



Change Project-Based Learning in Teacher Education in Botswana

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Abstract

Environmental education (EE) and education for sustainable development (ESD) pedagogies are intricate, and to enhance learning, teacher education has to be innovative in teaching approach. This article investigates how the change project approach enhances project-based learning in practice. The investigation is based on teacher education programmes in Botswana teacher education institutions (colleges of education) where a few teacher educators were introduced to Education for Strong Sustainability and Agency (ESSA) change projects. Preliminary results of the change projects' evaluation indicate that change project ideas were enthusiastically accepted by teacher-educators and students across the teacher education colleges in Botswana. This research is a follow-up to change project implementation and its outcomes in two teacher education institutions in Botswana. It is framed within a project-based learning approach in teacher education. Data were generated through site visit observations and interviews with teacher-educators and student-teachers. The outcome indicated the viability of project-based learning (PBL) as an appropriate approach to transformative pedagogies for ESD in teacher education. The PBL approach is recommended for teacher training education to facilitate strong sustainability and agency among student-teachers.

Key words: project-based learning, change project, ESD, environmental education, teacher education.

Introduction

Environmental and sustainability education is an important global trend that could be promoted through teacher education and partnerships in this era of environmental challenges. The idea of an ESD change project has been born out of a call for reorienting education towards sustainability. In Botswana, one way of responding to such a call was to engage in ESD change projects in teacher education institutions to promote environmental and sustainability education. In this research, we investigate how the change projects implemented by educators who participated in the Swedish Education for Strong Sustainability and Agency (ESSA) enhances the project-based learning (PBL) approach (Lee, Blackwell, Drake & Moran, 2014; Krajcik & Blumenfeld, 2006; Markham, Larmer & Ravitz, 2003). The main object was to get insight into how they used the course concepts of strong sustainability and agency to identify, plan, design and create projects as part of capacity-building in their institutions, and how this

linked to the curriculum. The educators facilitated learner-centered activities in these projects, mobilising resources as they reflected on the learning outcomes from the change projects.

50 teacher educators from 28 teacher education institutions in the SADC region were exposed to the ESSA course, whose objectives were to support professional development and to enhance institutional capacity to initiate and support change in the field of ESD pedagogies. Change projects were developed out of, and were directly linked to, institutional situations. The projects were structured into phases. During the initial phase, institutions completed an institutional audit and identified an aspect of the institution's issues to focus on. The audit provided an opportunity to deepen insights and clarify what needed to change in the institution through the change project. Course participants were expected to work closely with colleagues and other interest groups linked to change projects, and share how insights gained from the course could enhance the work done in environmental education. Furthermore, they were expected to ensure that the change project was both relevant and innovative in sustainability practices in the institutional work context. During this phase, they were also expected to ensure that their colleagues were able to work closely with the development and implementation of the change project by linking it to the curriculum. Throughout this phase of the project, there were coordinators and mentors from the Teacher Education Department of the Ministry of Education and the University of Botswana, who were available to provide support.

This article focuses on the following key objectives:

- ESD change project initiatives implemented in the institutions;
- How other stakeholders support the change projects;
- How change actions feed into the curriculum, teaching and learning in the institutions; and
- How the change projects bring in the whole institution to participate.

Ideally, a change project should be part of participants' work, and implementation must be carried out within the institutions' work plans and budget. The change project approach is meant to respond to the needs and opportunities within the broader institutional context. It should respond to participants' professional development, the institutions' priorities, and to the field of ESD within the institution. Project-based learning (PBL) offers an inquiry-based approach that provides opportunities to transform and reform learning experiences characterised by engaging learners in contextually complex projects (Lee *et al.*, 2014; Krajcik & Blumenfeld, 2006; Markham *et al.*, 2003). PBL is an ideal tool to analyse the outcomes of the institutional change projects.

