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Factors that impact on the effectiveness of Professional Development programs for science teachers in Saudi Arabia

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ABSTRACT

The Saudi Arabian Government has made a substantial investment in reforming the science curriculum in Saudi Arabia. The need for effective professional development (PD) programs is especially crucial in the context of recent curriculum reform in Saudi Arabia. The country has adopted new science curricula following the guidelines of renowned global publishers like McGraw-Hill. However, the introduction of the new science curriculum is posing challenges for science teachers, as it requires a paradigm shift from a teacher-centred to a learner-centred pedagogy. The research for this research involved an in-depth study on the impact of mandatory PD programs on Saudi Arabian science teachers in order to identify potential challenges to achieving the expected level of benefit from the PD programs. This study used a qualitative approach to data collection techniques. Through employs three main methods for data collection, observation,open-ended questionnaire and interview. The most effective professional development programs are likely to be those that address the specific subject matter that relates to the teaching issues faced daily by teachers, rather than those that cover vague and decontextualised educational or pedagogical concepts. Other factors include teachers' involvement in learning communities, the facilities and resources provided by the school, and individual learning styles. On the other hand, common factor responsible for the failure of professional development programs is that the content covered is not relevant to the teachers' specific needs. PD programs in Saudi Arabia are mainly focused on quantity instead of quality.

Introduction

Some studies emphasise on factors that impact on the effectiveness of PD programs. For example, Supovitz and Turner (2000) suggest that high quality professional development programs need to have six elements. The first element is the scope for teachers to inquire, question and do experiments with their teaching. This element makes the training free from the rigour of curriculum or textbooks and encourages scientific reasoning. The second element is intensive, sustained and coherent professional development plans; therefore, a long-term and consistent plan for teachers' professional development is required to make it successful. The third element is keeping teachers engaged in concrete teaching tasks that must be based on teachers' experiences with students. The fourth element is to have a

strong focus on teachers' subject matter knowledge and content skills. The fifth element is to link the program with certain professional development standards, which can be achieved by setting higher learning goals for the trainees. Finally, the sixth element is to develop a strong connection between teachers' development and school reform. This element focuses on the need to consider school development as well as teacher development.

It is evident that teachers are keen to attend professional development programs that are not only relevant to their needs but also address practical aspects of teaching (Sywelem & Witte, 2013). In this respect, Darling-Hammond, Wei, Andree, Richardson, and Orphanos (2009) observed that the most effective professional development programs are likely to be those that address the specific subject matter that relates to the teaching issues faced daily by teachers, rather than those that cover vague and decontextualised educational or pedagogical concepts.

Secondly, for teachers to gain the greatest benefit from professional development, there is a recommended number of hours of professional development programs that teachers should attend within a given span of time. Richter et al. (2011) reported that in the United States, most teachers are required to achieve 120 hours of professional development over a five-year period, while in Europe, teachers are required to achieve 12 to 75 hours of professional development every year. Johnson (2006) stresses that there should be more than 80 hours of teacher development programs if a change in teacher practice is required. In this regard, Mansour et al. (2014) mention the importance of arranging follow-up training. In the case of a professional learning program, these hourly requirements would be linked so that skills are developing over time, rather than isolated hours as per a professional development program.

Thirdly, the mode of delivery and the training approach also have a significant influence on trainees' level of satisfaction. Studies have found that teachers are more likely to enjoy a training program that caters to a variety of learning methods and techniques, including songs, games, story-telling and drama (Uysal, 2012). It is also evident from studies that professional development programs that provide participants with the chance to practise the ideas have been more effective. Uysal (2012) cited examples of how pleased the teachers were to do collaborative work and to prepare and present lessons using new ideas in small groups during the training. The availability and quality of training materials also play a crucial role in making the programs successful. Moreover, it is important to receive proper feedback from the participants and have post-program evaluation to ensure an ongoing positive impact of the training programs (Uysal, 2012).

Fourthly, some researchers place importance on heeding teachers' voices and opinions while designing PD programs for science teachers because it is the teacher who knows what s/he is required to learn to implement new teaching methods (Alshehry, 2018). Moreover, it is argued that teacher PD should be conducted using the same methods that

teachers will be replicating with their students (Almazroa & Al-Shamrani, 2015; Alshehry, 2018). In other words, as the active-learning teaching method that teachers are required to become familiar with follows a constructivist teaching and learning model, it is best that teachers be provided with a professional development program that follows this constructivist model and creates a setting that matches that of their own classrooms (Gupta, Herrington, & Yezierski, 2018). Thus, as observed by Lowe and Appleton (2015), PD programs should take into account teachers' beliefs about teaching science along with the new features of the curriculum and their pedagogical understanding of science teaching. Highlighting the importance of the constructivist approach in teachers' PD, Appova and Arbaugh (2018) argue that teachers' motivation for learning does not work with mechanical approaches such as the "carrot and stick" method (p. 17), but rather comes from teachers' learning needs, their readiness and opportunities to learn.

Finally, teacher learning is also facilitated through constructive feedback. According to the United Nations (2001, p. 1.8), feedback is essential for participants' learning, in that feedback identifies the present state of learning, feedback highlights what needs to be learned and suggests how to proceed with such learning, feedback monitors progress in learning, helping to diagnose problems quickly and find effective solutions and feedback provides positive reinforcement for learning achievements.

Thus, it is important for the presenters of PD programs to listen to the participants to gain feedback, which ultimately improves the PD structure and ensures that the participant is receiving the information clearly.

