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Enhancing Life Sciences Teachers' Biodiversity Knowledge
A Professional Learning Community Approach

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Abstract

In the last two decades, South Africa has made efforts to integrate biodiversity content in its Life Sciences curriculum; however its implementation lacks systemic coherence. This is due to ineffective professional development approaches. This paper provides insights into how Life Sciences teachers in the Eastern Cape can be supported through professional learning communities (PLCs) as a potential approach to enhancing their biodiversity knowledge. PLCs are communities that provide the setting and necessary support for groups of classroom teachers to participate collectively in determining their own developmental trajectories, and to set up activities that will drive their development. The case study presented in this paper is part of a broader qualitative PhD study which explored the functionings and conversion factors in biodiversity teacher PLCs in South Africa. Drawing on teachers' and facilitators' experiences and the observation of the PLC approaches, the capability approach was used to analyse the functionings and conversion factors that enhance teachers' biodiversity knowledge. The paper highlights that for PLCs to be effective approaches for professional development, they need to be aligned to teachers' valued functionings. It also reveals that different conversion factors enable teachers' achievements of valued functionings in the PLC. The paper aims to contribute to wider policies on capacity building for teachers.

Introduction and Context

South Africa is rated as one of the countries with the most biological diversity in the world (DEA, 2014). The country is home to about 95 000 known species (2014). However, an assessment of biodiversity and ecosystems in 2011 found that, compared to other southern African countries, South Africa has a high number of threatened species (Driver *et al.*, 2012). Approximately 12 million South Africans depend on the natural environment to meet their needs (2012). This results in overharvesting of biological resources – one of the main causes of biodiversity loss in the country (DEA, 2014). Biodiversity loss is not only a South African crisis, it is a global phenomenon (UNESCO, 2014). This report highlights that global biodiversity, which plays an important role in maintaining and enhancing the well-being of over seven billion people in the world, continues to decline. The realisation of biodiversity conservation as a global concern has resulted in various international conventions, policies, and legislations (Shava & Schudel, 2013). South Africa is a signatory to these international conventions and has national policies aimed at conserving biodiversity such as this National Environmental Management Biodiversity Act. This act introduces a legal framework for governing sustainable development in South Africa and includes a clause for all training and education programmes to integrate education for sustainable development (ESD) (Republic of South Africa, 1998). Thus, like many other countries in the world, South Africa has included biodiversity components in its Curriculum Assessment Policy Statement (CAPS).

The Life Sciences subject covers a considerable amount of biodiversity-related elements (DBE, 2011). However, due to a lack of teachers' subject knowledge, poor pedagogy, and assessment practice, its implementation lacks systemic coherence (Songqwaru, 2012). Professional development efforts have been made to support teachers with the implementation of environmental learning, such as biodiversity content in the curriculum; however, very little has been achieved in ensuring that environmental issues such as loss of biodiversity are consistently and coherently implemented in the school curriculum (Lotz-Sisitka, 2011). Many professional development initiatives have been described as once-off trainings, often with little relevance to the needs of teachers (DBE, 2015). For professional development programmes to be successful, they have to be personally meaningful to the participating teachers, and should be aligned to their needs (Darling-Hammond, 2008). In response to this and in line with international trends, South Africa calls for collaborative learning as a main strategy to support the ongoing professional learning and development of teachers through support systems that promote the establishment of PLCs (DHET & DBE, 2011). PLCs aim to move teachers from being subjects in their learning spaces to becoming educational change agents (2011). In South Africa, PLCs are relatively new policy concepts; thus, limited research exists on how PLC approaches contribute to teachers' professional development. In line with the South African policy landscape, the Fundisa for Change national teacher education programme aims to pilot and develop the concept of professional learning communities (PLCs) within the context of environmental learning (Lotz-Sisitka, 2011). The study focusing on how professional development initiatives can be structured and supported to expand teachers' biodiversity knowledge was positioned within the Fundisa for Change programme. This paper therefore speaks to the research gap by exploring how PLC approaches can enhance teachers' capability for teaching biodiversity content in the curriculum. This paper is framed by the following two questions:

- What are teachers' valued functionings in teaching biodiversity?
- What conversion factors in PLCs enable and/or constrain teachers' achievement of their valued functionings in teaching biodiversity?