Conceptualising Project-Based Learning in ESD

The concept of PBL in ESD in teacher education calls for both epistemological orientation and pedagogical innovations to promote sustainability and agency. PBL has much to offer in teacher education settings through its emphasis on learning through working on projects in teams (Nation, 2008). It is the challenge for teacher educators to facilitate these processes. PBL could

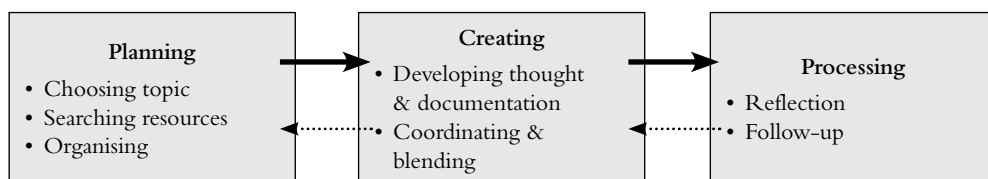
be introduced to teacher education institutions to promote sustainability education through change projects (Han & Bhattacharya, 2001:12).

The Buck Institute for Education (2015) describes PBL as a teaching approach that engages students in learning essential knowledge and life-enhancing skills structured around complex, authentic questions and carefully designed projects. For this reason, PBL requires time, thought, and careful planning to be of value. Furthermore, environmental project-based learning provides an ideal opportunity for interdisciplinary learning. 'A project is meaningful if it fulfills two criteria. First, students must perceive the work as personally meaningful, as a task that matters and that they want to do well. Second, a meaningful project fulfills an educational purpose' (Larmer & Mergendoller, 2010:2).

PBL approaches enable educators to deploy a constructivist approach in teaching ESD/EE. Constructionism (Papert, 1991) is both a theory of learning and a strategy for education. It builds on 'constructivist' theories, asserting that knowledge is not simply transmitted from teacher to student, but actively constructed in the mind of the learner. Learners are not required to get ideas from the facilitators, but to create ideas drawing on the project. Moreover, constructionism suggests that new ideas are most likely to be created when learners are actively engaged in building some types of external artefacts that they can reflect upon and share with others. In this study, artefacts are the institutional change projects.

Han and Bhattacharya (2001) and Papert (1991) differentiated between constructivism and constructionism. They posit that constructivism expresses the theory that knowledge is built by the learner, not supplied by the teacher; while constructionism 'expresses the further idea that happens especially felicitously when the learner is engaged in the construction of something external or at least sharable' (Papert, 1991:3). They further agree that constructionism supports the constructivist viewpoint that the learner is an active builder of knowledge (Han & Bhattacharya, 2001). In this research, the project ideas were the creations of the participants, linking sustainability to projects aiming to solve an environmental issue in their institutions. Drawing on Han and Bhattacharya (2001) generally, three phases can be suggested in conducting PBL. These are: planning, implementation (creation), and reflection and follow-up (see Figure 1).

Figure 1. Framework of project-based learning



Source: Han and Bhattacharya (2001)

In the planning phase, the student-teachers (with the assistance of the teacher-educator) choose a project, locate the required resources and organise the collaborative work. Through these activities, they identify a topic, gather relevant information and generate a potential solution.

In the second phase, the students engage in activities such as development, documentation, coordination, contributions and presentation. Students are also expected to build a product that can be shared with others during this second phase. The third phase of the project includes reflection and follow-up on the projects. The students share their project outcomes in a small group or with the entire class, obtain feedback, and reflect on the learning process and the project (Han & Bhattacharya, 2001).

Project-based learning is closely related to problem-based learning, especially in the institutional ESD change projects under this study, where the starting point was for teacher-educators and student-teachers to agree on an institutional issue of concern. The initial planning stage for the project was to make a significant change in college practices that would promote sustainability of the resources in relation to the identified issue. This could not be separated from the curriculum, as student-teachers were involved to make it relevant to their academic life. The project was expected to create links between theory and practice.

