

In Support of Greening the Economy: How to Enhance TVET's Contribution to the Development of Generic Green Skills

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Abstract

Technical and vocational education and training (TVET) plays a significant role in supporting green economic restructuring and tackling environmental problems through skills development. This paper outlines current theories and some practices related to pedagogy for education for sustainable development (ESD) that can enhance TVET's contribution to generic green skills development. It reviews the pedagogical approaches and strategies commonly used in ESD curriculum to develop students' key sustainability competencies. Following on from this, the paper reports on the results of a pilot study where the researcher observed classes in a TVET institution and interviewed the staffs involved in teaching a generic green module. It also elaborated an ESD pedagogical model developed based on the finding of literature review and the pilot. The study revealed a significant gap between pedagogical approaches put forward in literature and ESD pedagogical practices within the context of TVET. In particular, lecture-based pedagogy observed during the study and the less locally relevant learning content cannot stimulate students' participation and learning motivation. Interviews also identified the challenge for teaching staffs in terms of transforming their role from a teacher-centered approach to the role of facilitator. This pilot study suggested, problem-oriented and project-organized pedagogical framework that includes real-world learning opportunities has potential to enhance the implementation of generic green modules to facilitate the development of students' generic green skills.

Keywords: Green skills, Generic green skills, TVET, ESD pedagogy, real-world problem solving

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Introduction

Challenges faced by humanity have led to the formulation of the concept of sustainable development. As a result, government put in place different measures to insure green restructuring of economy. Therefore, the requirement of innovation and other changes related to green restructuring has an important impact on the labour market restructuring and green skills development.

Since early 2000s, the contributions of **Technical and Vocational Education and Training (TVET)** to sustainable development have been widely acknowledged. UNESCO (2006) identified the significant role of TVET in facilitating green economic growth and its contribution to a sustainable future. Publications on the topic also revealed that TVET has a crucial role to play in **the world of work**, which prepares workforces to consider environmental and sustainability aspects in their professional practice and embrace green technology (e.g. Maclean, 2005; Siriwardene & Qureshi, 2009; Mertineit, 2013; Pavlova, 2015; Baryono, 2017). United Nations (2015) also regarded TVET as a means to achieving sustainability since **TVET almost underpins all the Sustainable Development Goals (SDGs)**.

Furthermore, since 2010, the understanding of TVET's contribution to sustainable development has been broadened, where TVET has started to re-orientate curriculum towards the inclusion of **Education for Sustainable Development (ESD)**. Although positive processes of greening TVET have been observed worldwide, many aspects of its effective implementation were still under-researched (Pavlova, 2016). First, the curriculum related to sustainability has been critiqued as more than a lofty theory, while ESD education requires action "on the ground" that provide opportunities for students to put sustainability principles into practice. However, over the last decade, sustainability education was positioned as "add-on" to disciplinary curricula or campus-based project learning (Brundiers & Wiek, 2011), and limited study has been done to examine how real-world learning opportunities could be integrated and contribute to sustainability education especially within TVET context. Additionally, traditional teaching methods such as lectures, may hardly equip students with required competences to make transition from the classroom to profession (Steinemann, 2003). Moreover, TVET pedagogy has been criticized due to its fails to prepare students with green skills as it utilized relatively uncritical response to industry demands, which tends to focus on fueling productivity, efficiency and economic growth through skills training but ignore the unintended environmental and social consequences (Anderson, 2009; Arenas & Londono, 2013, Bedi and Germein, 2016).

In Hong Kong, the processes and structures to facilitate skills learning through training have been put in place by government and businesses. Training Providers in Hong Kong such as Hong Kong Productivity Council (HKPC), Hong Kong Vocational Training Council (VTC) have provided broad opportunities for skills learning through different training programs (Pavlova, 2016). Green skills have been included in these training programs to some extent since there is a need for developing green economy and a more sustainable future. One of the approaches for introducing green skills in these programs is through developing new learning module that includes green knowledge and reflection on green practice needed for greening economy and society. However, the effectiveness of implementing these learning

modules and equipping students with green skills/ competences¹ has not been well examined. There is hardly any research has been done that focuses on the classroom practices during these modules delivery.