This paper aims to contribute a) to the South African policy landscape on teacher professional development, and related global policies such as the Global Action Programme (UNESCO, 2014), and b) towards transforming and strengthening teachers' practices.

Professional Learning Communities

PLCs are 'communities that provide the setting and necessary support for groups of classroom teachers to participate collectively in determining their own developmental trajectories, and to set up activities that will drive their development' (DHET & DBE, 2011:14). Examples of PLCs are: teacher learning communities, teacher networks, critical friend groups, study groups and professional networks. PLCs are grounded in adult learning theories aligned with socio-cultural learning, grounded in the work of Vygotsky (1978). Through Vygotsky's theories, the idea of scaffolding was identified by Bruner, which implies that people learn at a much higher level when support for their learning gap is provided through peer interaction, or the contribution of a more knowledgeable other (Vygotsky, 1978). In the case of PLCs, this suggests that teachers must understand their own acquisition of biodiversity knowledge, and its relationship within the social context, in order to enhance their knowledge. This requires a forum for teachers to construct biodiversity knowledge through a continuous cycle of learning rooted in reflection, social collegial interaction, professional dialogue, and all processes that can provide scaffolding for improved knowledge for teaching (Stoll *et al.*, 2006). Here the focus is on a course-initiated PLC and explores the potential of this approach to enhancing teachers' biodiversity knowledge in the Eastern Cape.

The Eastern Cape Context

The Eastern Cape is situated in the south-eastern part of South Africa. Based on the last census, an estimated 6.75 million people lived in the province (ECSECC, 2015). The Eastern Cape is considered the poorest province in South Africa and faces significant social challenges, including: poverty, income inequality, food insecurity, and unemployment (2015).

The Eastern Cape produces the poorest grade 12 results every year (ECSECC, 2015); with political, social and economic factors compounding the poor performance rates of learners in the province. This is due to the lack of access to decent learning facilities, large class sizes, and a lack of funds (Ncanywa, 2014), among other features. Language in schools is another significant barrier to effective teaching and learning (Murtin, 2013). There are 23 school districts demarcated across the province, grouped into three geographically demarcated clusters. Clusters A and B are 99.9% rural and consist of schools situated in villages from the former apartheid era of the Transkei and the Ciskei (Ncanywa, 2014). Most of these schools are underdeveloped, with poor infrastructure. Cluster C has a number of former model C (semi-private) and private schools found in each district (Ncanywa, 2014). The sample group is from cluster B.

The Eastern Cape Biodiversity Context

Environmental threats within the region include land degradation, soil erosion and high pressure on groundwater (Hamann & Tuinder, 2012). The main use of water is irrigation, which accounts for almost two-thirds of water resources required in the province. Overall, it has more estuaries than any other South African province, with river ecosystems under considerable pressure due to high demands for water resources (2012). Most of these estuaries are described as healthy and are important nursery and feeding areas for a wide range of fauna and flora (DEA, 2014). In terms of biodiversity, the Eastern Cape has a higher biome diversity than any other province in South Africa, including all South African biomes except the desert (Hamann & Tuinder, 2012), as well as a number of endangered ecosystems. A total of 316 threatened plant species are found in the province, which is also home to four endemic freshwater fish species, eight threatened marine fish species, six threatened frog species (four of which are endemic) and 19 threatened reptile species (18 of which are endemic) (2012).

