

Breaking Barriers: supporting Maltese chemistry teachers through a teacher learning community

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Abstract

Student-centred approaches have been associated with deeper learning and improved interest in science. The chemistry curriculum and the pedagogies used in the chemistry classroom in Malta and other countries are often traditional and emphasise content delivery. This exploratory study focused on the way teachers learn and how they approach and feel about making changes to their teaching towards a more student-centred approach. A teacher learning community of four chemistry teachers was formed. Focus groups and reflective journals were used to generate data. Results show how teachers appraise the nature and content of different kinds of professional development sessions and how the community helped teachers with different epistemological beliefs to move along the teacher-centred to student-centred continuum.

Keywords: professional development; teacher learning community; student-centred teaching; teacher needs.

Introduction

Over the years, according to several reports, there was a decline in students' interest in science in Europe and beyond (Rocard et al., 2007; Osborne and Dillon, 2008). Some of these reports highlighted the low uptake of science subjects beyond compulsory school age and the low numbers of adequately qualified young people working in Science, Technology, Engineering, and Mathematics (STEM) fields (Rothwell, 2014) while others reported students' underachievement in the science subjects. The physical sciences, namely

physics and chemistry, have often been found to contribute to the negative attitudes towards science (Bennett and Hogarth, 2006). Rocard et al. (2007) linked students' interest levels to the way science is taught in schools.

Lack of relevance of certain topics and the gap between the subject and the students' life experience have also been found to contribute to this decline in interest. Student-centred (SC) approaches, such as Inquiry-Based Learning (IBL) that actively engage students in the thinking and learning process through real-life tasks and problems have been repeatedly associated with deeper learning and an improved interest in science. Another SC approach that has received considerable attention in chemistry is the Context Based Approach (CBA). The CBA uses a real-life context as the starting point for the topic or lesson to orientate and motivate students, and goes beyond providing examples as illustrations or applications (de Jong, 2006). These approaches do not only develop students' understanding but also appear to improve students' attitudes towards science (Bennett, Lubben and Hogarth, 2007).

However, chemistry curricula and pedagogies used in the chemistry classroom in Malta and other European countries are often traditional (Osborne and Dillon, 2008; PRIMAS project report, 2011). These curricula are often packed with knowledge that students need to learn, limiting the time available for practical work and for a deep "understanding of the process and nature of science" (Ministry of Education, Employment and the Family, MEEF, 2011, p. 9). This paper reports on a study focusing on the way a group of Maltese chemistry teachers approach and consider changes to their teaching towards a more SC and CB approach.

Background

1. Making the Chemistry curriculum more relevant to students' needs

As in other European countries, in Malta, there are shortcomings in the chemistry curriculum, pedagogy and assessment. The curriculum is mainly targeting students who need to be prepared for further specialisation in the subject. Both the content and pedagogy associated with such curricula are criticised because they fail to engage and inspire students with further study of the subject (Osborne and Dillon, 2008). The need of a programme that provides "chemistry students and teachers with time and space to engage with the subject, encourages student-centred learning and includes practical work as an integral part of the programme" (Farrugia, Mizzi, Zahra and Zarb, 2017,

p.1) has often been expressed. The publication of the Maltese National Curriculum Framework, NCF (Ministry of Education, Employment and the Family, 2012) was a breath of fresh air. It recommends the use of IBL and emphasises the need to render learning relevant to students.

Studies carried out with Maltese science teachers showed that chemistry teachers tend to favour teacher-centred (TC) pedagogies and activities that limit exploration (PRIMAS project, 2011; Vella Bondin, 2016). Moreover, despite the reported advantages of the use of SC approaches, there are a number of teacher concerns which cannot be ignored. In a study about Maltese chemistry teachers' views on the use of the CBA (Bonello, 2016), teachers expressed concerns such as the lack of examples of real-life applications or contexts, and constraints due to time and assessment, with the biggest challenge being the fear that students may learn less than they do through traditional teaching and will then perform less well in examinations.