Therefore, this study intended to develop the theories and practice of ESD pedagogical innovation within TVET. It developed an ESD pedagogical model based on the finding of the literature review and a pilot study conducted in a TVET institution in Hong Kong, which aimed to contribute to minimize the gap between pedagogical theory and practice in greening TVET curriculum and enhance TVET's contribution to the generic green skills development.

1 Literature Review: Conceptual Framework

This section clarifies the concepts relevant to this study and identifies the suggested ESD pedagogical approaches and strategies. First, it reviews literature on the understanding of ESD, and conceptualizes the concept of ESD pedagogy based on the clarification of ESD and ESD learning processes. Second, it reviews the definitions of green skills to demonstrate the relationship between sustainability competences and green skills, and lists the classification of generic green skills. Last, it reviews the suggested approaches and strategies related to ESD pedagogy to shed light on the formulation of an ESD pedagogical framework for this study.

1.1 The conceptualization of ESD pedagogy

Commonly, ESD is regarded as a particular way for linking education and sustainable development, although it is described and conceptualized variously regarding to different interpretation of sustainable development and educational ideologies (Corney and Reid, 2007). For instance, UN DESD regards ESD as a sustainable development program, which emphasizes that

*“ESD, must consider the **three spheres of sustainability – environment, society (including culture), and economy**. Because ESD addresses the local contexts of these three spheres, it will take many forms around the world (UNESCO, 2005, p28)*

The World Conference on Education for Sustainable Development (2009) defined ESD as **“an approach to teaching and learning** based on the ideals and principles that underlie sustainability”.

As this study is to explore the ways that how ESD pedagogy could be applied and innovated to facilitate the development of generic green skills within TVET, it defines ESD as a way to link education and sustainable development, which put learning in the center of efforts and initiatives to foster sustainability.

Additionally, there is no specific definition regarding to ESD pedagogy in the literature, and the literature on specific pedagogies for ESD is limited as well

¹ Green skills and competences was used interchanges in this study, meaning that skills are interpreted in a broad sense and include skills, knowledge and attitude that facilitate people to understand the need for a sustainable future and behave accordingly.

(Summers et al., 2005; Corney and Reid, 2007). The ESD Sourcebook (Learning & Training Tools NO.4, 2012) identifies ESD pedagogy as

“... often place-based or problem/issue-based. ESD pedagogies encourage critical thinking, social critique, and analyses of local contexts. They involve discussion, analysis and application of values. ESD pedagogies often draw upon the arts using drama, play, music, design, and drawing to stimulate creativity and imagine alternative futures”. (UNESCO, 2012, p.15)

Similarly, a research that synthesizes the studies carried out in 18 countries to identify the contribution of ESD to quality education also reveals that **ESD pedagogies promote cooperation and collaboration, issues investigation, real-work problem solving from multiple perspectives and equity in the classroom by meeting all student needs**. It further indicates that although many ESD pedagogies has been used in practices within different disciplinary traditions for years, they are now implemented in **interdisciplinary contexts** and applied to **address sustainability issues**. These ESD pedagogies do more on developing learning of skills, perspective and values required for sustainable societies instead of facilitating learning of knowledge (Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C., 2016). It can be seen that these identified characteristics of ESD pedagogy are consistent with the characteristics and key learning processes of ESD reviewed below.

- *Interdisciplinary and holistic*
- *Values-driven*
- *Critical thinking and problem solving*
- *Multi-method*
- *Participatory decision-making*
- *Applicability*
- *Locally relevant*

Source: Implementation Scheme of United Nations decade of education for sustainable development (DESD), UNESCO, 2005, pp. 18.