Theoretical Framework

Functionings and capabilities are among the core concepts of the capability approach developed by Amartya Sen. A functioning is 'the various things a person may value doing or being' (Sen, 1999:75) which are the practical realisation of one's chosen way of life. Capabilities are 'the alternative combination of functionings that are feasible for [a person] to achieve; they are the substantive freedom "a person has to lead the kind of life he or she has reason to value"' (Sen, 1999:87). While capabilities and functionings are inextricably linked, they remain distinct (1999:87). Capabilities represent a possibility instead of an actuality (1999:87). Of interest to this paper was the understanding of what Life Sciences teachers' valued functionings were in relation to biodiversity teaching. Life Sciences teachers might have similar valued functionings, but different capabilities, and thus require different resources to achieve them (Sen, 1999). Also central to the capability approach is the concept of conversion factors (Robeyns, 2005). Conversion factors are those which can allow teachers in PLCs to convert resources to new functionings (Robeyns, 2005). She distinguished between three sources of conversion factors that can constrain or enable people's capabilities. These are:

- *Personal conversion factors*: those determined by one's mental and physical aspect. They are internal to the individual, such as intelligence.
- *Social conversion factors:* those determined by the society in which one lives, such as curriculum policies.
- *Environmental conversion factors*: those determined by or emerging from the physical environment in which a person lives. These can be aspects of one's geographical location, such as proximity to an ocean.

Robeyns (2005) further noted that personal, social and environmental conversion factors are interrelated. Therefore, the capability of individual Life Sciences teachers in the PLC is likely to be dependent on these interrelated conversion factors. The context in which the PLC activities happen, and the teachers' relationships in the PLC may have the potential to expand or constrain individual teachers' biodiversity knowledge (Robeyns, 2005). It is thus not enough to know what functionings Life Sciences teachers can or cannot achieve; we also need to know the circumstances in which PLCs are situated.

Research Design

The research was a qualitative case study, stressing the socially constructed nature of empirical experiences, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry (Denzin & Lincoln, 2011). Case study methodologies are significant for learning about environmental learning (Lotz-Sisitka & Raven, 2004) as they enable research about environmental issues in contexts including biodiversity. The PLC activities happened in two contact sessions (three days a session). Four teachers (T1, T3, T5, T6) had five years of teaching experience or more. Both sessions were attended by the same ten Life Sciences teachers and three facilitators. The teachers were qualified to teach Life Sciences. Except for T2, they all had one or more qualifications in the field of education. The qualifications varied from a Senior Secondary Teaching Diploma in Education to a Bachelor of Education Honours degree. Data was generated through six semi-structured interviews with teachers (given codes T1-T6), two facilitators (given codes F1 & F2), and observations of the contact sessions. Document analysis was done on the Life Sciences CAPS documents, which served as primary data sources (Harland, 2014). The data generated was analysed using the capability approach concepts of capabilities, functionings and conversion factors described above. Careful attention was given to ethical issues that confronted the researcher, including policies regarding informed consent, confidentiality and anonymity (Harland, 2014).

Research Findings

At the beginning of the PLC activities, the teachers' valued functionings in relation to the teaching of biodiversity were explored. In line with the PLC objectives, teachers indicated that their core functionings were to expand their biodiversity knowledge, improve their teaching and strengthen assessment practice.

Biodiversity knowledge

An analysis of the Life Sciences curriculum shows that biodiversity knowledge mainly follows two knowledge strands: (a) diversity, change and continuity, and (b) environmental studies (DBE, 2011). Those include concepts such as biodiversity of micro-organisms, plants and animals; and pollution ecology and human impacts on the environment. Teachers valued being knowledgeable about biodiversity. Two teachers noted the following as potential goals: 'To have more information about biodiversity and to know why it is important to conserve species' (T2) and 'To gain more knowledge on how to teach learners on the ecosystems' (T6). Emerging from the observations, teachers lacked in-depth understanding on the core concepts of biodiversity, such as: biomes, taxonomic classification, ecological niche, human impact on biodiversity and the three levels of biodiversity (species diversity, genetic diversity and ecological diversity). Teachers were unable to fully explain some of the concepts. For example, T3 defined marine species as 'species found in water'. None of the teachers knew which biomes were found in their context. In response, the PLC activities were structured to explore the core concepts of biodiversity. For example, the concept of marine species was expanded to include species that are not found in water but rely on species found in the water. Another example was that maps of biomes in South Africa were engaged with, exposing teachers to the different biomes. Teachers maintained that biodiversity content is challenging, noting: 'I did not know that biodiversity was challenging. I only noticed that after we have dealt with it' (T4), and 'Biodiversity is challenging. A lot of teachers are not knowledgeable on it' (T5).