Literature Review

Teacher and context-related factors

Factors related both to the teachers themselves and to the context play an essential role in ensuring the success of a PD program. Teachers' motivation and commitment can contribute to successful professional development and learning. Motivation is an essential factor in learning teaching, and the experience that a teacher gains is significant (Simon & Campbell, 2012). Studies show that teachers' successful professional growth also depends on the level of commitment they exhibit (Sywelem & Witte, 2013). Other factors include teachers' involvement in learning communities, the facilities and resources provided by the school, and individual learning styles.

Teachers' involvement in networked learning communities seems to lead to changes in practices, philosophies, instructional time and collegial interactions (Mayer & Lloyd, 2011). Therefore, the desired outcomes of a professional development program can be achieved if the teachers have the opportunity to interact with peers in a comfortable environment (Uysal, 2012). It is also observed that teachers' involvement in a network of learning communities can help bring about the desired changes in their practices, attitudes and classroom instructions (Mayer & Lloyd, 2011). This situation was observed in a recent

study of science teacher professional development programs in three districts in Saudi Arabia involving 3150 science teachers (Mansour et al., 2014). The authors revealed that the teachers' development was more successful and effective when the participants had the opportunity to share ideas with each other about their way of teaching and the way the training ideas can be related to their classroom or school contexts. In their study, Mansour et al. (2014) quoted a trainee teacher in a professional development program who claimed, "cooperative learning was the best because it helps overcome any difficulty in my understanding and helps provide an opportunity to revise the information" (p. 960).

Additionally, the extent to which the learning from a professional development program is applied in teachers' practice depends largely on the facilities provided by the school. Mansour et al. (2014) argue that the facilities available in the school are one of the main factors that encourage teachers to try out the professional development ideas in the classroom. The school administration is an important agent for providing such facilities to the teachers so that they have the emotional, financial and other resources to facilitate their classroom practices (Mansour et al., 2014). Thus, the school environment is critical for supporting a teacher to take a professional development experience and move it towards professional learning practice.

In conclusion, for successful professional learning to occur, the starting point is a high-quality program. When creating a high-quality program, the teachers' needs, the school facilities and the teacher's commitment need to be considered. According to Uysal (2012), the central points to address are teachers' needs, teachers' experiences and the teaching–learning context. It is also of utmost importance to value the ideas of the participating teachers, treat them as experts and encourage reflective practices among them to ensure a more sustainable impact of the training on their practices. That is, it is important to consider the teacher as central to the program to ensure professional learning occurs.

Factors that can negatively impact on professional development for science teachers

There are a number of factors that impede the desired outcomes of teachers' professional development programs. Like success factors, they can be related to the program or to teachers and contexts.

Professional development program-related factors

Program-related factors mainly concern the barriers generated by the presenter and/or the provider of the professional development program. Firstly, the professional programs might lack sound planning and evaluation phases, as sometimes the trainers are not given enough time to prepare and deliver the program (Uysal, 2012). Also, the delivery of the program may not be of a high standard, as the trainers are either inexperienced or have a tendency to be too theoretical (Mansour et al., 2014).

Another common factor responsible for the failure of professional development programs is that the content covered is not relevant to the teachers' specific needs. A recent study of 295 elementary school teachers in Saudi Arabia who attended a number of professional development programs offered by Local Education Authorities (LEAs) revealed that all these programs are designed centrally without taking into account the specific needs of teachers, and programs like these can serve only a "one size fits all" purpose for all participants (Sywelem & Witte, 2013, p. 888). According to Abdulrab and Sridhar (2012), the science teachers who attend PD programs do not receive much benefit from those programs due to the focus of the programs being only on methods in general rather than covering science teaching skills. Similar problems have been reported by other studies. For example, Uysal (2012) observed that teachers were not informed about the aims of the course prior to the training, the course content had little relevance to their specific needs and they had no scope to reflect on their problems to suggest possible solutions. Among other limitations mentioned by teachers were the unsuitable setting, an overcrowded training room, the short duration of training and "unorganized and boring" presentations or lectures (Uysal, 2012, p. 19).

Teacher and context-related factors

Teacher and context-related factors involve the individual teachers, the place where they intend to implement the PD program ideas and education policy. Firstly, the execution phase of any professional development program faces many challenges. Mansour et al. (2014) cite examples of participating teachers who found the professional development program interesting but not suitable to apply in their working context. In this respect, the role of the school administration is of importance. Teachers from a recent study stated that the school administration does not provide support for the professional growth of the teachers and does not allow teachers to take part in professional development events such as workshops, seminars or courses of their choice (Sywelem & Witte, 2013). In relation to this research, it is the mandated, generalised professional development that is to be explored from the teachers' perspective. However, it is the contention that mandated, generalised professional development programs have a negative impact on the possibility of teacher professional development occurring in Saudi Arabian schools.

Another major factor that causes the poor outcome of professional programs is the huge workload that teachers have to cope with. Teachers are often stressed with the burden of teaching a large curriculum within a short period of time. Moreover, teachers have to perform other duties in addition to classroom teaching (Mansour et al., 2014). Furthermore, the importance of continuing professional development programs as a means of professional development has been undermined by some teachers. There are teachers who believe that continuing professional development programs do not consider important factors like teachers' existing knowledge, experience and needs, and do not take into account the school and system in which teachers work (Sywelem & Witte, 2013). Also, there is the possibility of being opposed by the students and guardians as the teachers are

trained to follow the inquiry-based teaching of science while students and guardians prefer the traditional approach (Gupta, Herrington, & Yezierski, 2018).

