providers to have a more coherent, sustained, and collaborative impact on science teachers' learning and change.

## Limitations and Suggestions for Future Research

This study was limited by its phenomenological case research design, which like other qualitative designs does not generalize to a larger population. Equally, the research question was very much specific to science teachers lived experiences, so verification of their sharing from other sources like PD trainers or developers was required. The population and sample of the study were fifteen science teachers from the three districts of Punjab (Pakistan), with a purposive sampling of both male and female science teachers. Future studies could expand to other provinces to examine notable differences. The sample was not collected from participants in the private sector and in a sense, it is a perspective view of the phenomenon and limited to public sector science teachers whose experiences tend to overlap. Future studies could furthermore explore how science teachers at different career stages interact with these learning opportunities and experiences. In the same

way, only semi-structured interviews were conducted in one session due to changing security protocols in Pakistani schools and time limitations. Interviews of this sort could be expanded to multiple sessions to get more in-depth expressions and feelings from the participants.

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# APPENDICES

## Appendix A- Sample Interview Questions for Science Teacher

1. What can you tell me about your academic background?
    a. How did you start your career as Science teacher? At what level?
    b. What motivate you to become Science teacher?
    c. From where you start your career as a science teacher and how did you progress in these years?
    d. How did your journey as a public-sector science teacher started?
    e. Did you get any orientation or induction experiences in the start of your career? How was it? What can you recall and let me know about those processes?
2. How were your initial experiences with the school environment, students, principal, and colleagues, etc.?
3. How much administrative and material support was available to you at the start of the career as a science teacher? Any changes/improvements in support for you in these years?
4. Did you able to apply your PD training in your teaching and learning context? Can you recall any example from your past experiences for such application? What do you learn about it? And in what ways did you used what you learned in your PD classroom?
    a. What factors made you motivated for active participation during such training? What surprised/puzzled you most during your participation in these activities?
    b. What do you think about the effectiveness of those PDs in your professional life? Which one(s) did you like to most? And why? Which one(s) did you find least applicable? And why?
    c. How did you decide to participate in such PD activities? Did you ever get any chance to identify your training needs to training providers or did some training institution asked you to identify your priorities or preferences for types of trainings before or after training?

   d. Did you encounter any barriers or challenges during or after getting such training? from which side you get? How much quality of your professional learning effected by such challenges/ difficulties? How did you able to overcome these difficulties?
   e. Did training institutions come to you for listening to your implementation experiences of your training knowledge and how you met/missed your targets?
5. Have you involved in these activities in any other capacities besides involving as a participant e.g., like Coordinator or lead/ master trainer, etc.?
6. How did you share your professional development experiences with your professional community like through writing/speaking or mentoring or any other way? If yes, did your experiences were helpful in impacting/facilitating learning of other science teachers?
7. If you look back over your past experiences of implementation and learning, what parts have been the most rewarding for you?
8. Based on your experiences of professional developments, what types of professional development activities you will recommend for science teachers at the secondary level in Punjab? Why will you recommend such trainings?
9. Do you have anything else that you would like to share with me based on your experiences of professional development?

## Appendix B – Informed Consent Form

**Georgia State University**

**College of Education and Human Development**

**Department of Middle and Secondary Education**

**Informed Consent**

Title**: A descriptive of Professional Development Experiences of Science Teachers at Secondary Level in Punjab, Pakistan.**

Principal Investigator: Dr. Kadir Demir

Student Investigator: Azhar Majeed Qureshi

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to investigate how science teachers experienced professional development activities in their career time. You are invited to participate because you are a science teacher at secondary level schools in Punjab and having more than of five years of professional development experience. A total 15 participants will be recruited for this study. Participation will require 60 to 90 minutes of your time once.

II. Procedures:

If you decided to participate, you would be interviewed once. The Interview will be audio-recorded. A student researcher will interview you. The interview will take place at a quiet location of your choosing.

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

Participation in this study may not benefit you personally. Overall, we hoped to gain information about what science teachers experienced about professional development activities during their career time.

V. Voluntary Participation and Withdrawal:

Participation in research is voluntary. You do not need to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at the time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:

We will keep your records private to the extent allowed by law. Dr. Kadir Demir and his researcher will have access to the information you provide. Information may be shared with those who make sure the study is done correctly (GSU Institutional Review Board, the Office for Human Research Protection (OHRP). We will use a fake name rather than your name on study records. The information you provide will be stored on the Dr. Demir's password, and firewall protected computer. The code sheet will be stored on Azhar Majeed's password and firewall protected a computer. Your name and other facts might point to you will not appear, when present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.

VII. Contact Persons:

Contact Azhar Majeed Qureshi at (202-431-8119) and aqureshi4@student.gsu.edu if you have questions, concerns, or complaints about this study. You can call if you think you have been harmed by the study than Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 and svogtner1@gsu.edu if you want to talk to someone who is not part of the research team. You can talk about questions, concerns, or suggestions about the study. You can call Susan Vogtner if you have questions or concerns about your rights in this study.