PBL as a strategy for strong sustainability and agency

ESD pedagogy should emphasise an interdisciplinary, culturally relevant, student-centered, practice-based approach on shared and group learning for problem-solving and agency (Wade & Parker, 2008). The focus of this paper is to follow-up on the change project implementation and its outcome as an institutional ESD pedagogical approach. The PBL approach explained above provides a focal point in the form of strong sustainability and agency. While the notion of strong sustainability has been quite ambiguous in literature, Ott, Muraca, and Baatz (2011:15) posit that strong sustainability aims at identifying criteria that distinguish non-sustainable from sustainable pathways on the grounds of a wider consideration of arguments for natural resource use than merely economic ones. This, they argue can be achieved through specifying the proper scope of the discourse by setting up a framework of fields of action and application by human agents who have to perform as a 'rational corrective' to clarify the diffuse discourse on sustainable development taking place in society. Implied within this definition, the notion of strong sustainability is about maintaining minimum critical thresholds of natural capital over time (Pelenc, Lompo, Ballet & Dubois, 2013). The idea of 'strong sustainability' encompasses issues of intra- and inter-generational distributive justice regarding natural resources (Ott & Döring, 2008), making reference to the importance of teacher-educator/student-teacher collaboration in these projects.

Strong sustainability encompasses what could be regarded as a good life (that is, life that is rich and flourishing). The key principles of strong sustainability have been identified as: resilience, sufficiency and efficiency (Ott *et al.*, 2011). Strong sustainability could be promoted through understanding planetary boundaries and ecosystem services. In these projects, strong sustainability would be seen through practical demonstration of resilience, resourcefulness and participation by teacher-educators and student-teachers in the project.

The concept of a human 'agent' implies acknowledging responsibility of human action as defined by Becker (2006). For the purpose of this study, the notion of 'collective agency' is considered, in which a community of human agents make sustainable choices in order to maintain the conditions required for human life on earth, while ensuring social sustainability

by taking into account the well-being and values of other individuals (Pelenc *et al.*, 2013:88). Collective agency has to emerge through a learning process based on interactions between people (Pahl-Wostl, 2006), where every individual member of the teacher colleges under this research pursues the perception of the collective-good, to bring about changes through these projects (Ibrahim, 2008:67). Agency, viewed this way, provides for individual freedom of choice. In this article, strong sustainability encompasses the ability – enhanced by project-based learning – to act willingly and independently as a means to promote sustainable development. It is hoped that the project may yield some personal attributes that would contribute to strong sustainability beyond teacher training and the project's lifespan.

Research Methods

The overall goal of the study was to follow up on change projects implemented at teacher education institutions in Botswana, and assess their progress as far as strong sustainability and agency are concerned. The ongoing change projects investigated for this paper were a grey water system at Francistown College of Education (FCE), and used/waste oil collection at Molepolole College of Education (MCE).

Study participants and methods

Out of the five institutions that were involved in change projects, two were selected to generate data for this study. These two were selected purposefully, since they experienced fewer implementation hurdles and were in advanced stages of project implementation. Both educators and student-teachers were fully involved in project planning and implementation. This is a qualitative research design based on interview and observation techniques as sources of data. The preferred techniques were mainly hands-on.

Interviews

Interviews were conducted amongst teacher-educators and focus group interviews with completing student-teachers at the teacher education institutions where there were ESD/EE change projects. We developed an interview guide for the teacher-educators. The guide was specific enough to adequately cover the evaluation questions and extract the teacher-educators' involvement with the change project. The student-teachers were interviewed in order to understand their participatory role in the change projects through focus groups; the advantage being that they provided collective views, as well as the implications behind those views (Gill, Stewart, Treasure & Chadwick, 2008). The researchers used an observation protocol (rubric/check list), research notes and insights from debriefing each other to produce the necessary triangulation for reasonable conclusions.