Additionally, the **key ESD Learning processes** that underpin ESD frameworks and practices were reviewed by Tilbury (2011) as

- *Processes of collaboration and dialogue (including multi-stakeholder and intercultural dialogue);*
- *Processes which engage the ‘whole system’;*
- *Processes which stimulate innovation within curricula as well as through teaching and learning experiences; and,*
- *Processes of active and participatory learning.*

Source: Tilbury, 2011, p. 31.

Therefore, ESD pedagogy can be understood as the **teaching and learning methods and strategies** that facilitate **the implementation of the key learning processes of ESD** in order to equip students with **sustainability competences**. This study use the concept of “ESD pedagogy” to emphasize the importance of transforming the key learning processes of education for sustainable development (ESD) into pedagogical innovation for TVET.

1.2 Conceptualization of Green Skills and the classification of Generic Green Skills

“Green skills” is a relatively new research area with the first publications appearing after 2009. There is a lack of consistency in interpreting green skills in literature (Pavlova, 2016). As this study aims to explore how ESD pedagogy could be applied and innovated to facilitate generic green skills² development within TVET, the nature of green skills and its classification is discussed and conceptualized below.

Green skills are interpreted as

“Technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community” (NCVER, 2013).

Another definition provided by Cedefop (2014) defined green skills as

“Abilities needed to live in, develop and support a society which aims to reduce the negative impact of human activity on the environment”.

The primary definition of green skills identified above reveals, firstly, green skills are proposed based on the concept of sustainability, which highlight the significance of developing sustainable society, economy and environment, though green skills tend to place more emphasis on the sphere of environment. In addition, green skills are regarded as the skills for sustainability in some literatures. For instance, skills for sustainability is considered to be the same as green skills in the policy paper of “The Australian Green Skills Agreement” (Council of Australian Governments, 2012). Acedo (2014) also indicates the relationship between ESD and green skills as *“ESD is at the core of green skills... There can be no sustainable development without education and without appropriate green skills for employability”* (p. 137-139). Secondly, it was emphasized that, green skills should play a major role in the greening of business, industry and community, which raise the challenges for TVET to develop workforce to support greener economy and society. Accordingly, green skills could be regarded as **the sustainability competences that especially require for green growth** (including environmental, social and economic aspects) within TVET context.

Moreover, the CEDEFOP (2010) study articulates what are specific green skills, generic green skills and the necessity of topping-up existing skills. Regarding to the distinction between generic green skills and specific green skills, it is widely accepted in the literature that, the former are **generic/ key/ core competences needed in almost any occupation**, and the latter are **task-oriented competencies required for a specific occupation**(e.g. Rychen and Salganik, 2003; European Commission, 2007; Pellegrino and Hilton, 2012; Pavlova, 2016). However, there is a terminological debate and ambiguity, which associate the term “competencies” with skills, abilities, capabilities, capacities, qualification and other concepts (Baartman et al. 2007; Wiek, Withycombe & Redman, 2011; Pavlova, 2016). This study employs the definition that emphasizes competency as

² Generic Green Skills is one type of green skills, see literature review below.

“knowledge, skills and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems, challenges, and opportunities” (Dale and Newman 2005; Rowe 2007; Barth et al. 2007, cited in Wiek, Withycombe & Redman, 2011, p. 204).

Therefore, green skills could be understood as the knowledge, skills and attitudes (including values) required for developing and supporting the green growth. They were categorized as generic green skills and specific green skills. Specific green skills includes the specific competences required for green industries and the topping-up existing competencies required in all industries. Generic green skills are the “general” competencies required in almost any occupation in order to facilitate the future workforce to understand the green growth issues and increase their environmental awareness.

Specifically, Pavlova (2015) further classifies the identified generic green skills into four categories, namely cognitive competencies, interpersonal skills, intrapersonal competencies and technological skills, based on two approaches (OECD and ILO, 2011; combined and Per capita Report, 2010).