While many teachers could see the benefits of such an approach, like the increase in relevance of the subject to the students' everyday lives and the suitability for students with different abilities, they felt that they should not rock the boat and change the formula that was working and giving reasonable examination results. Thus, chemistry teachers were reluctant to change their teaching methods. These comments are understandable in a school culture which is rather examination-oriented and with high stakes examinations dominating much of what is done at school. Such fears have been reported in other studies investigating the implementation of SC pedagogies carried out in Malta (such as Farrugia, 2015; Farrugia et al., 2017).

The teachers' own experience of learning the subject has a strong influence on how they choose to teach it. Participants in Farrugia et al.'s study (2017) found it "difficult to conceptualise organising ideas and teaching chemistry in a way that is different from the way they have always experienced the subject" (p. 4). Teachers clearly need help and support in dealing with these concerns and changing their teaching approaches and building the confidence needed. Overcoming barriers and moving from an approach focused on covering content to one that is more SC and dedicated to making learning meaningful requires the examination and analysis of teachers' beliefs and attitudes.

2. *Teacher Beliefs and Attitudes*

Teachers' beliefs are significant when it comes to understanding classroom practices (Pilot & Bulte, 2006; Luft & Roehrig, 2007). For the purpose of this study, beliefs were defined as "clearly personal constructions, entities that belong to an individual" (Luft & Roehrig, 2007, p. 39). Teacher epistemological beliefs are of particular importance because the way teachers view the nature and the acquirement of knowledge is "intertwined with teachers' beliefs about learning, understanding, or student knowledge; since the way a teacher conceptualises knowledge impacts their teaching beliefs" (Luft & Roehrig, 2007, p. 41).

Teachers are the most important players in the successful implementation of educational reform (Stolk, de Jong, Bulte, & Pilot, 2007; Vos, Taconis, Jochems & Pilot, 2010; Farrugia et al, 2017). However, implementation rarely occurs in the way intended by designers. One reason for this is the teachers' attitudes towards the change. Studies (such as Gutwill-Wise, 2001) have shown that when teachers had negative attitudes towards a reform, implementation was not so successful. Another reason is the teachers' success or otherwise in the use of the new pedagogies in their classrooms. Teacher learning may be a challenge since teachers, whether novices or experienced, tend to "stay with the conception they have of their own success in the conventional programme they followed themselves, and their ideas about 'what counts as chemistry education'" (Pilot & Bulte, 2006, pp. 1102 - 1103). Similar observations were made in local studies (Bonello, 2016; Farrugia et al., 2017). Consequently, teachers may integrate new programmes into old practices because the latter are closer to their belief system than the new programmes (Vos et al., 2010; Bonello, 2016).

Teachers' reactions to an education reform may also depend on whether they perceive their professional identities as being threatened or strengthened by that reform (Van Veen & Slegers, 2006). Self-efficacy beliefs will determine whether they are prepared to try out and eventually implement new classroom practices (Stolk, Bulte, de Jong & Pilot., 2009a). Understanding teacher beliefs is crucial for the development of professional development (PD) programmes that can have a long-term impact on teacher learning and growth (Luft & Roehring, 2007).

3. Teacher Learning and Professional Development

Teacher PD is a delicate matter that needs to be addressed when implementing educational reforms in order to encourage and support teachers with the change (Guskey, 2002; Stolk et al, 2009a). PD courses are often offered using a top-down approach, focusing on changing teachers' knowledge, beliefs and practices, instead of using them to increase the likelihood of successful implementation (Eilks, Parchmann, Grasel & Ralle, 2004; Stolk et al., 2009a, 2009b; Stolk, de Jong, & Bulte, 2011; Farrugia et al., 2017). However, developing a practice that is different from what teachers themselves experienced as students, requires more powerful learning opportunities than simply acquiring knowledge or teaching resources. Modern PD courses acknowledge that teacher professional growth is complex and should address knowledge, beliefs, attitudes as well as concerns when implementing reforms, rather than just highlighting existing gaps in skills. (Guskey, 2002; Stolk et al, 2009a). Guskey (2002) recommends that the PD experience should include support, continued follow-up and pressure that helps teachers to persevere through the implementation of the reform until positive classroom experience reinforces and encourages the new practice. Teacher development is also influenced by the school context and professional contact within and outside the school.