Observations

These were done at project sites by the researchers and the Teacher Training & Development Department of the Ministry of Education, who also provided support through capacity-building workshops, and paid regular visits to determine whether the acquired knowledge

and skills from the ESSA course and change projects were applied in practice. The criteria for the observations included processes followed during college-based workshops, such as practical application of skills acquired from the ESSA training, and student participation in change projects.

Data analysis

This included a review of data generated, transcribing recorded information, determining significant statements, clustering statements, and interpreting data and clustered themes as sources of information (Miles & Huberman, 1994). Analysis also included observable actions in practical projects at both institutions.

Drawing on the PBL model presented in Figure 1, Figure 2 (see below under *Discussion*) provides the framework for analysis, highlighting elements of strong sustainability and agency in the change projects as reflected in how educators and students participated in the planning, creation and reflection process.

Institutional Change Projects

In this section, we report results from the two institutions, based on the research objectives and the two phases of the projects. The main objective of this study was to analyse the progress and impact of institutional change projects' implementation. More specifically, the purpose was to derive information about change project implementation, support from other stakeholders (specifically the Ministry of Education), teaching and learning links, and stakeholder and student participation in the project. In the first phase, ESD capacity-building workshops were undertaken for staff and student-teachers. These workshops were conducted with the support of, and in collaboration with, the University of Botswana in which the authors were support agents. The second phase entailed the material component of the project. The results of the two projects are presented separately.

Francistown College of Education (FCE)

The change project at the FCE was on grey water recycling and its integration into the curriculum, across disciplines. The project involved collecting water from student hostels and kitchens, and required material sourced through the college and partners.

The FCE is an institution with an average enrolment of 150 students, almost all of whom are accommodated in the college. A lot of water is used in the students' hostels and kitchens; all of which goes to waste. This is what generated the project idea of collecting and recycling water for gardening and landscaping purposes. The college incurs high water bills as a result of this high water usage; the project's objectives were therefore to enhance the mainstreaming of ESD into all the subjects in the curriculum, and to keep the college environment green.

Capacity-building workshops

The teacher educator who participated in the ESSA course deployed the cascading model to build capacity among educators and students. To facilitate this process, three colleagues were

coopted to form a committee to drive the change project activities. As a committee, they ran ESD workshops for heads of departments (HODs), and the institution's management (whose principal was very enthusiastic), educators, support staff and student-teachers. The focus of the workshops was to build the capacity of the college community in terms of their understanding of ESD in the context of their day-to-day activities, work, teaching and learning processes. However, other colleagues, particularly from Religious and Special Education, indicated that it would be very difficult for them to mainstream the change project ideas into their subject areas, since they perceived ESD concepts to be mainly focusing on practical subjects.

As part of the change project, participants conducted an institutional analysis of how the various subjects could mainstream the change project into their daily teaching and learning activities. Table 1 highlights the various integration modes that were highlighted.

Table 1. Change project integration at Francistown College of Education

| | Method / Strategy of change project integration | | | | | |
|--------------------------------------|---|--|------------------|-------------|-------------------|------------|
| | Verbal encouragement | Enforcement of college rules on sanitation | Syllabus content | Infusion | Research Projects | Clubs |
| Departments / Offices | | | | | | |
| Principal | | | | | | |
| Deputy Principal - Academics | | | | | | |
| Deputy Principals - Administration | | | | | | |
| Dean of Student Affairs | | | | | | |
| Agriculture | | | | | | |
| Art, Craft & Design | | | | | | |
| Guidance and Counseling | | | | | | |
| Home Economics | | | | | | |
| Religious Education | | | | | | |
| Science | | | | | | |
| Special Education | | | | | | |
| Setswana | | | | | | |
| Social Studies | | | | | | |
| Mathematics | | | | | | |
| Communication & Study Skills | | | | | | |
| English | | | | | | |
| Music | | | | | | |
| Physical Education, Sports & Culture | | | | | | |
| Foundations of Education | | | | | | |
| Total no. of staff | 3 | 1 | 9 | 6 | 3 | 1 |
| Percentage | 15.7 | 5.2 | 47.3 | 31.6 | 15.7 | 5.2 |

From the capacity-building workshops, the idea and choice of the change project emerged by collectively assessing the main environmental issue in the college; in this case, the amount of grey water that goes to waste.