Cognitive Competencies

- Environmental awareness and a willingness to learn about sustainable development
- Systems and risk analysis skills to assess, interpret and understand both the need for change and the measures required
- Innovation skills to identify opportunities and create new strategies to respond to green challenges

Interpersonal Skills

- Strategic and leadership skills to enable policymakers and business executives to set the right incentives and create conditions conducive to cleaner production, cleaner transportation, etc.
- Coordination, management and business skills to facilitate holistic and interdisciplinary approaches that encompass economic, social and ecological objectives
- Communication and negotiation skills to discuss conflicting interests in complex contexts
- Marketing skills to promote greener products and services
- Networking, IT and language skills to enable participation in global markets
- Consulting skills to advise consumers about green solutions and to spread the use of green technologies

Intrapersonal Competencies

- Adaptability and transferable skills to enable workers to learn and apply the new technologies and processes required to green their jobs
- Entrepreneurial skills to seize the opportunities of low-carbon technologies

Technological Skills

- Quantification and monitoring (waste, energy, water)
- Management systems (waste, energy, water)
- Procurement and selection
- Material use and impact quantification
- Impact and use minimization
- Impact assessment
- Risk management

Source: Pavlova, M. (2017) Green Skills as the Agenda for the Competence Movement in Vocational and Professional Education. (pp. 936-937).

1.3 The Identified ESD Pedagogical Approaches

Teaching and learning through **solving actual, real-world sustainability problem** has been suggested as an effective approach to address sustainability competencies in literature (Rowe, 2007, Brundiers et al., 2010, Remington-Doucette, et al. 2012). Most of the ESD pedagogical framework that incorporate real-world problem solving opportunities are developed based on the approach of **problem-based learning (PBL)**, **project-based learning (PjBL)** or **the integration of PBL and PjBL** (e.g. Brundiers, Wiek & Redman, 2009). Thus, the review below focused on elaborating the theory and practice related to PBL, PjBL and the integrated model of PBL and PjBL.

1.3.1 Problem-based learning (PBL)

Problem-based learning (PBL) is widely identified as an effective approach for ESD as it focuses on complex interdisciplinary problems, which provides students the opportunity to gain experience in addressing complex problem that they may face in future professional careers (Steinemann, 2003). It encourages students to work in a team and integrate theory with practice to find viable solution options for the problem, which is assumed as the purpose of PBL approach to professional education (Savery, 2006).

The foundations of Problem-Based Learning are firmly laid on the work of many researchers such as Dewey, Piaget, Bruner and Gagne. It incorporates the objectives of

- *The development of **problem solving ability**;*
- *The development of **self-directed learning ability**;*
- *The integrated structuring of learning within the context of the **graduate's practice**; and*
- *The encouragement of **motivation for learning**.*

1.3.2 Project-based learning (PjBL)

PjBL is a form of situated learning that based on constructivism theory. It indicated that students gain a deeper understanding of learning material when they actively

construct their understanding by working with and using ideas in real-world contexts. (Krajcik & Shin, 2014). PjBL, which interweaves knowledge application and project practice, can help students to consolidate and broaden their understandings (Tempelman & Pilot, 2011), and provides opportunity for students to develop the communication, problem-solving and team-working skills which are needed in their future careers (Elshobagy & Schönwetter, 2002). Furthermore, when students perceived that they are developing the professional skills needed for their future careers, their **learning motivation will be enhanced** (Fang, 2012). This kind of motivation can be sustained through meaningful, real-world problem and projects (Bell, 2010)

Additionally, Pavlova (2015) suggested that, PjBL that helps students to understand ethics and the ways issues can be addressed should play a central role in pedagogical approaches to ESD. Similarly, a pan-European study, which compared sustainability subjects in technology universities, found that the most effective pedagogy for students to learn about sustainable development is a community-based project with collaboration of multiple learners as well as use of a constructive learning pedagogy (Jollands & Parthasarathy, 2013).