Overall, there is research literature that reports lack of support from the government or the Ministry of Education for successful implementation of PD, which has an adverse effect on teachers' reform efforts and confidence levels (Gupta et al., 2018). Some of the serious impediments to successful implementation of PD include heavy teaching loads, poor timing of delivering PD, inadequate circulation of the PD program and lack of proper incentives to encourage teachers to take part in such programs (Alshamrani, Aldahmash, Alqudah, & Alroshood., 2012). Similar concerns were expressed by Appova and Arbaugh (2018), who reported that the PD programs in Saudi Arabia are mainly focused on quantity instead of quality and do not encourage teachers to explore better learning opportunities. Moreover, it is contended by Almazroa and Al-Shamrani (2015) that the PD programs for Saudi science teachers do not have a "systematic, comprehensive and coherent evaluation model" (p. 14).

Research Methods

This study used a qualitative approach to data collection techniques. The first phase of the data collection involved observing three PD programs for science teachers. Empirical in nature, the observations aimed to record the events that unfolded during the PD and the actions of the participants involved in the PD pro study recorded behaviours relevant to answering the main research questions in order to improve understanding of the context and nature of the mandatory PD programs. The second tool of data collection used in this study was an open- ended questionnaire which was employed to develop insight into the situation and help choose potential interview participants. The third research tool used in this study was the semi- structured interview as it afforded an opportunity to explore participants' views on aspects of the research question and offers a deeper understanding of the perceptions of science teachers about the effectiveness of professional development.

An open-ended questionnaire was completed by 81 science teachers who attended the in- service PD program in the Sarat Ubaidah region. Science teachers were recruited via letters sent by the Saudi Department of Education to all primary, middle and secondary school principals. Of the 414 science teachers listed in that region, a total of 81 teachers, comprising both experienced and new teachers, attended the five mandated PD programs and completed a questionnaire. Observations were conducted only on the three PD programs detailed above (attended by 47 teachers). Of the total 74 questionnaire respondents, 38 science teachers consented to participate in the interview; of these, only 21 participants engaged in the interview phase. The remaining 17 participants refused to engage in the interview either because they no longer wished to participate in the study, did not wish to be recorded, or failed to answer attempts at communication.

The data collected from this study, required guidelines to ensure the data was analysed in a systematic way. The notes recorded during the observations were reviewed multiple

times to identify common issues before categorising them into broad themes. The data collected was based on the researcher's observations of the level of engagement exhibited by the participants, as well as the questions they asked the presenters during the PD seminars. The notes recorded during the observations were reviewed multiple times to identify common issues before categorising them into broad themes. The following steps were followed to analyse the questionnaire data; commonalities between responses were read and grouped together, similar responses were colour coded into the same category, translated from Arabic to English (to ensure categorisation and coding occur before any potential changes in meaning could occur), and labels were used as themes to list and present findings for a certain question.

The data generated from the interviews were transcribed from the audio recordings. The participants' gestures, volume, emphasis, vocal intonation and body language were noted during the interviews. The coding process involved repeated readings of the interview transcripts to identify some broad headings for categorising the various types of responses. Original plans to use computer software like NVivo were abandoned after realising the program did not support language scripts written from right to left (such as Arabic). Instead, different colours were used to highlight participant responses and codes generated manually in Microsoft Word. Upon completing the coding in Arabic, similar codes were compiled to generate broad themes from the interview.

The findings were presented in the form of narrative discussions. The narrative texts included quotes from selected interviews (translated into English) that captured the typical feelings and experiences of the participants. A certified Arabic/English translator double-checked the participants' quotes to ensure the accuracy of the translations. The data was interpreted by comparing the findings from interviews against the research question and relevant literature as well as the personal experiences and contextual knowledge of the researcher. Finally, triangulation of data was used to promote the validity of the research.

Findings

The bar chart below (Figure 1) demonstrates the ease of implementation of ideas from professional development (PD) programs according to science teachers who participated in the questionnaire.

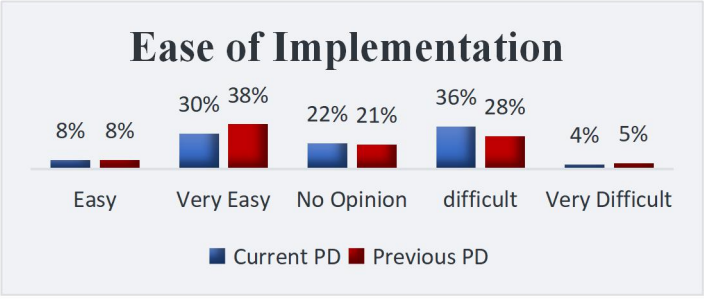

Figure 1. Ease of implementation of professional development programs for science teachers (open-ended questionnaire).

A ‘very easy’ level of implementation of ideas from PD was stated by 8% of participants with regard to both the current PD and PD programs attended previously. Furthermore, 38% of questionnaire respondents found it ‘easy’ when it came to the implementation of ideas from their current PD program, while 30% of respondents expressed the same level of ease with implementation of ideas from previous PD. A ‘no opinion’ rating was provided by 22% of participants with regard to the current PD, and 21% of questionnaire participants gave this same response to the ease of implementation question with regard to previous PD programs. A ‘difficult’ ease of implementation value was provided by 36% of participants in relation to the current PD program and 28% of participants in relation to previous PD. Finally, 4% of participants responded with a ‘very difficult’ perceived ease of implementation with regard to the current PD program, while 5% of questionnaire participants gave this ease of implementation in relation to previous PD programs.