Grey water recycling

For the actual material project, the college identified and engaged the services of a voluntary consultant, with the assistance of the Water Utilities Corporation (the main parastatal organisation for supplying water in Botswana), to assess the water quality for irrigation. The college maintenance staff dug the trenches for pipes from the dining hall to the water collection reservoir. The students provided labour for the construction of the stand for a 10 000l reservoir tank, which was built in collaboration with the Bricklaying Department of Shashe Brigade. Shashe Brigade is a government-owned technical artisan institution that offered its construction services for free.

Molepolole College of Education (MCE)

The change project at the MCE focused on the proper disposal of used oil. The college project team, led by the educator who attended the ESSA course, conducted college-based capacity-building workshops similar to the FCE. The main objective of their change project workshops was to educate the college community about a clean environment within the ESD framework.

Capacity-building

After the initial capacity-building interactions with the institution community, the educator started working closely with students and initiated the production of an ESD manual with student-teachers. The manual was meant to support educators and student-teachers in their understanding of ESD, and the activities they could undertake in the teaching and learning processes for mainstreaming the change project approach. Some students actually went further and drew on the change project for their mini project presentations in Science. The college identified 'proper disposal of used oil from the kitchen' as its change project.

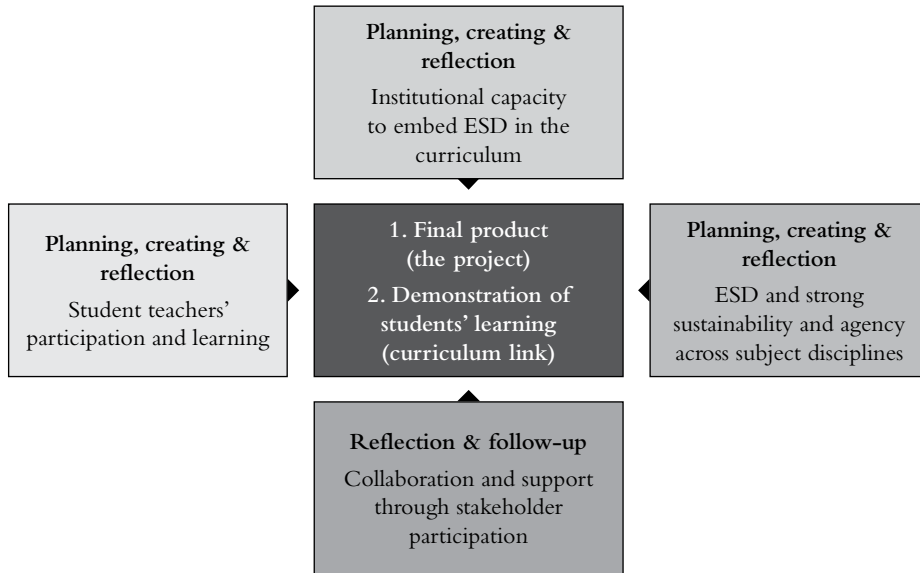
Proper disposal of used cooking oil

The institution uses a lot of cooking oil, which is not disposed of appropriately as most of it spills all over the area around the dining hall and is improperly stored in containers adjacent to the dining hall. It is frequently kept there for long periods, which presents an unsightly environment aesthetically, and poses a health hazard as it attracts cockroaches and rodents. In response, they came up with a change project around the safe disposal of oil. The institution consulted with a non-government organisation (NGO), Tshole Trust, which offers a service that collects and disposes of used oil. The NGO provided information on the safe storage and recycling of oil and they also provided a receptor tank into which the used oil could be stored for collection. The college bought several 20l containers, into which the kitchen staff could empty the oil before it is transferred to the larger tank, where it would be collected by Tshole Trust.