However, there is no one accepted definition and model of PjBL. Buck Institute for Education (BIE) as a research and development organization that specialized in doing research on project based instruction, has done a lot of work on effective approach of PjBL. This study intends to using the '**BIE Standards-Focused**' PjBL model (Markham, 2003) as the foundation for further developing ESD pedagogical framework. This standards-based PjBL model was formulated to be accessible and well-structured, which clearly specified six steps that can help tutors or students to plan an effective project, including

- Develop a project idea
- Decide the scope of the project
- Select Standards
- Incorporate simultaneous outcomes
- Work from project design criteria
- Create the optimal learning environment

1.3.3 The Integrative model of PBL and PjBL

ESD has increasingly focused on integrating problem- and project-based approach to create more real-world learning opportunities for students to better understand and address sustainability challenges (Wiek et al., 2013; Brundiers and Wiek, 2013; Kricsfalusy, George and Reed, 2016).

Brundiers and Wiek (2013) explained the aims for combining PjBL and PBL as, first the combination of PBL and PjBL can avoid both the risk of "**getting caught in the knowledge-first trap by endlessly analyzing problems**" and "**jumping prematurely to solutions without sufficient problem framing and analysis**" (p. 1728). Second, it can **expand the engagement structure of PBL through involving stakeholders** in a collaborative learning and critical reflection process instead of only involving stakeholders that act as consultor (Brundiers and Wiek, p. 1728).

Accordingly, at least three approaches that focus on the integration of PBL and PjBL can be identified in the literature.

- **Problem- and Project-Based Learning (PPBL) approach**

PPBL approach is developed based on constructivist and experiential learning, which especially incorporates the approaches of PBL and PjBL (Wiek et al. 2013). It adopts the learning process of **problem inquiry as in PBL** in order to develop solution options for problem solving through **group project**. In these settings, learning shifts from passive to active, wherein students investigate a real-world problem and work on solution options by engaging in small-group work (Brundiens and Wiek, 2013).

In addition, Brundiens et al. (2010) initially proposed the ASU-SOS “functional and progressive” PPBL model for building sustainability competence through effectively and structurally integrating real-world learning opportunities into curriculum.

- **Problem Oriented Project-Based Learning (POPBL) approach**

In addition, another similar approach proposed to address ESD was identified as Problem Oriented Project-Based Learning (POPBL). Yasin & Rahman (2011) indicates,

*“POPBL has to start with **the analysis of a research problem** followed by **the design of the project** to solve the problem through **the implementation of the activity planned** in order to solve the problem under study” (p. 3).*

Four main phases in POPBL approach was suggested as:

- I. Group Formation
 - II. Problem formulation
 - III. Design and data collection (project implementation) and
 - IV. Data analysis and report writing.
- (Yasin & Rahman, 2011, p.3)

- **Problem-Based and Project-Organized Model (Aalborg Model)**

Aalborg Model (Kjarsdam and Enemark, 1994, see Figure 3) is another integrative approach targeted at problem solving through project work. It is a combination of problem-based (meta-concept) and project-organized approach, and formulated as problem-orientation, project work, interdisciplinary, participant directed-learning, exemplary principle and teamwork (Kolmos, Fink and Krogh, 2006).

All the learning activities in this model are finally centered in the process of problem solving, where the learning process are begin with problem analysis and ended in the project work (report/documentation). Aalborg Model has been used in Aalborg University crossing all educational programs, including the sustainability programs such as Engineering Science and Sustainability (Holgaard, 2016).

In summary, PBL and PjBL are combined in an integrated way to provide student with real world problem solving opportunities in order to foster their sustainability

competences. The project work within these ESD approaches/ models mainly plays a role in offering an opportunity for students to address a real world problem and create change in some way, while the problem-oriented/based learning process plays role in facilitating the learning through problem formulation and exploration. In addition, all of these integrative approaches/models have emphasized the importance of interdisciplinary learning, self-directed learning, community involvement and real world problem solving. Nevertheless, they still have some difference. First, PPBL approach, which emphasis outside-classroom settings as a learning laboratory, tends to pay more attention on creating real-world learning opportunities for students throughout different processes. Second, POPBL approach place more emphasis on the characteristic of problem-oriented as it argued problem formulation is the large part of the learning process. Third, the Aalborg PBL model (problem-based and project-organized learning) is originated from PBL approach, which highlights the principle that all the learning activities should be organized centering in problem solving.