For these reasons, PD opportunities where teachers build their own knowledge and learn with others, where existing beliefs are challenged and they take charge of their own learning, have been found to be favourable learning environments for teachers (Stolk et al., 2009a). They are generally more successful in reform implementation than traditional courses (Eilks et al., 2004; Vos et al., 2010; de Jong, 2012, 2015a, 2015b) as they provide a comfortable space for sharing experiences, supporting and empowering them to implement the change (de Jong, 2015a) and develop ownership of the new teaching ideas (Eilks et al., 2004). A successful teacher learning community (TLC) meets regularly over an extended period of time, links teacher learning with actual classroom practice and involves a good relationship between the teacher and the provider (Eilks et al., 2004).

The Study

The study focused on the way teachers learn and how they approach and feel about making changes to their teaching towards a more SC and CB approach. A TLC was formed with four chemistry teachers who volunteered to

participate in a long-term PD opportunity led by the first author of this paper, henceforth referred to as the PD leader. Four strategies recommended by Stolk et al. (2009b) for the development of PD courses were adapted for this study:

- Providing access to new and modified teaching and learning resources as well as opportunities to practice with these resources in their own classrooms.
- Providing the possibility to reflect and share their practical experiences during the TLC meetings.
- Motivating teachers to collaborate with their colleagues.
- Giving teachers the necessary tools to design their own resources.

This paper focuses on the first year of this TLC that attempted to support teacher PD during the transition to a more SC approach. The study sought to answer the following research questions:

1. What do teachers need to transition to a more SC approach?
2. How does the TLC support teachers through this transition? What are the views and attitudes of the teachers about the TLC?

Methodology

1. Research Design

A qualitative approach was chosen for this study. A case-study was used to generate and collect qualitative data, which involved a group of teachers who were supported in the transition from a TC instruction to a more SC approach in their chemistry classrooms by using the CBA.

The PD course was gradually developed during a one-year programme based on both existing evidence as well as on data that emerged according to the participants' beliefs and needs (Appendix). Thus the course provided tailor-made support and guidance. This course also gave the tools and opportunities that allowed participating teachers to design their own CB chemistry resources to be successively implemented in their own classrooms. The TLC provided a neutral and comfortable space for discussion and sharing of experiences. Considering the likelihood of the concurrent introduction of a new chemistry programme, the PD course catered for its initial preparation and implementation.

2. *Sample*

Chemistry teachers who teach chemistry at Secondary Education Certificate (SEC) level in state, church and independent schools around Malta were invited to participate in this research study. Formal invitations for participation were made after obtaining approval and consent from all entities involved. Four teachers volunteered to participate in this study: two from church schools and two from state schools, all relatively young (22 - 33 years old) and not having many years of teaching experience (0 - 7 years).

3. *Data Collection*

Reflective journals and focus groups were used for data generation and collection.

3.1 Reflective Journals

The participating teachers kept a reflective journal throughout the whole PD course. They were asked to make an entry after every PD session. The reflective entry was guided as the PD leader provided them with questions/prompts related to the session and their views about the transition. A reflective journal permits the person writing the journal to reflect upon “what is happening in terms of one’s own values and interests” (Robert Wood Johnson Foundation, 2008). It may also help reduce researcher bias when interpreting the data (Roller and Research Design Review, 2012).

The PD leader kept a reflective journal too. A detailed record of the planning stage for each session as well as thoughts after each session were kept. This allowed the PD leader to have a detailed record of how actions and choices influenced the generated and collected data. This helped to analyse and compare the teachers’ attitudes and their journey during the PD course.

3.2 Focus Groups

Three focus-group discussions were carried out with the TLC, once every school term. A fourth focus group discussion was carried out at the very beginning of the course. This helped the PD leader to get an idea of the teachers’ expectations as well as their views and beliefs about chemistry education and the CBA. These data were used to cater for the participants’ specific needs. Successive focus group discussions then dealt with issues which

arose along the transition, namely CBA resources and their first-hand experiences in a TLC.

Focus groups yield detailed data and allow the researcher to gain important insights. They emphasise the interaction of the group, where they are encouraged to discuss among themselves. This gives power to the participants as it gives priority to their views and ideas. It is also a flexible method of data collection as changes could be made during the focus group itself as the researcher keeps the discussion on track and encourages participation from all members (Denscombe, 2007).