Participants were also asked to explain their reasoning for the chosen level of ease of implementation of ideas from PD. The reasons given by the participants for expressing various levels of ease of the implementation of ideas from the PD they had attended currently as well as previously were related to six main factors: implementation, relevance/meaningfulness of the programs, availability, motivation, workplace and the PD program. As teachers showing ‘very easy’ and ‘easy’’ implementation of ideas from the PD indicate their overall positive attitudes, responses to these two categories were merged under one heading, ‘ease of implementation’. Again, the two categories of ‘hard’ and ‘very hard’ were also merged into one named ‘difficulty of implementation’, as these two refer to science teachers’ negative attitude about the implementation of PD.

Workplace

The results showed that six of the 74 PD participants expressed ‘ease of implementation’ for the current PD because of the workplace, while 10 of the participants reported ‘ease of implementation’ for the previous PD due to the workplace. The participants found that the current PD ideas could be implemented in the school. For example, participants said it was easy to implement the current PD ideas because “the school is prepared to implement the program ideas”. Other participants claimed that the current PD ideas could be implemented easily at schools “because of the low number of students and the colleagues’ cooperation”. One participant added that “the number of the students is good”. While explaining reasons for choosing ‘ease of implementation’ in relation to previous PD, participants mentioned how the school can help to implement the PD easily, as one participant said, “The teaching environment and the student numbers and their level in my school, I can implement most of the ideas”. Another participant expressed that “in general, the school management cooperation and its encouragement and the low number of students might make all the ideas easy”.

There were 10 participants who expressed ‘neutral’ for previous PD in relation to workplace, and six participants showed ‘neutral’ to current PD while considering the workplace. One participant found the previous PD to be ‘neutral’ because “the students are not capable of modern ideas”. Another participant said, “I face some difficulties in the classroom because the number of students is low and in some classroom[s] there are only

three or two students". The other participant stated that "there are some ideas that suit the educational environment and the school's students and I will implement [them]". In relation to the previous PD, the participants also showed 'neutral' opinions toward implementation of the PD ideas because of the workplace. For example, one participant said, "The environments differentiate where some of the students can develop themselves and the student helps in implementation where others can't". Another participant added that "my classroom environment doesn't assist me in the implementation of these ideas". Additionally, one participant said it is neutral "because of the number of the students and that the students are established on some of the strategies and not having the classroom prepared".

The results showed that 20 of the PD participants expressed 'difficulty of implementation' of the current PD ideas because of the workplace. Again, 14 of the participants reported 'difficulty of implementation' for the previous PD due to the workplace. According to participants' opinions, the implementation of current PD ideas is hard because of "not having the right and proper school environment". Other participants said "the managers and the parents only focus on what is written on the papers" and "there is no lab and there are no organised halls" [classrooms]. In order to highlight his reason for choosing 'hard to implement' for the previous PD, one participant said, "The environment is totally incompatible with the knowledge of the program's presenters". Another participant mentioned "not having the proper environment for the professional development", as well as "the huge number of the students in the classroom" and "having a lot of lessons are not taken into consideration as well as the required administrative activities and duties".

Availability of equipment

The results showed that 13 of the PD participants expressed 'ease of implementation' of the current PD ideas because of availability of equipment. Again, 10 of the participants reported 'ease of implementation' for the previous PD ideas for the same reason. The participants found that the current PD ideas was easy to implement since equipment was available, stating that, "The school environment has all the tools that help the teacher in developing himself". Another participant added, "The methods are often simple and it doesn't require big and complicated possibilities". One participant mentioned the school as "having the tools that help in implementing the virtual experiments from the computer, display devices and appropriate spaces". In relation to the previous PD, participants said that it was easy to implement ideas because most of the necessary equipment was available. For instance, the participants stated that implementation was "very easy because of the available required necessities". Another participant said, "The school is prepared to implement the program ideas as well as having the resources and the devices in all of the classrooms". Moreover, one participant stated that the easy implementation of PD ideas was because of "having the encouraging and display requirements and having the cooperation between the groups of students".

Four participants expressed 'neutral' for the implementation of previous PD ideas in relation to availability of equipment, and two participants showed 'neutral' to current PD ideas for the same reason. The participants found the current PD ideas to be 'neutral' to

implement because of the availability of equipment. As one participant said, “it’s not easy to have the tools”. Another participant added that “all the implementation tools are available”, while yet another said it is ‘neutral’ because of “lack of possibilities”. With regard to the previous PD, one participant rated the implementation of ideas as ‘neutral’ because of availability of equipment. The participant stated that “it’s hard to have the tools available”. Another participant said, “Some programs needs the tools and effort”. Nine of PD participants expressed ‘difficulty of implementation’ for the current PD ideas because of the availability of equipment, and four of the participants also reported ‘difficulty of implementation’ for the previous PD ideas due to the availability of equipment. The participants explained the reasons why the current PD ideas were difficult to implement, as one participant mentioned “the possibilities in the school doesn’t help”; “not having the equipment and the required tools”; and “not having a lab that contains modern experimental tools and not having helpful tools”. Another participant was wondering “how the [implementation] takes place without the tools and possibilities”. In relation to the previous PD, the participants showed a ‘difficulty of implementation’ opinion because of the availability of equipment. For example, one participant said “the programs they require tools and devices that are not available in school”. Another participant stated that difficulties included “the teaching tools and the place and the devices for the executed program”.