In addition to engaging with key concepts, the PLC activities also explored the roles of biodiversity, and drivers and responses to biodiversity loss. Among the drivers of biodiversity loss explored were habitat change, pollution, invasive species, overexploitation and climate change. Some of the emerging responses to biodiversity loss discussed included: environmental education, indigenous conservation species, policy, legislation and international environmental conventions.

Pedagogical practices

The curriculum document stipulates that teachers should be able to conduct practical and fieldwork activities (DBE, 2011:33). For example, under the topic of 'biosphere and ecosystems', teachers are expected to 'choose one ecosystem close to the school within a local biome for special study' (DBE, 2011:33). Teachers' weak pedagogical knowledge was confirmed by F2 who noted:

> The problem is not only content but also methodology of teaching. Most teachers don't use exciting teaching methodologies such as experiential learning, field learning, outside learning. Even simulations, in most cases they are quite artificial in the sense that the examples used by teachers do not really speak to the real world.

Among other pedagogical practices, teachers therefore sought to enhance their practical knowledge for conducting practical activities and fieldwork. They revealed that pre-service training, however, did not sufficiently capacitate them on how to conduct practical activities, as T2 said:

> It is difficult to do practicals; I don't know how to do it. At university we were only taught theory and did not do it in practice. You don't know whether what you are doing is right, you don't have enough resources. At least if I can get support on how to do practicals, like how you are supposed to present and reflect on the topic.

To enable teachers to achieve their valued functionings, the PLC activities examined a range of pedagogical approaches appropriate to biodiversity concepts and learning context. Pedagogical approaches (with examples of methods) were discussed under the following categories (Rosenberg, O' Donoghue & Olvitt, 2008):

- *Investigative methods:* participatory methods, fieldwork, case studies;
- *Deliberative methods:* social learning methods, critical media analysis, scenarios;
- *Learning-by-doing methods:* projects and practicals, community problem-solving;
- *Experiential methods:* interpretive trails, role-play, values clarification; and
- *Information transfer methods:* presentations, guided questioning, excursions.

Different pedagogical approaches were discussed and modelled. For example, the scenario planning method was used to demonstrate a reduction in mussel species; role-play was used to explain the concept of human impacts on biodiversity; and field activities were conducted to expand teachers' capabilities for conducting fieldwork in the marine ecosystems. As part of the fieldwork activity, teachers had to identify marine species, and use them to construct taxonomic keys and food chains.

Assessment practices

The Life Sciences curriculum describes three different types of assessments: tests, examinations and project-based assessments; with all assessments structured according to Bloom's taxonomy (DBE, 2011). The weighting of cognitive demands are shown in Table 1.

Table 1. Weighting of cognitive demands of assessment tasks

	Knowing science	Understanding science	Applying scientific knowledge	Evaluating, analysing and synthesising scientific knowledge
%	40%	25%	20%	15%

Source: DBE (2011)

The Life Sciences curriculum clearly outlines the different topics to be covered in the summative assessments and their marks allocation; for example, the topic of biodiversity and classification is allocated 7%, and human impact accounts for 17%. Despite these curriculum stipulations, teachers were not clear about which types of assessments would best cover biodiversity concepts. Therefore, in the PLC, different assessment practices were explored. The focus was mainly on assessment tasks that promote higher-order thinking and problem-solving skills as teachers lacked the ability to compile questions that promote these skills. This was in line with what teachers valued; for example T1 valued 'learning how to assess learners in different ways that are challenging, not just recalling'. T2 expressed that she did not know how to allocate marks; she revealed:

> Allocation of marks – I don't know it. I just take past question papers, cut and paste with already allocated marks. I don't count that this one falls under knowledge, evaluation, synthesis or comprehension, simply because I do not know how to do it.