3.3 Triangulation and Validity

The use of two different methods as well as different sources of data generation permitted triangulation. This helped in giving a richer explanation as the study is considered from more than one perspective, thus increasing its validity (Cohen et al., 2007). According to Cohen et al. (2007), “in qualitative data, validity might be addressed through the honesty, depth, richness and scope of the data achieved, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researcher” (p. 133).

When the methods used contrast with each other but obtain similar or identical results, the researcher’s confidence about the findings increases (Denscombe, 2007). The use of the reflective journals and focus groups allowed the PD leader to generate a more complete picture of the perceptions, feelings and attitudes about the TLC and the use of the CBA for each individual participant in the research study. A comparison could also be made between the data obtained from the participants with those generated from the PD leader’s reflective journal.

4. *Data Analysis*

Firstly, an analytical framework was developed based on the literature (Harland & Kinder, 1997; Tsai, 2002; Luft & Roehrig, 2007) on teachers’ beliefs, views and attitudes about school chemistry; the need to transition to a more SC approach; participation in the TLC; and the involvement in a PD course. The initial focus group discussion was transcribed and analysed. These data were used in the development of the PD course to cater for the participants’ specific needs. The other focus group recordings were also transcribed and, together with the reflective journals, coded according to the listed themes. Coding led

to the discovery of patterns and other themes which emerged during the course.

Analysis was not restricted to the themes in the analytical framework but was also open to other themes and findings that emerged during the study.

Findings

Following the analysis of the focus groups and the reflective journal entries, it was possible to identify some of the specific needs that teachers require to transition to a more SC approach. One of the main reasons behind these participants' choice to be part of this PD course was the upcoming implementation of a new chemistry programme that is organised differently with respect to the one they are used to and promoting a different approach. Teachers were concerned and overwhelmed about having to plan afresh and to teach in a different way with respect to what they normally do. Therefore, the new programme was taken as a guide to help teachers use more SC approaches, specifically the CBA.

Teachers have a crucial role in educational reform, and this is greatly affected by their attitudes towards change and their epistemological beliefs. During the first focus group teachers identified themselves as either TC or SC, with three of the four participants identifying themselves as SC. This helped them in identifying their starting position at the beginning of the PD course.

A teacher's beliefs may not always be translated into their practice, due to various factors. During this study the participants listed the following factors which influence their practice: (i) lack of time due to the content overload in the syllabus, and subsequent insufficient teaching time; (ii) lack of knowledge, experience and confidence in the use of different pedagogies; (iii) issues with students, colleagues and parents; and (iv) a local education system that prioritises examinations and grades and focuses mostly on the preparation of students to perform well. Thus, the participants tended to feel more comfortable with using traditional methods even though they believe that the use of more SC approaches is the way forward in chemistry education.

During this study, several needs were identified for teachers to transition to a more SC approach. These will be presented in the following sections:

1. *Having a clear understanding of important terms used to describe pedagogical approaches.*

It was very important that at the very beginning of the course, the participants had time to share their thoughts and beliefs about current chemistry education, the new chemistry syllabus, their current teaching, and their expectations from this course. In the first session, participants were asked to identify themselves as TC or SC. The first months of the PD course focused mainly on helping the participants reflect on the type of teacher they were. They discussed teacher and student roles, their understanding of TC and SC approaches, IBL, scientific literacy, the teaching of soft skills, planning less traditional lessons, trying out some new classroom activities and sharing relevant experiences.

Eventually, discussions focused more on the characteristics of the CBA, its advantages and concerns as well as some practical examples of how this approach can be used effectively. Participants were more interested in practical classroom matters and when the sessions were somewhat theoretical, some participants had somewhat negative feedback. The TC participant said that similar sessions take her back to her university days and that she is not interested in theories and definitions. She was not interested in using the discussions and the provided examples to understand better these pedagogies and to reflect on her current practice and any ensuing adaptations. On the other hand, the other participants realised that they were more SC in their practice than they originally thought. Clarifying misunderstandings and misconceptions about certain technical terms helped them analyse and understand their current practice better.