The professional development itself

Two participants expressed ‘ease of implementation’ for previous PD in relation to the PD itself, while no-one expressed ‘ease of implementation’ for the current PD. Also, two participants showed ‘neutral’ responses for implementing the current PD in terms of the PD itself, while six participants showed ‘neutral’ responses for implementing the previous PD for the same reason. In relation to implementing the previous PD, the participants said, “Depends on the differentiation of the program where some programs are hard to implement while others are easy”. Another participant reported that “some programs are useless and some are useful”. One participant added, “Some of it [the PD] are not appropriate”.

There were only two participants who showed ‘difficulty of implementation’ responses for implementing the previous PD in terms of the PD itself. The participants linked ‘difficulty of implementation’ for implementing the previous PD in terms of the PD itself because of “the lack of the subject and the professional programs”.

Interviews result

When talking about the potential of implementing the PD ideas in school, the participants talked more about the barriers than the opportunities. Among the barriers mentioned by participants were workloads, lack of educational aids, work environment, challenging curriculum, the content and focus of PD, lack of practical application of PD and low-level and less-motivated learners.

Workloads

While talking about the barriers to implementation of the PD, the participants reported they have to struggle with workloads at school, which is aggravated by the non- teaching activities. One science teacher said that "the teacher has to explain and apply, and do other stuff, so he usually neglects the practical side; as for me, the curriculum of chemistry was too much for the academic year" (Fahad). Also dealing with three different syllabuses is another cause of excessive teacher workloads, which limits the desire to implement the ideas from PD. One participant mentioned: Since I started in the field of teaching, it has been eight years. I teach three syllabuses. I teach first, second and the third class in secondary. It is impossible to creatively implement three curricula, especially when they [the Ministry of Education] suddenly change the curriculum and say that you must be inventive in the three curricula. We face difficulty with the number of lessons and the number of curricula. (Jabeer)

Another reason causing challenging workloads for teachers is making up the lessons missed by teachers while attending PD. Regarding this, one teacher stated: We are inconvenienced by the professional development programs that are implemented during working days. As a result, we have to compensate for the missed lessons, especially we, as science teachers. We have four lessons in the second classroom and four lessons in the third classroom and if we have only two or three classrooms in the school, the teacher will encounter problems. This is caused by the lack of time, and the teacher's attempts to compensate for lessons missed due to attending PD sessions. If the professional development programs are over three days, there will be a disaster due to the huge number of missed lessons to be compensated for, and the quota of lessons which must be taught. (Talal)

Another cause of the excessive workloads for teachers is the challenge of new teaching methods, which means teachers need more time to prepare. This was particularly observed by a teacher who said:

In order to make a concept map, I need a lot of time. In addition, the method of representative education or other methods all require preparation. I do not have enough time because each week I have 20 mandatory lessons, which are difficult to cover in detail. You might say that the preparation should be done at home, but the volume of work is so high that my work day would stem from morning to night. I am really under pressure and there is no reward. (Talal)

Another teacher explained the time-consuming preparation that a teacher needs in order to teach using the new methods and gave an example: A PD in active learning shows where we try to make the student the centre of the learning process in a practical way, and make him able to find the information by himself. If I give the information, I may only take one minute to do so, but if I let students find it themselves, then we may take the whole (time) class to find the information. (Ahmad)

Unsuitable/insufficient teaching–learning materials

Participants mentioned the unsuitable/insufficient teaching–learning materials as one of the barriers to the implementation of PD at school. It was stated by some participants

that the teaching–learning materials available at school are not suitable for teaching the new curriculum. For example, the new curriculum suggests using certain computer programs in the classroom that are not available at school. On this aspect, one teacher said, "We have a computer program but it's outdated and might not be applicable for the modern curricula" (Ahmad). Overall, a shortage of materials in school has been reported by participants, which is in contrast with the PD environments that are equipped with all necessary materials and equipment. Another participant stated: We attended a professional development program on the Experiments Book. The place we attended the PD was 100% equipped where it was possible to apply the Experiment Book to a lesson. But when I came back to my school, I did not have any thing available to use. (Sami)

Work environment

Another barrier to the implementation of PD, as mentioned by science teachers, is the overall work environment at school. In fact, most teachers mentioned a discouraging environment with limited support and resources at their schools. As the schools are located in rural areas, they do not have access to modern amenities and services. For example, one teacher said, "Honestly, the work environment is not motivating for the teacher. My school is located in a village where services are not available" (Mohammed).

The implementation of innovative teaching ideas becomes even more challenging in rural schools than in the schools in the city areas. As one teacher reported, "Implementing some of the teaching strategies in an ideal type of school in Riyadh [the capital city of Saudi Arabia], which has all the tools, is not like applying it to a school in Sarat Ubaidah [rural area]; there will be a big difference" (Talal).

Moreover, implementing the new teaching ideas in schools is not often supported by principals who still have a traditional view of teaching. As one participant said: Maybe you have a school principal that does not help you apply an idea in school or change anything because he has a traditional mentality that does not want to accept change. Everything is fixed and does not change; some of them even do not like to change the location of their office desk. (Saleh)

The content and focus of professional development (relevance)

Another factor that acts as a barrier to implementation of the PD ideas is the non-specialised nature of the PD itself. All of the participants except one said that they attended PD programs with a focus on science teaching in general rather than a specific focus on specialised subjects such as physics, chemistry or biology. This was explained by one teacher who said, "Unfortunately, there have been general professional development programs, but there have been no specialised ones" (Sami). A typical general PD session such as this would have general goals and would comprise physics, chemistry and biology teachers all in the same program. One teacher gave an example of this as he said, "About 50 physics, chemistry and biology teachers were gathered together, just to know about the new curriculum; no further details were given" (Ahmad).