Discussion

The findings discussed in this section are related to the research objectives and intended outcomes derived from the change projects in the two institutions. The adapted framework (Han & Bhattacharya, 2001) depicted in Figure 2 acted as a springboard for understanding and synthesising the emerging outcomes of project-based learning in the change projects.

Figure 2. PBL outcomes in the change projects



Source: Adapted from Han and Bhattacharya's (2001) framework

The main outcomes are related to the key focus framed within the PBL process components of planning, creating, and reflection (Han & Bhattacharya, 2001). The key emerging research outcomes were: student-teacher participation in the change project, use of change projects for institutional capacity to embed ESD in the curriculum, the importance of collaboration and support through stakeholder participation, and the need to use interdisciplinary collaboration to deepen ESD and strong sustainability and agency across disciplines. All these are directly linked to the key objectives of the research, coming out of the change project and its link to the curriculum (see Figure 2).

Student-teachers' participation and learning

One of the themes of involving people in sustainable development actions is to develop appropriate and genuine participatory approaches and methods that are purposeful (Lotz-Sisitka, 2006). Participatory approaches focus on ESD learning in multiple contexts, including higher education (2006). The change projects approach in this study offered opportunities for such participatory approaches involving real problems with real consequences in these

institutions (Nation, 2008). At the very least, educators wanted to make certain that the change projects engaged students in the planning process and the actual creation of the project in ways that developed agency, ownership and sustainability.

The project activities offered student-teachers a chance to experience the tangible reality of the problems in their institutions, as well as ownership of the project as active participants rather than mere consumers of knowledge. Through their participation in the change projects, student-teachers seemed to be able to gain information, skills and attitudes for a sustainable environment in their colleges; through learning-by-doing and solving problems surrounding sustainability in their context areas, and understanding that ESD is practice-based. This way, change projects not only developed students' critical thinking, research and problem-solving skills, it gave them experience in applying these skills to real world situations (Nation, 2008:109). This is consistent with Genc's (2015) study at Bartın University in Turkey, where he found that prospective student-teachers were motivated by doing short-term project tasks which were found to be adequate in prompting them to make attempts to solve 'real social problems (e.g. garbage, water supply and sewers, abandoned land, erosion, paper recycling)' (2015:114).

This was clearly illustrated in the case of the MCE, where students were able to develop their own activities and exercises by designing and developing projects for their course assessment, drawing on the change project, which they further went on to present to their peers. This is illustrated by a student-teacher who said: 'For my Science assignment, I used the project to see how it can be used to solve the problem of pollution caused by oil.'

In the FCE, the students went on to demonstrate the skill of volunteerism by constructing the stand for the reservoir tank. This participation of student-teachers further enhanced their collaboration, cooperation and interaction skills, and group unity, as they had to work closely with each other. By getting involved directly in the project, the MCE students could see the importance of the ESD manual as a means of getting others to understand the relevance of the change project. All of these initiatives are part of what concerns education, and builds resilience and capacity within the socio-ecological challenges they daily encounter – a perspective held by Gough (2006), Sen (2009), Lotz-Sisitka (2010) and Lupele & Lotz-Sisitka (2012), all of whom emphasise that this is the main ESD agenda within the agency and capability orientation. These are all critical skills for the future success (within teacher education structures) of our response to global sustainability issues (Bell, 2010), as observed by the educator at the MCE: 'Students learnt about the future potential of business opportunities that might emerge from disposal of oil as illustrated by Tshole Trust ... The project could also instill entrepreneurial skills after they have finished college.'