2. *Converting TC resources into more SC ones.*

One very important need that was identified was that teachers required guidance in developing teaching and learning resources for more SC approaches. The PD leader started by developing tailor-made resources for each individual participant according to the classes they were teaching that year. During the PD sessions, the community discussed the thought process behind the resources and the different factors that had to be considered. The teachers were then asked to make any changes they deemed necessary, implement them, and write a short reflection before sharing their experience with the rest of the community.

During this part of the course, it became very clear that two participants that identified themselves as SC were actually using SC approaches in their practice. They were very comfortable with the implementation of the resources, and they identified similarities between the resources prepared by the PD leader and the resources that they had already used with their students. They were very enthusiastic about trying them out and then reporting back their experiences. They reported that their students enjoyed the experience. It was evident that they were gaining confidence in the use of these pedagogies.

Another participant was a newly qualified teacher with no previous experience in the classroom and generally hesitant about implementation. This could have been because he was already overwhelmed with having to plan his first set of teaching materials while experiencing the reality of the classroom for the very first time. The participant who identified herself as TC openly admitted that, at times, she did not plan when and how to implement the resources. She did not have much positive feedback regarding her students and her experience.

3. Trusting that students can be autonomous learners.

All participants, irrespective of their individual beliefs, felt that certain concepts – such as the structure of the atom and covalent bonding – can only be covered using teacher explanation. In fact, they were very hesitant when presented with a more SC way of teaching these concepts in class. One reason for this may be reluctance to trust their students to be responsible for their learning. When asked to share their fears, they explained that by using SC approaches, they feel they would be leaving their students without any guidance or teacher input. After pooling different ideas presented by the participants, the PD leader developed a detailed SC lesson plan illustrating how the topic may be taught using a more SC approach, while making sure that the students do not get misconceptions or any lack of understanding. Following this, three of the participants were more willing to try out such lessons as they realised better what a SC lesson would look like.

4. Reflecting on current practice and any possible adaptations.

Apart from writing a reflection after every PD session, teachers were also asked to write an entry after implementing an activity. Reflection is believed to be an essential exercise when it comes to transitioning to a different type of practice (Stolk *et al*, 2009a). Three of the participants admitted that they did not like writing reflections. One participant described it as a waste of time and in fact

her entries became shorter and more superficial with time. In one of her entries, she wrote that “these new trends in education are only buzz words” and that they are given more importance than required.

Two other participants considered this task as useful. However, the fourth teacher took this part of the course most seriously. While reading her entries, one could see that she really reflected on her current practice and compared it with her experience in the course. Following these reflections, she realised that she is more SC than she actually thought and she was looking forward to trying the new resources in class. By the end of the year, in collaboration with another teacher, she was looking forward to having more responsibility in the development of the resources. The journal entries were useful in identifying the readiness of the different community members in adapting their practice to a more SC one.

In her journal entries, the PD leader reflected about her dual role in the course. She ensured that the course: (i) offered a continuation between sessions; (ii) incorporated different, effective aspects of PD; and (iii) created a safe space in which the participants felt comfortable to share whatever came to mind (Eilks et al., 2004; Stolk et al., 2009a; Stolk et al., 2009b). Moreover, she had to develop good quality resources so that the participants could see that transition was possible by using or adapting resources that they already had. Developing resources was very time consuming. So, the PD leader, being also a teacher, could understand one of the participants’ biggest worries about this transition. As a teacher she also wanted to show that working in a community helped, since sharing experiences, concerns and examples of resources made it less isolating and led to more support and understanding.

5. *Feeling supported, heard and not alone.*

The community members were all apprehensive of the upcoming implementation of the new chemistry programme. All participants were very comfortable with sharing examples of their realities and connected over similarities. Those participants who identified as SC were also able to connect on a different level as they had similar epistemological beliefs. This connection was strengthened when they shared examples of SC resources that they had already used or planned to use.

All participants declared that they were comfortable in the TLC: they felt included, heard, supported, respected and that their ideas were valued.

However, when the sessions focused mainly on resource development – where discussions centred on what they had already used and what can be done to make the lesson more SC – one of the most experienced SC teachers voiced some concerns: “At times I feel a bit frustrated at this since I feel I am expected to speak first”. She felt that sometimes some members of the community just sat and listened, although she understood that this might have been due to their lack of teaching experience. This was in fact very true for one participant who had just started his first year of teaching.