Although these models were developed and used mainly in higher education (Bachelor and Master Level) and were not specified to TVET context, they provides important theoretical foundation for the development of ESD pedagogical model for TVET.

1.4 The Identified ESD Pedagogical Strategies

Considering on essential role of pedagogical strategies for effective classroom practices, this section reviews the identified ESD pedagogical strategies used or proposed to be used in ESD related courses to identify their main features.

Tilbury (2011) reviewed approximately 200 articles to understand the processes and learning for ESD in the Phase II of the DESD. The list of ESD pedagogical strategies (**Table 1**, see below) summarized in the Phase II report was adapted from a study (Cotton and Winter, 2010). It revealed the common ESD pedagogical strategies adopted in higher education.

In addition, Lozano et al. (2017) reviewed the pedagogical strategies that can be used in delivering sustainability-oriented course and proposed twelve pedagogical strategies selected from those that have well-cited references in ESD literature or are known to be broadly used. These pedagogical strategies are non-exclusive, with some overlap in techniques among them and a clear potential to use two or more of these educational strategies synergistically.

In summary, all these identified and classified pedagogies strategies could be flexibly used in different ESD learning context. The application of these ESD pedagogical strategies within different ESD learning context should be considered holistically, such as students' characteristics and their previous learning experience about sustainability, the learning objectives set for a specific lesson as well as the learning resources and space provided for sustainability education.

| <i>Pedagogical strategies</i> | <i>Learning process involved</i> |
|--------------------------------------|---|
| Reflexive accounts | Considering their own position in relation to new knowledge about sustainability can help students understand how individual actions contribute to sustainability. This pedagogical approach provides opportunities for learners to reflect on personal roles, attitudes and responsibilities in relation to a range of sustainability issues. |
| Critical reading and writing | Reading and writing are seen by tutors as important social practices and the key to progressing sustainability and literacy. Learners can gain from deconstructing discourses to identify the possible motivation of the author. They may also be able to envisage alternative futures, and write a contrasting account based on differing perspectives. |
| Problem-based learning | Problem-based learning is an iterative learning process that is used to teach a whole range of subject matter. In the context of ESD, a sustainability-related issue may be identified and students asked to investigate this to generate a body of knowledge. They can then develop a vision of alternative actions and potential solutions to the problem, which they use to devise a plan of action. The action may then be carried out, followed by a period of reflection and evaluation. This process promotes both the conceptual and practical aspects of sustainability literacy. |
| Fieldwork and outdoor learning | Research has shown that fieldwork is an example of experiential pedagogy that can influence students' emotions (Sivek, 2002) and help develop the critical thinking skills so essential to understanding the complexity of sustainability (Jones, 2003; Scott and Gough, 2003). Fieldwork for sustainability is often based on issues in the local community and environs, linking theory to real-world examples (Hope, 2009). There is also evidence that outdoor experience is an important precursor to understanding sustainability (Palmer and Suggate, 1996) and promotes learning by encouraging active learning (Hope, 2009). |
| Modelling good practice | Learning also taking place implicitly through the hidden curriculum. The research captured how many educators sought to reduce paper use and turned off lights out at the end of sessions as a means of teaching learners the importance of action-taking. |

Table 1 *Research into commonly adopted ESD pedagogics in higher education – adapted from Cotton and Winter (2010) (Tilbury, 2011, p. 26).*

2 Pilot Study: Conceptual Framework

This section introduces the aims and setting of the pilot study, reveals the problems and challenges identified from the pilot study and clarifies its implications on developing the conceptual framework for this study.