VIII. Copy of consent Form to Subject:

We will give you a copy of this consent form to keep.

If you are willing to volunteer for this research and be audio recorded, please sign below.

_____ _____

Participant Date

_____ _____

Principal Investigator/Researcher Obtaining Consent Date

## Appendix C - Participants' Demographic Information

| Science Teacher | Gender | District | Professional Qual-ification | Job Title | Teaching Experience (Years) | Current Teaching Subjects |
|---|---|---|---|---|---|---|
| 1 | Male | Lahore | M.S. Ed | SSS (Biology) | 20 | Biology, Chemistry, Physics |
| 2 | Male | Lahore | BSc. B.Ed. | SST (Science) | 25 | Biology, Chemistry, Physics |
| 3 | Male | Faisalabad | MSc. B.Ed. | SSS (Physics) | 22 | Physics, Mathematics |
| 4 | Female | Lahore | M.S. Ed | SST (Science) | 07 | Biology, General Science |
| 5 | Male | Lahore | BSc. B.Ed. | SST (Science) | 20 | Biology, Chemistry, Physics |
| 6 | Female | Gujranwala | B.Sc. B.Ed. | SST (Science) | 21 | Biology, Chemistry, Physics |
| 7 | Male | Lahore | B.Sc. B.Ed. | SST (Science) | 24 | Biology, Chemistry, Physics |
| 8 | Female | Lahore | MSc. (Chemistry) | SSS (Chemistry) | 16 | Chemistry, Biology |
| 9 | Male | Lahore | B.Sc. B.Ed. | SST (Science) | 28 | Biology, Chemistry, Physics |
| 10 | Female | Gujranwala | MSc. B.Ed. | SSS (Physics) | 20 | Physics, Mathematics |
| 11 | Male | Lahore | B.Sc. B.Ed. | SST (Science) | 31 | Biology, Chemistry, Physics |
| 12 | Female | Lahore | MSc. B.Ed. | SSS (Physics) | 28 | Physics, Chemistry, Math |
| 13 | Male | Gujranwala | MSc. M.Ed. | SSS (Physics) | 23 | Physics, Mathematics |
| 14 | Male | Lahore | B.Sc. B.Ed. | SST (Science) | 26 | Biology, Chemistry, Physics |
| 15 | Male | Lahore | MSc. M.Ed. | Senior Headmaster | 25 | Biology, Chemistry, Physics |

## Annexure-D Data Explication (Interview Transcription to Theme Construction)

| Interview Description | Initial Coding | Axial Coding | Categories | Theme | Analytical Memos |
|---|---|---|---|---|---|
| During training, I had learned too much from other teachers about any topic if a teacher illustrated better than me; so I picked his or her points to implement on my students. Or if another teacher is describing a topic in much easier way than me, I picked that style immediately. (Ms. Bano)<br><br>Yes, we collectively gathered information and made assignments… It was a better experience...It was a positive type of experience and it was too good because everyone was from the different area and they told us about their tasks, we collected material by ourselves and shared our up-to-date knowledge. It was a very nice experience. (Ms. Samrana)<br>If there is someone who is not taking interest and feeling uncomfortable then they should ask his problems. When everyone is working in group then why someone is sitting aside silently(Mr. Bhatti)<br>"I think I learnt from in-service training. I learned from fellow teachers. I always try get something from everything.. (Ms. Saima)<br>"yes we collaborate with our friend trainers if we need to know something then we talk to are master trainers, we solve problems by sharing ideas."(Mr. Farooq)<br>"We used to share that material in a group. It was group learning. Every group was there to share something." ."(Mr. Alvi) | Learning from Trainers<br><br>Personal Participation<br><br>Participant Sharing<br><br>Knowledge Exchange<br><br>Collaborative Work<br><br>Group Learning | Learning Experiences<br><br>Personal Sharing Experiences<br><br>Teacher Learning Experience<br><br>Mentoring Experiences<br><br>Participation Experiences<br><br>Learning Experiences | Group Work Experiences | Meaningful Experiences* | Most the teachers were excited in sharing their learning experiences. How they learn from the PD sessions and how these sessions were helpful in resolving their classroom issues. They also tried to highlight their contribution in these experiences. Most of them also shared their personal stories. However, the role of trainers in their group learning was not significant instead they shared more about the PD environment and the other participants' roles. |
| In the beginning, it was just routine to teach them because it was my first year. But then in mid of my career when I did refresher courses, I modify myself and started teaching differently. Similarly, PD trainings gave me strength to motivate my students in a new way and the benefit of becoming a good science teacher. (Ms. Bano)<br><br>Yes! I have seen too many changes in myself. As a professional science teacher, I think I am the luckiest person who worked in PEAS [Punjab Education Assessment System] ...It was very useful for me ...I got much to learn and I am very thankful to them [PD trainers] that I improved so much. (Mr. Rana) | Teaching Experiences<br><br>Learning from Trainers | Learning Experiences<br><br>Change Experiences | Learning and Change Experiences | | |