Due to the COVID-19 pandemic and school closure, the community was unable to continue meeting face-to-face and turned to live online sessions instead. This changed the dynamic of the community. The focus turned mainly on the work to be done while the friendship aspect took a back seat. One member’s reflective journal entry in fact read:

I think that the fact that we work together to build resources is great. I think we all discuss and give input in different ways. Having said that, I feel that ‘community/friendship’ is lacking in the sense that people are there to work in a very focused way ... I miss the occasional joke or talking about everyday things like partners, family, frustrations about traffic, etc. ... the small things that are not chemistry but build relations and friendships. Like I said, in terms of work effectiveness, it is excellent, but I miss the ‘friendship’ of it all.

Discussion and Conclusions

1. What do teachers need in order to transition to a more SC approach?

There are many factors which can prevent teachers from adopting a SC approach, and many of these have to do with the day-to-day realities of the classroom. However, a major factor concerns the beliefs that teachers hold about teaching and learning. Most participants held SC beliefs and this was also observed in their class practice. Each community member started at a different position on the TC-SC spectrum at the beginning of the PD course, and while they all progressed towards becoming more SC, they did not end at the same point. This may be due to different individual levels of readiness towards change. Lack of pedagogical knowledge, lack of confidence, and pressure from different sources may result in different teachers needing more time for change. These findings are similar to those of Van Veen and Slegers (2006).

The type and the content of the PD sessions are also important. When PD sessions were mostly theoretical, participants had more negative feedback showing that the top-down PD approach was not favoured. Such sessions made teachers feel obliged to change without showing them how (Eilks et al., 2004; Stolk et al., 2009, Stolk, et al. 2011; Farrugia et al., 2017). Concrete examples of alternative methods and activities as well as implementation of these activities are a very important aspect for teachers adopting a different approach in their classrooms. When one has never experienced something different, the fear of the unknown may lead to wondering about what would happen in terms of classroom management, student learning, student and parent feedback, as well as exam performance. These findings are similar to what was reported by Bulte et al. (2006), Bonello (2016) and Farrugia et al. (2017).

Teachers tend to keep using the conventional methods they are used to because they know that those methods will produce results, although these may be limited in scope. Bulte et al. (2006) state that, because of this, different “projects report that they consider the problem of the learning process of teachers as difficult to solve” (pp. 1102 - 1103). Eilks et al (2004) and Stolk et al. (2009b) state that one way of overcoming this issue is by linking one’s own learning to actual classroom practice. During this study, the main implementation phase of the course coincided with the start of the pandemic when all schools closed. So, implementation had to be postponed and the focus mainly revolved around resource development and discussions about alternative ways of teaching certain concepts.

Another identified need that is strongly related to implementation is gaining confidence in the use of alternative pedagogies. Even though three participants identified themselves as SC and showed this in their practice, they still lacked understanding of some aspects of SC approaches. Furthermore, their SC practices were limited to ‘easier’ chemical aspects but had serious reservations about using SC approaches with more abstract and difficult concepts. Members were most apprehensive that their students would be left alone and without guidance. They needed reassurance that SC learning involves different levels of guidance according to their own and their students’ needs. This is a common misconception about SC approaches (Farrugia, 2015).

A similar approach with different levels of guidance, was used with the community members. The PD leader started with the preparation of detailed

resources and lesson plans for each individual teacher. With time, these changed into skeletons, guiding questions and prompts which gave more responsibility and flexibility in the development of resources and lessons to the teachers. This helped them increase their confidence in the use of different approaches. However, due to the lack of implementation opportunities this aspect could not be investigated fully.

Another important conclusion is that reflection needs to become a natural component of a teacher's daily schedule. During the study, one teacher identified reflection as a waste of time and not all participants took this process seriously. This may be due to different reasons, such as the extensive teacher workload or other issues as individual beliefs and lack of self-confidence. The teacher who identified herself as TC was most reluctant with the reflective exercise, while the other participants who identified themselves as SC and had already experimented with different approaches in the classroom were more open to reflect on their practice and the PD sessions. Thus, this reflection may have helped teachers to learn more and become more confident.