2.1 Introduction of the Pilot Study

This pilot study was conducted in one TVET institution in Hong Kong. It aims to understand how students and teachers respond to a green enrichment module - **Green Knowledge and Practice** involved in this study, including teachers' pedagogical practice, students' participation and the challenges faced by both teachers and students in teaching and learning this module.

This pilot study employed in-class observation and on-site conversation as research methods. The researcher has conducted 4 in-class observations in two different classes, which have covered 3 different topics within the module, including

- Green office/workplace
- Climate change and carbon footprint
- Sustainable development and corporate social responsibility

The researcher also conducted 4 on-site conversations focused on teaching reflections with two teachers after every in-class observation, and 1 formal conversation with team leader to know about the module setting and discuss the observation feedback.

2.2 Identified problems and challenges in teaching this green module

A number of challenges and problems regarding teaching and learning this module have been identified and they are discussed below.

First, the lecture-based and content-centered pedagogical approach, which organized the lessons into one-way knowledge delivery and ignored students' prior learning experience and their learning needs, could not stimulate students' learning motivation and provide the opportunities for them to explore the real-world sustainability issues. In addition, the learning content that arranged based on fixed teaching and learning package, which is less locally relevant and hardly relevant to different students' learning or working experiences, cannot support students to make the connection between learning and practice as well as knowledge acquisition and knowledge transformation.

Second, most of the teachers who deliver this module are primarily responsible for teaching other subjects such as surveying, and not specialized in or familiar with the generic green knowledge and practice as well as sustainability issues which are complex and need to be understood and considered in an interdisciplinary context. In addition, most of students did not have any training or learning experiences related to sustainability issues as well. Thus, it posed a serious challenge for teachers to facilitate the development of students' understanding of the sustainability issues and support students to explore the potential ways to address these sustainability problems at the workplace.

Third, although the assessment scheme has included both continuous assessment and end-of-module assessment, some of the assessment formats such as knowledge-based exams may not be so effective in evaluating students' sustainability competences and the intended learning outcomes. These assessment formats would hardly drive students' learning initiatives and facilitate students to explore the real-world problems

and make a change. The mini-project as end-of-module assessment does not provide students an opportunity to explore the real-world sustainability problem since the guidance, supervisions and learning resources provided for students are not sufficient. However, these identified challenges are not only faced by the TVET institution in Hong Kong, it seems to be the common issues in sustainability education. For instance, Remington-Doucette et al., (2013) identified the challenge for implementing the sustainability-related introductory course in a university as

“students’ lack of basic knowledge, skills, and understanding of sustainability concepts and methodologies and a dearth of instructor capacity for coordination, supervision, and facilitation of a large number of real-world projects each semester.” (p. 411)

Similarly, it indicates that students are lack of learning ability, prior learning experience and knowledge related to sustainability, and the instructors’ capacity for supporting students’ project learning and fulfilling students’ learning need in sustainability are insufficient as well.

2.3 The Implications on developing the conceptual framework

This section focuses on the implications of the pilot study on the development of the conceptual framework for this study and it includes aspects of teaching content, pedagogy, assessment and intend learning outcomes.

Teaching Content

- 1) Campus-based curriculum. There is a need to make full use of the campus recourses to develop curriculum. The workplaces on campus could be also considered as real-world learning recourses.
- 2) To use students’ prior learning experience to generate the learning content. This may turn a perceived disadvantage of “students’ background are varied” to an advantage that use different backgrounds as a source for cross-disciplinary learning.
- 3) The learning content could be reoriented to be more locally relevant through utilizing of local cases to organize learning activities and lead students’ discussion.

Pedagogy

- 1) Constructing learning environments based on learner-centred approach, and employing the pedagogical strategies, which could encourage students’ participation and stimulate their learning interest, such as
 - Participatory/collaborative learning
 - Problem-based learning
 - E-learning technologies
- 2) Making the connection between this generic module and students’ major subject by individualized learning or inquiry-based learning within a small group.
- 3) Integrating characteristics of Education for Sustainable Development (ESD) into the pedagogical practice.
- 4) Creating more learning resources for students by cooperating with industry’s experts and inviting them to share some experience / ideas about sustainability: how do they deal with environmental issues on response to green economy restructuring.