The extract above shows that T2 understood the importance of asking different levels of questions, but she lacked the competence to compile assessment tasks aligned with different cognitive levels. She thus valued learning about allocating marks to enhance her ability to design different levels of questions. F1 supported the teachers' views, as he said:

> Teachers cannot assess. When you look at their developmental tasks that they do in their schools, they are of poor quality. They are not developing learners at all. The types of questions asked in the informal tasks are not a variety of questions that learners expect to see in the formal tasks.

To expand on the PLC teachers' capabilities for assessing biodiversity concepts, assessments *for* learning and assessments *of* learning were discussed. Bloom's taxonomy was used to unpack the cognitive levels to be considered in assessments of knowledge, comprehension, application, analysis, synthesis and evaluation. Focusing on assessment, an excursion to the mangrove forest was conducted. As part of the excursion, teachers did an activity (Figure 1) in three groups, in which they had to answer questions, allocate marks, and state and justify the cognitive levels of the questions.

Figure 1: Activity on assessment

1. Using the field guide on mangrove, list the species found in the mangrove ecosystem.
2. Giving examples from (1), explain why those species are found in that ecosystems.
3. Using the information in (1), draw a food web of the mangrove ecosystem species.
4. Identify any evidence of human activities in the mangrove ecosystem.
5. Discuss any human impact on the ecosystem.
6. Suggest ways on what can be done to protect mangrove swamps and their inhabitants.
7. Using information in (1), construct a dichotomous key for species identified.

Teachers answered the questions but struggled to allocate marks. Table 2 shows the marks allocated by teacher groups.

Table 2: Marks allocated for the assessment activity done

Question	Group 1	Group 2	Group 3
1	3	4	4
2	2	2	4
3	2	3	7
4	2	1	5
5	5	3	5
6	5	3	4
7	6	6	6
Total	**25**	**22**	**35**

Discussions took place on how and why different marks were allocated by different groups. Emerging from all the groups was that the marks were allocated depending on the amount of time, thinking and information required to answer a specific question. For example, all groups agreed that question (3) required understanding and application. Similarly, all the groups gave more marks to question (7) because it is a synthesis question and required higher-order thinking.

Conversion factors in professional learning communities

At the end of the PLC activities, teachers indicated that they achieved their valued functioning. They noted that, in the PLC, there were conversion factors that enabled and/or constrained them to achieve their valued functionings.

Teachers' experiences and qualifications

The difference in qualifications and experiences allowed teachers to learn from each other. The teachers who had fewer years of teaching experience acknowledged their lack of experience as a constraint to their full participation in the PLC. For example, T2 had one year of teaching experience, and she expressed:

> I am new in teaching. Some of the things, I have never heard about them. So I didn't know how to deal with them. There are difficult concepts in Life Sciences that it becomes difficult to present when you don't understand them. So there were colleagues helping or showing me what the concepts mean and how to teach them.

Irrespective of individual differences, the PLC was structured so that all teachers' opinions were valued and respected, as F2 noted:

> There were definitely some who were battling. But it helps when people are feeling enabled to say 'I do not understand.' They were able to express themselves. It could be because of the community of practice. I did hear one of the teachers saying 'we all participated'. I tried to make sure that we don't have dominance.

Effective facilitation skills

There were three knowledgeable and experienced facilitators in the PLC. This was confirmed by T4 who, for example, noted 'the facilitator helped in explaining what "assessment" is and the different forms of assessment, she emphasised that knowledge is not the only thing that learners need to acquire, this will have an impact on my teaching'. The different facilitators were an enabling factor as they brought in different expertise. Good facilitation was thus a personal conversion factor that enabled teachers to achieve their valued functionings.