Institutional capacity to embed ESD in the curriculum

The change project approach in these two institutions was based on two major premises. The first was to identify, plan for, create and reflect on a project – in order to change a situation of concern. Both colleges responded by generating a project, namely: a grey water recycling system in the FCE, and a system for the proper disposal of used oil at the MCE. Related to the first premise, the second was to enhance institutional capacity to initiate and support change in the field of ESD pedagogies, by linking this to the curriculum. Capacity-building workshops

seemed to deepen the understanding of ESD, and strong sustainability and agency. Capacity-building strengthened the understanding of ESD as practice-based, through the change project and its potential to reorient it towards the curriculum. For educators who were drivers of the projects, they used the change project as an organ that aided both fellow educators and students in bridging the gaps that exist in knowledge and skill. This was also reflected upon at the FCE in the research undertaken by some educators, who demonstrated this understanding by showing how the change project can be embedded in the various college subjects to mainstream ESD (see Table 1). For students at the MCE who drew on the change project to carry out their Science mini projects, this made their tasks manageable and achievable (Bell, 2010; Nation, 2008), an aspect emphasised by the educator who said:

Since there is a topic of proper disposal of used oil in the Science syllabus, from this project other students were able to use it for their written project which is part of their assessment in Science which helped them because of their participation in the change project.

From these projects, students were able to drive their own learning through inquiry, to work collaboratively with others and make presentations. All this reflected the knowledge they acquired from the change projects (Sipos, Battisti & Grimm, 2008; Bell, 2010; Nation, 2008). Powers (2004), in her evaluation of school community place-based projects in the United States, found that there is a strong link between students' learning and their participation in community projects; she emphasised that 'closely related research has demonstrated that students who are engaged in real-world learning are more likely to succeed than are those who learn equivalent material from more abstract textbooks' (2004:18). She further reiterated that repeated case studies revealed that schools and communities throughout rural America have been transformed by grounding students' education through engagement in local community projects and 'intentionally moving away from didactic approaches to standardised schooling' (2004:18). The evaluation concludes that this approach, which is equivalent to the change project-based approach, increases their interest in their community issues (Powers, 2004; Sipos *et al.*, 2008) – as was the case with the students who actively participated in the change projects.

ESD and strong agency across subject disciplines

In the initial phase of the change projects, especially at the FCE, it became apparent that monodisciplinarity and monosectorial practice still remain (Lotz-Sisitka, Wals, Kronlid & McGarry, 2015). This was particularly evident in the limited understanding of ESD as a cross-cutting concept in the Religious and Special Education departments, whose initial response in the capacity-building workshops was antagonistic and did not seem to comprehend the relevance of the change project in their subject areas. This was highlighted by the educator who said:

The Special and Religious Education departments were initially reluctant to participate since they think this about the environment, they don't see where they fit ... But when it came to building the tank students came from all subjects, including theirs!

This could be reflective of the observation made by Sipos *et al.* (2008), who argue that higher education in western societies overwhelmingly fragments knowledge into disciplines, and often leads to conflict between individuals and their ideologies. Lotz-Sisitka *et al.* (2015:74), in their argument for ‘transformative, transgressive learning research and praxis in the sustainability sciences that appear generative of a higher education pedagogy’, suggest that issues need to be understood and engaged via transdisciplinary perspectives, across multiple institutions, involving multiple actors. They contend that:

In order to transform for the sustainability turn or transition, people everywhere will need to learn how to cross disciplinary boundaries, expand epistemological horizons, transgress stubborn research and education routines and hegemonic powers, and transcend monocultural practices in order to create new forms of human activity and new social systems that are more sustainable and socially just.

These authors are arguing for institutional departments to take a more reflexive approach, which breaks through their mono-discipline niches and transitions into negotiation, searching, and learning with others in order to bring about such transformations in their institutions (Lotz-Sisitka *et al.*, 2015:75). In the context of this study, this was partially achieved at the FCE, through attempts to create synergy among teacher-educators across the whole institution, by collectively planning, creating and reflecting on the change project development process (Han & Bhattacharya, 2001), through collective workshops and involvement of students from across the disciplines. The research that was conducted to reveal opportunities for change project mainstreaming could also assist in this regard. The aim was to get the two departments at the FCE, and other educators and students at the MCE, to buy into ESD through the production of a manual for those who initially did not see their role in these projects, or lacked understanding and enthusiasm towards the initiative.