2. *How does participating in a TLC support teachers in this transition? What are teachers' views and attitudes about the TLC?*

The teachers had a shared purpose in being part of the TLC. Their apprehension about implementing the new chemistry programme was due to different factors. Their epistemological beliefs together with their lack of confidence in using more SC pedagogies 'pushed' them to connect and to feel part of a community. By sharing their experiences, concerns and examples of resources they realised that they were not alone.

The TLC preferred a more practical PD. Theoretical sessions were not very popular, while the more practical ones that focused on resource design, development and implementation attracted higher interest. Stolk et al. (2009a) explain "that for a successful reform, instead of emphasising gaps in teachers' skills, their knowledge, beliefs, attitudes and concerns need to be included in the development and implementation of a new curriculum" (p. 167). One notes that not all participants exploited this opportunity equally. This strongly relates to their readiness towards the transition. Less experience and TC tendencies led to the more negative aspects of changing the way of teaching and rendered transition to a more SC mode more difficult. Those teachers with SC beliefs made use of these sessions to gain more confidence in the use of such pedagogies. They also realised that developing SC resources does not

necessarily mean starting from scratch. In addition, these participants were ready to take a more leading role in design and implementation by the end of the PD course. This is in agreement with de Jong (2015a) who states that TLC “provide a context that motivates teachers for professional learning and supports them when they are involved in curriculum innovation” (p. 261).

Throughout the whole year, all participants had positive views and attitudes towards the TLC and were comfortable with sharing and discussing together. They were also comfortable with the PD leader being part of the community who shared similar experiences and concerns. This helped the community to become more confident and comfortable with discussing different ways of teaching various chemical concepts. This is corroborated by Eilks et al. (2004) who state that successful teacher learning occurs when community members and the provider, in this case the PD leader, build a good relationship. The TLC provided a comfortable space for teachers to share their experiences and to feel empowered to try out new things as they knew that they were heard, that their opinions were valued and that they had a constant support system.

This study was intended to explore the first year of a TLC through a long-term PD course, that concentrated upon breaking barriers that are generally encountered during teacher professional learning. This showed participants that their needs are a priority and that they are heard. Different teachers view teaching and learning differently and have different grades of readiness to transitioning towards a different role or practice. The limitation of this study was the lack of implementation opportunities, mainly due to circumstances dictated by the COVID-19 pandemic. Further studies can focus more on implementation, reflection on practice and analysis of the effectiveness of the designed resources in the classroom.

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Appendix

Plan of PD Sessions

Scholastic Year 2019 - 2020	
Session (Mondays 15.00 - 16.30)	Topics to be covered (order of topics will depend on participants' needs)
23 rd September 2019	<ul style="list-style-type: none"> • Focus Group 1 • Introduction – getting to know the community of teachers
7 th October 2019	<ul style="list-style-type: none"> • What is Science Education? • Teacher and Student Role
21 st October 2019	<ul style="list-style-type: none"> • Teacher-Centred vs Student-Centred Education
28 th October 2019	<ul style="list-style-type: none"> • Inquiry-Based Learning (IBL) and Stages of Inquiry
11 th November 2019	<ul style="list-style-type: none"> • Using Student-Centred Activities in the classroom (Includes first implementation exercise)
2 nd December 2019	<ul style="list-style-type: none"> • Developing an IB Lesson Plan
16 th December 2019 (end of term 1)	<ul style="list-style-type: none"> • Focus Group 2 • Opinions and Views about the community after the first term
17 th February 2020	<ul style="list-style-type: none"> • The Context-Based Approach (CBA)
2 nd March 2020	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
16 th March 2020	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
23 rd March 2020 (new)	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
30 th March 2020 (end of term 2)	<ul style="list-style-type: none"> • Focus Group 3 • Opinions and views about the CBA and its use in developing resources for the new syllabus
20 th April 2020	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
27 th April 2020 (new)	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
4 th May 2020	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
18 th May 2020	<ul style="list-style-type: none"> • Using the CBA to develop resources for the new Learning Outcomes chemistry syllabus
22 nd June 2020 (end of term 3) (new)	<ul style="list-style-type: none"> • Focus Group 4 • Feedback on the resource pack developed for the first topic of the new syllabus