Collaborative learning space

The PLC brought Life Sciences teachers from different schools together. This provided a collaborative learning environment allowing teachers to express their views and engaging in group activities, as T1 noted:

> It was good to interact with others in a controlled environment. We got time to discuss challenging topics, share information and to express ourselves to the facilitators and to our colleagues about how we feel about particular topics, or how they should be taught.

The teachers' participation in the PLC thus enabled them to achieve their valued functionings. This was noted by F1 who said 'the enabler was the freedom that teachers had in terms of participation. They were free to express themselves and that helped them learn better.' Teachers were given opportunities to reflect on their learning. This allowed for further learning.

Site where the PLC activities happen

The PLC activities took place at Donaldwoods near the Dwesa Nature and Marine Reserve. Excursions were conducted to the marine ecosystems. Teachers found excursions to be great enablers to their valued functionings, as T4 noted: 'The field trips worked for me. I can now differentiate between the different marine ecosystems. I can now differentiate an estuary from mangroves, a sandy shore from sand dunes.' The ocean emerged as a conversion factor that enabled teachers' capabilities for conducting fieldwork and acquiring scientific skills.

Policy context

Curriculum documents were used to inform PLC activities. Teachers had different interpretations of the curriculum and its demands. They were not confident in using the curriculum documents. This was confirmed by F1, who reflected that 'teachers did not understand the CAPS requirements and that was a concern'. Curriculum documents were used for different activities; for example, they were used for conceptual progression and to analyse the assessment and pedagogical practices required for biodiversity-related topics. Using the curriculum documents in the PLC thus enabled the teachers' achievement of their valued functionings. As T3 noted, 'there is progression of knowledge which we did not know. So now if I take a policy document, I will say here there is progression.'

Access to teaching and learning support materials

In the PLC, teachers engaged with different materials that were designed to provide them with access to additional learning support material. Resource materials from local organisations were used to expand teachers' situational knowledge. For example, field guides were used to identify the marine ecosystems and species. Teachers indicated that the teaching and learning support materials used in the PLC enhanced teachers' biodiversity knowledge, pedagogies and assessment practice. T6, for example, said 'the materials provided were very effective, especially during the activity time'. Teachers received teaching and learning support materials to use in their work to enhance teaching and learning, as T5 confirmed: 'we have been given a lot of materials which will assist us as far as our teaching is concerned'.

In addition to the above, teachers mentioned time as the main conversion factor that constrained their in-depth understanding of some of the biodiversity concepts, and pedagogical and assessment practices. This was confirmed by F2 who stated: 'I believe we could have touched more things in details but we were worried about the schedule.' To reconcile this constraint, teachers expressed that either more time could have been provided for the activities, or the PLC activities should be ongoing.

Interpretation and Discussion of the Findings

Biodiversity education is oriented towards socio-ecological change processes and requires learners to engage with local and global biodiversity issues and associated risks (O'Donoghue, 2015). Biodiversity education also calls for assessment practices that will assess learners' high-order thinking skills and problem-solving skills (O'Donoghue, 2015). The challenge for teachers is to design activities that allow for critical engagement with contested and complex concepts of biodiversity in local contexts. This requires interdisciplinary approaches to teaching and learning (McKeown & Hopkins, 2014). The PLC activities examined the range of teaching methods that are most appropriate to Life Sciences and to the biodiversity concepts and context of learning (i.e. investigative and deliberative methods) (Rosenberg *et al.*, 2008). In Life Sciences, assessments should be designed to cover the different cognitive levels, to cater for a range of abilities of learners (DBE, 2011). Teachers were not clear on what types of assessments would best assess biodiversity concepts (Songqwaru, 2012). Therefore, the PLC activities explored assessment practices that would expand the teachers' capabilities for developing assessment tasks that would would, in turn, expand learners' higher-order thinking skills and promote critical-thinking and problem-solving skills.