Misunderstanding of some concepts of the PD was also reported as a barrier to its implementation. One teacher explained: There are professional development programs

about active learning. We were able to understand only some concepts. I am telling you the implementation was apparent about 30% to 40% sometimes up to 50% of the time, and the reason was due to weak application. We did not practise what we learnt during the PD. There was supposed to be more opportunity to practise what we learnt during the professional development program, but there wasn't. (Fahad)

Lack of practical application of professional development

A lack of focus on implementation was also reported by the majority of participants as a barrier to PD implementation. In this regard, one teacher said that: The problem here is when you take a course about these modern ways of learning, they say you have to use the modern ways [new teaching methods], you have to deliver the information to the students and students should be the centre of the learning process. Okay then how can I apply that in a practical way and how can I deliver the information to the students and make them the centre of the learning process? How can I do that? No answer. (Ahmad)

Another teacher also felt that the PD was offered solely in a theoretical way, which eventually does not help with implementing the ideas. He said that: The professional development program that we receive from the trainer at the training centre is a theoretical one. Most teachers attending this course do not know how to implement it. The truth is that the courses are good but the matter of application is necessary...For example, the differentiation method of teaching and the method of the cooperative learning were presented in PowerPoint and slides and explained to us over two hours, three hours, five hours. Thank you...The end! How does the teacher apply this? Not all of us have the same level of understanding and ability to apply. (Talal)

While commenting on the aspects of PD programs that participants found most difficult to implement, teachers mentioned some factors that acted as barriers. The definition of a barrier is a tangible or intangible concept that teachers perceive as affecting their capacity to implement the PD idea in their classroom. The barriers can be divided to two main groups: barriers related to the individual teacher and barriers related to the Saudi Arabian context.

Challenges for individual teachers

According to Alshamrani et al. (2012), poorly timed, minimally advertised, limited PD programs, lack of incentives and an already heavy teacher workload reduce the effectiveness of the PD programs offered to teachers. This view is reflected in the data presented in result section, which presented the responses from participants when asked to identify the barriers likely to impede the implementation of strategies learned during PD programs into their classrooms. Their responses can be divided to three main groups: barriers related to teachers' workload, teacher collaboration and teacher resistance to change.

Teacher workload

Teachers may feel that there is a contradiction between the Saudi Arabian Government's support of PD programs and the barriers that exist to attending such training,

with these problems outweighing any possible advantages. One main barrier, amongst others, that influences the effectiveness of PD programs is the workload experienced by teachers on a daily basis in Saudi Arabia (Alshamrani et al., 2012). When talking about the school environment, participants reported struggling with excessive workloads at school that arise from performing activities in addition to regular teaching, such as managing many different syllabuses, achieving vast curriculum objectives and making up for lessons missed during PD attendance (Sellen, 2016). They also pointed out the high volumes of course content that have to be covered during the academic year and the additional preparation time required for applying new teaching methods in the classroom.

Teachers already perform many daily administrative tasks in addition to their teaching time in the classroom. As it stands currently, teachers may struggle to keep up with their workload as well as implement new teaching strategies without appropriate support. Non-teaching tasks such as administrative operations, lesson planning and yard duty place additional strain on teachers by taking up valuable time that could otherwise be better spent focusing on teaching in the classroom. Attending PD programs is a barrier to the teacher's ability to facilitate their work requirements as it takes up critical teaching and preparation time. Additionally, the lessons missed by the teacher participating in the PD program must be covered at a subsequent date, thereby placing additional strain on an already overcrowded teaching schedule. For these reasons, to combat pressure on teaching schedules, additional time could be specifically allocated for teacher training in order to accommodate the time teachers need to attend PD programs. Adding extra time to teachers' schedules to undertake PD would serve as an incentive and help to overcome their resistance.

Teacher collaboration

Schools that fail to encourage teachers to collaborate with colleagues after attending the PD programs are another barrier to effectively integrating ideas gained from PD programs into the classroom. Although the primary role of PD programs remains to promote professional growth of teachers (Leithwood, 1992), the participants in this study indicated that there is little, if any, collaboration between teachers who attended PD programs and non-attending teachers. Although teachers who have attended PD programs may feel they have acquired certain knowledge or skills, the likelihood of them sharing their knowledge to a third party is not always certain.

The participants stated that there are no formal procedures within the school environment for transferring the experiences gained from PD programs to other colleagues. Some of the participants indicated that they voluntarily share new ideas to their colleagues despite existing procedures not compelling them to do so. However, some participants have encountered disinterest from colleagues who had no desire to embrace new ideas or change their existing teaching practices. Others who requested their principal to organise workshops in which to share the main ideas with the broader teaching staff faced resistance from any staff who held traditional views of teaching. Some attendees also reported that they had gained little from the PD programs.

Therefore, the need to create a suitable school environment in which teachers can transfer new teaching ideas and methods would be an ideal scenario. An appropriate environment would reduce the strain put on teachers caused by travelling to PD programs during school time. School-based professional development that occurs as a natural transfer of information between teachers could aid the dissemination of teacher knowledge and reduce the perceived 'onus' on one teacher to attend one specific PD program and bear the responsibility of sharing its information. Kelly and Cherkowski (2017, p. 21) state that:

Part of creating a PLC (professional learning community) culture in schools is providing enough opportunities for teachers to meet together and establish a learning climate that values and welcomes honesty and courage to share teaching practices as an on-going inquiry, as well as a level of vulnerability that serves to strengthen the emotional bonds of the group as they work from a place of empathy and care rather than defensiveness and judgement. According to Kim, Erekson, Bunten, and Hinchey (2014), holding PD programs during school hours increases the chances of teachers gaining the most benefit from the training.