Where some colleagues viewed change projects as located within a niche outside theirs, this synergy could open opportunities for reflection on such dominant pedagogies, and encourage pedagogies for sustainability that require transformation into new approaches to education processes (Sipos *et al.*, 2008). This is particularly important in teacher education institutions, whose products are a mass of teachers who are going to replay these same pedagogies in the schools across Botswana. Sipos *et al.* (2008) insist that if our collective goal is for a more sustainable future, we must manifest, encourage and impart values that contribute towards teaching for sustainability. This requires new approaches to education that will move teacher education towards the goal of interdisciplinarity by building bridges between academic fields. Through institutional change projects, the PBL approach proffers opportunities for this, as it provides roles for every stakeholder in the teacher education institution.

Collaboration and support through stakeholder participation

As has been observed in most projects undertaken where stakeholders’ expectations about a project are high and the projects’ sustainability is brought into question (Powers, 2004), we felt an ethical responsibility that effort spent by student-teachers and educators would not

be wasted if we provided the required support throughout the change project cycle from the planning to the evaluation stages. At the outset of the change projects, we collaborated with the Teacher Training Development of the Ministry of Education for support in capacity-building workshops, and the monitoring and evaluation of the change projects. As Lee *et al.* (2014) recommend, for teacher education institutions to experience success with PBL, and for PBL to become more integrated into their curricula, institutional support must be put into place; particularly from key stakeholders like the management of the institution, the Ministry of Education, and other key partners such as (in our case) the University of Botswana. This was clearly evident throughout the change project process, where there was sustained interaction among these key supporting agents and the institutions. At the FCE particularly, where the college principal was very enthusiastic, the barriers and obstacles encountered in the planning and creating stages of the change project were responded to collectively, which motivated the change project team facilitators and student-teachers to sustain their interest in the project.

Conclusion

The change projects seemed to increase motivation and engagement in learning for both educators and student-teachers. Student-teachers were the main beneficiaries, as they participated in and contributed to the change projects. The holistic approach introduced through change projects rooted in their participation connected them to the project activities and helped them view themselves as integral parts of the transformation brought about by these projects. It is therefore clear that PBL, through change projects, positively influences and motivates student-teachers to undertake tasks to solve environmental problems that affect them socially (Genc, 2015).

From these change projects it became clear that ESD for strong sustainability and agency requires educators to understand the interdependence and interconnections between disciplines (Yasin & Rahman, 2011). Hence, subject disciplines at these colleges need to come up with collective projects that will enable them to integrate the various issues and aspects in their various subjects (be they environmental, social, or economic) in order to develop interest in other disciplines (Nation, 2008). The process of learning can be enhanced through the incorporation of the diverse elements of change projects that call for more relevance to the real lives of the college community. Change projects can be used for both the content and its pedagogy, to achieve this objective of transformative and transgressive learning (Lotz-Sisitka *et al.*, 2015) in teacher education.

From this study, it becomes evident that PBL through change projects can offer the organising model (Sipos *et al.*, 2008) that unites pedagogic practices for sustainability within teacher education institutions. This approach provides a valuable bridge for interdisciplinary, practical and project-based sustainability pedagogies across the college subjects for transformative learning environments for student-teachers. However, future follow-ups on these change projects should still be considered, to raise questions about how and why some teacher-educators make the choices they do when implementing or resisting collaborative innovative pedagogies such as PBL, as was evident in the initial phase at the FCE.

While teacher-educators valued increased student participation, it cannot be concluded that they changed, except for those who showed their support of the change projects and participated. Another evident aspect was that, for the success of PBL in teacher education colleges, the value of institutional support from key stakeholders like the management of the institution, colleagues, the Ministry of Education and other key partners cannot be overemphasised.

Notes on the Contributors

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