Resonating with Cundill *et al.* (2014), the PLC activities started with an exploration of the teachers' expected outcomes of the learning process. This helped the faciltators to be responsive to teachers' individual valued functionings related to the teaching of biodiversity. The teachers lacked the ability to identify and work with the biodiversity content in the Life Sciences curriculum. This was due to a lack of capacity in teacher education institutions to adequately prepare teachers with sound subject content knowledge for biodiversity teaching (McKeown & Hopkins, 2014). In South Africa, environmental knowledge has been integrated into teacher education programmes such as the environmental education elective in a Bachelor of Education, Honours degree (Lotz-Sisitka, 2011; O'Donoghue, 2015). This is to expand teachers' capabilities to work with environmental and sustainability knowledge (such as biodiversity knowledge) in the school curriculum. These programmes are yet to make an impact on teachers' knowledge. This was demonstrated by the teachers' lack of competence to work with biodiversity concepts. The teachers' valued functionings were aligned to the integrated and applied knowledge required for quality teaching (disciplinary, pedagogical, practical, fundamental and situational) (DHET, 2011). These were core to the PLC activities.

Even though the teachers had similar capability sets, they needed different resources to achieve their same valued functionings (Sen, 1999). In the PLC, there were different personal, social and environmental conversion factors (Robeyns, 2005) that enabled and/or constrained the teachers' valued functionings in teaching biodiversity. The goal of PLCs is for teachers at all stages of their careers to learn from each other (Stoll *et al.*, 2006). Thus, individual experiences were personal conversion factors that enabled teachers to achieve their valued functionings. The PLC activities were structured so that all teachers' opinions were valued and respected. This is defined by the characteristic of inclusive membership (Stoll *et al.*, 2006). Resonating with Huggins, Scheurich and Morgan (2011), external expertise brought in through the facilitators were recognised as personal conversion factors for the achievement of teachers' valued functionings. 'Without the inclusion of outside assistance in PLCs collaboration simply cannot occur due to the lack of sufficient pedagogical and content knowledge within the community' (Huggins *et al.*, 2011:85). As noted by Reddy (2011), teachers have different interpretations of the curriculum and its demands, but working with curriculum documents in the PLC enabled their ability to interpret the curriculum. PLCs do not operate separately from their surrounding entities (Stoll *et al.*, 2006). For example, as noted above, the presence of the ocean close to the venue were the PLC activities happened was an environmental conversion factor that enabled teachers to expand their capabilities for conducting fieldwork and acquiring the scientific skills required by the Life Sciences curriculum.

In South Africa, there is a lack of quality teaching and learning resources for teachers to teach environmental and sustainability content such as biodiversity (Lotz-Sisitka, 2011). The school textbooks generally present incomplete information. In the PLC, teachers received teaching and learning support materials to enhance their teaching of biodiversity content.

PLCs create a structure for groups and individual professional development through collaboration (Stoll *et al.*, 2006). In this case, it was through sharing ideas and experiences, and engaging in discussions and demonstrations. Teachers acquired new biodiversity knowledge and various skills through social interactions. Vygotsky (1978) noted that learning is a social activity and people learn from their capable peers. The teachers recognised that engaging in professional conversations in the PLC was an enabler to their teaching practice and professionalism (Tshiningayamwe, 2016).

Conclusions and Recommendations

In summary, identifying teachers' valued beings and doings is critical for their own learning. This allows for PLC activities to respond to teachers' individual needs. The PLC structure expanded the teachers' functionings related to their teaching of biodiversity, and agency to be active participants in the PLC. In the PLC, professional development was situative, and outcomes were influenced by personal and group processes. However, for PLCs to be more effective, they need to support teachers' continuous learning by being sustained over time. This requires making more time available for PLC activities, which will allow in-depth engagement with biodiversity knowledge, and pedagogical and assessment practices. This also requires identifying the different functionings.

Notes on the Contributor

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