Teachers' resistance to change

Education reform involves more than introducing a new curriculum and teaching methods and expecting teachers to adapt accordingly. Active learning focuses heavily on student enquiry and critical thinking, which is something that is contrary to the traditional roles of students and teachers in Saudi Arabia. Moving away from this method requires a reduced level of teacher authority and instruction and more focus on student initiative and autonomy. The teacher is no longer the sole leader of discussion or instruction, but rather a facilitator of the discussion amongst students, providing a forum for student ideas. In theory, this shift to active learning appears to place less onus on the teacher; however, the adoption of independent thinking and greater student independence may provoke a sense of fear in teachers who are not equipped with the necessary skills to facilitate this correctly.

Resistance to accepting a new curriculum requires a change in pre-existing teacher opinion and behaviour. This process requires support from multiple sources, open discussion and appropriate conditions for learning. In order to create strategies to reduce teacher resistance to change, it is important to first understand the reasons for this resistance. Resistance to change can stem from teacher overconfidence in their existing teaching ability (Chen & Kompf, 2012). Changes can be interpreted via teachers' opinions and level of competence about what is "suitable education" (Ballet & Kelchtermans, 2009, p.1154). Additionally, some teachers feel their scientific expertise is being questioned while others lack sufficient confidence or fear reduced professional autonomy, or a combination of both (Terhart, 2013). In the Saudi Arabian context, "since teachers and lecturers possess such a high status in society and absolute power in the classroom, it is not surprising that they are reluctant to relinquish this power in favour of more 'student-centred' pedagogy" (Elyas & Picard, 2010, p. 138). Consequently, most teachers revert to traditional teaching practices after the professional development rather than encouraging active learning in more dynamic and collaborative learning environments. PD programs can play an integral part in shifting teacher thinking and practice by first focusing on modifying teachers'

attitudes towards implementing active learning methods before seeking changes in their practice (van Aalderen-Smeets & Walma van der Molen, 2015).

Although participants are introduced to proposed new teaching methods during the PD program, little time is invested in discussing their attitudinal change. Similarly, teachers are shown specific strategies to incorporate new approaches but not encouraged to shift their entrenched attitudes. In this regard, Madden (2017) argues that teachers need time and space to build the kind of expertise that is acknowledged, recognised and valued, and they need support that should help them identify and focus on the learning that they consider to be important. It is also important to provide teachers with conditions that ensure their safety and comfort while sharing their ideas and anxieties. According to Smith (2017), the ideal environment that supports and encourages teachers to think deeply, reflect critically and engage in open discussion is needed to create the ideal conditions for learning.

To be effective, professional learning relies heavily on teacher support, because risk-averse educators present a major barrier to change (Le Fevre, 2014). A possible means of reducing the perceived risks associated with change could be to encourage teachers to engage in critical thinking, which could go on to ultimately encourage positive changes in their teaching practices (Smith, 2017). Critical thinking may be one way to reduce teacher resistance, yet teachers' behaviour may also be a barrier to change. By participating in meaningful discussion, teachers may feel their work has an important role in their life and the lives of their students. According to Smith (2017), teacher dialogue originating from a range of sources, including school principals, could act as a meaningful provider of intellectual engagement. In fact, no behavioural change can be expected without significant investment in improving teachers' attitudes. Curriculum reform requires teachers to adapt not only their subject knowledge, but also their own learning and teaching methods (Lowe & Appleton, 2015).

In this study, some participants blamed the manner in which the PD programs were run for their resistance to incorporating the suggested changes. They identified a lack of implementation strategies, clear goals and scientific content as being among the serious shortfalls they encountered during the sessions in PD programs. Moreover, there were participants who felt the PD programs were offered only in a theoretical way. Some participants stated that the presenter was unprofessional and the programs felt like a routine. Some other participants said they felt the supervisor (the presenter) was mandated to present the program or they received little or no information about the program prior to attending. The negative perception might arise from the fact that their attendance was mandatory. Furthermore, the presenters' interaction during the program failed to reflect the principles upheld by active learning. Many presenters themselves, ironically, failed to incorporate active learning methods into PD programs while advocating that teachers implement such principles in their own classroom. Incorporating active learning directly into PD programs could provide teachers with a good example of active learning that could help teachers to implement this method of teaching in the classroom.

One possible solution for reducing teacher resistance to change could involve taking teachers' thoughts and feelings about change into consideration as well as considering the environment in which the change could occur. "When the subjectivity and objectivity of

teacher resistance are recognized, the right strategies can be developed to reduce teacher resistance" (Chen & Kompf, 2012, p. 113).

Challenges of context

Wilson (2013) identifies that the context or 'environment' of PD programs is the school culture, the socioeconomic backgrounds of the students and teachers and the availability of resources. The findings suggest that each element impacts on the implementation of new models of teaching in science classrooms. Specifically, in Saudi Arabia, after translating and adapting the science curriculum from McGraw- Hill, the Ministry of Education has now instructed teachers to foster independent learning methods for students. However, implementation of the new models requires addressing many challenges from many corners: the nature of rural communities, the cultural context, preserving cultural values in the classroom, inadequate resources, student motivation, the new science curriculum and broader resistance to change. These issues are discussed below.

Rural communities

As stated by the participants in this study, unequal access to requisite resources and deep-rooted views among parents in more conservative rural communities make the implementation of the new teaching methods more challenging. Many civilians in rural and remote areas lack access to electricity and, by extension, access to the internet. According to Lamb and Glover (2014), rural schools are more likely to have fewer resources, and teachers employed by these schools are offered fewer possibilities for professional development.

Unfortunately, witnessing teachers offering students the opportunity to facilitate their own learning frustrates parents who are more familiar with traditional teaching methods. Parents from rural communities in the southern regions in Saudi Arabia expect teachers to adhere to the rigid methods associated with the old curriculum. The way the rural parents perceive teachers' roles in the matter of teaching relates to the influence of the local culture in shaping the teaching of a particular discipline. In Saudi Arabian society, especially in remote and rural areas, successful teaching involves students passively copying material from the blackboard without asking questions rather than engaging in critical thinking practices. According to Alhassan (2012), in Saudi Arabian schools, there is a focus on teaching the entire assigned subject content rather than focusing on developing students' problem-solving, critical thinking and independent learning abilities. The findings from this study indicate that support from parents for students and teachers is vital for students' learning. However, in Saudi Arabia, most parents share the view that it is solely the responsibility of the government to provide education (Khan, 2011).

Successful student learning is also dependent on family support. Some countries have been able to appreciate the role of the family as partners in the educative process in student learning (Al-Issa, 2009). Therefore, it is imperative that the government attempts to educate not only teachers but also the parents on the advantages of the new teaching methods. According to Al- Issa (2009), despite the efforts of the Saudi Government in education reform, the role of Saudi families' participation in the education system in terms

of policies, curricula and teaching methods is still limited. This deficiency can be attributed to an education system that does not allow the families and the community to play this role because there are no policies that specifically relate to families and no new initiatives to involve the family in their children's education options (Al-Issa, 2009). One way to encourage smoother implementation of new teaching practices is for parents to understand the benefits the new teaching methods can offer and how parents can be active participants in their children's learning. In fact, significant encounters between teachers, parents, school principals and the wider community are the most effective professional development activities for teachers (Villegas-Reimers, 2003).

Preserving cultural values in the classroom

Like most other nations, Saudi Arabian schools have functioned as an implicit preserver of cultural heritage throughout history. Being knowledge-based institutions, schools in Saudi Arabia differ from other countries through their deep emphasis on preserving Saudi Arabian culture and upholding religious values. Saudi society is a very conservative society, where schools are expected to preserve the culture from generation to generation to retain the purity of the cultural heritage and purify it from other cultures (Alsafe, 2003). Where other countries have embraced the diversity that multiculturalism offers to schools, Saudi Arabia still faces challenges in embracing this. The cultural expectations of schools present a major barrier for those who are keen to implement an educational reform agenda and also challenges promotion of the required changes that first need to be accepted both by scholars and a conservative society committed to upholding religious beliefs (Al salomy, 2016). The acquisition of a new, foreign-based curriculum in Saudi Arabia may not be in tune with its previous ambition to maintain cultural purity; however, it may assist the nation in becoming more attuned to global educational reform agendas, including the UN's objectives to encourage a global partnership for development (UNESCO, 2017).

Inadequate resources

Lack of necessary resources within schools represents another significant factor that impedes the fostering of collaborative learning practices in Saudi Arabia. Participants highlighted that while the government appears committed to updating the science curriculum, such commitment has yet to extend to the requisite facilities to implement such changes. Actively implementing new learning practices is often hindered by inadequate school resources.

Participants stated that teaching–learning materials available at school are inadequate for teaching the new curriculum. For example, the new curriculum suggested using certain computer programs in the classroom that are unavailable at school. Overall, the shortage of materials in school reported by participants contrasts sharply with the PD environment, which is often fully equipped with all necessary materials and equipment. Although insufficient facilities and learning equipment could reduce academic performance, they do not necessarily equate to low-level academic results (OECD, 2013).

Inadequate school resources also encompass school principals' willingness to support their teachers in implementing new teaching ideas (Alabdulkareem, 2017). It is imperative that school principals constantly organise new learning opportunities for teachers to

demonstrate that they are "sensitive to the fears of some teachers' in trying new things" (OPM, 2008, p. 26). The role of the school in encouraging the continuous learning of teachers is seen as a fundamental area to be addressed by schools. As evident in this study, many participants admitted they only attended PD programs at the behest of their principal rather than their own personal desire to participate. For this reason, school leadership must continue to encourage teachers' professional development to ensure their continuous improvement. The principals' authority means they are best placed to motivate teachers to take advantage of PD programs. However, the principal should also provide the teacher with the necessary resources and support, as Beatriz, Deborah, and Hunter (2008) explain that: school leadership has become a priority in education policy agendas internationally. It plays a key role in improving school outcomes by influencing the motivations and capacities of teachers, as well as the school climate and environment. Effective school leadership is essential to improve the efficiency and equity of schooling. (p. 9)

Conclusion

The most effective professional development programs are likely to be those that address the specific subject matter that relates to the teaching issues faced daily by teachers, rather than those that cover vague and decontextualised educational or pedagogical concepts. Other factors include teachers' involvement in learning communities, the facilities and resources provided by the school, and individual learning styles. On the other hand, common factor responsible for the failure of professional development programs is that the content covered is not relevant to the teachers' specific needs. PD programs in Saudi Arabia are mainly focused on quantity instead of quality

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