Assessment

- 1) Employing formulate assessment to encourage more class participation. Part of the assessment could be allocated as students' presentation on a specific topic and group discussion on sustainability.
- 2) Learning portfolio could be used for reporting the project progress at least once a week, so that more guidance could be given based on students' reflection and the quality of the project learning could be maintained.
- 3) Evaluation of students' learning outcomes should base on a more systemic competence framework, which clearly specified green knowledge, attitude and skills that students expected to have.

In summary, this pilot study helped to identify the problems and challenges in implementing green generic modules and formulate an approach towards developing an ESD pedagogical model to facilitate the effective implementation.

3 Preliminary ESD pedagogical model: Problem-oriented and Project-based Learning

This section clarifies the components of the Problem-oriented and Project- organized pedagogical model (POPOL) and illustrates the pedagogies strategies and learning activates within POPOL's four learning phases.

3.1 Problem-Oriented and Project-Organized Learning Model (POPOL)

The preliminary ESD pedagogical model – **Problem-oriented and Project-organized Learning (POPOL)** (Figure 1, see below) was developed based on the findings and reflections from the pilot study and the literature review.

The literature review has revealed the significance of learning through real-world problem solving and solution generating for developing students' sustainability competences. The identified ESD pedagogical models also have a common focus on examining the ways to include real world leaning opportunities and implementing ESD through real world problem solving. However, the pilot study conducted in a TVET institution in Hong Kong indicates that it would be unrealistic to provide students with real world learning opportunities in this green enrichment module.

Thus, this POPOL model was developed to address the gap between approaches suggested in literature and practical situation of the TVET institution, which intend to create real-world learning opportunities through bringing the real-world sustainability problems into classroom and facilitating students to connect the identified sustainability issues with their previous and current learning and working experiences. It places more focus on learning through real-world problem solving instead of learning in the real-world setting. In this way, classroom learning will act as a bridge to connect real-world sustainability problems with students' real-world learning and working experiences based on their individual and industrial context, and to transfer the process of knowledge acquisition to knowledge application for problem-solving inside and outside classroom.

The POPOL model emphasizes three major points:

- (1) It integrates the pedagogical approach of **problem-oriented** learning (POL) and **project-organized** learning (PjOL). POL places emphasis on learning through identifying, formulating and exploring the sustainability problems. Here “problem-oriented” refers to designing and organizing the learning contents and activities based on specific sustainability problems, and using problems to drive students’ learning motivation, while PjOL focus on organizing learning through group projects that focus on proposing solution options for or even solving the real-world sustainability problems. It is a learning process that takes place among the elements of personal learning, collaboration and problem solving.
- (2) It includes the real-world learning opportunities into students’ learning through four progressive processes (adapted from Brundiens et al., 2010). The processes of “Bringing the world in” and “Stimulating the world” mainly aim to prepare students with necessary knowledge and skills to further explore the real-world problems, while the processes of “Visiting the world ” and “Engaging with the world” principally aim to encourage students to apply the knowledge into their learning and working context. However, the learning processes for “knowledge acquisition” and “knowledge application” are not fixed. For instance, visiting and engaging with the world can also facilitate the knowledge acquisition. Here place emphasis on knowledge acquisition through “Bringing the world in” and “Simulating the world” is to emphasize the importance of preparing students with knowledge and skills to further engage in real-world problem solving. More specific learning objectives and learning activities for each learning phases are illustrated in table 2.
- (3) It emphasizes that the design of pedagogical strategies, learning contents and learning activities should facilitate students to understand the local issues in a global context and recognize that the solutions to local problems can have global consequences, vice versa. In addition, it should also encourage students to connect their individual and industrial experiences with the identified issues in order to simulate the engagement in real-world contexts.

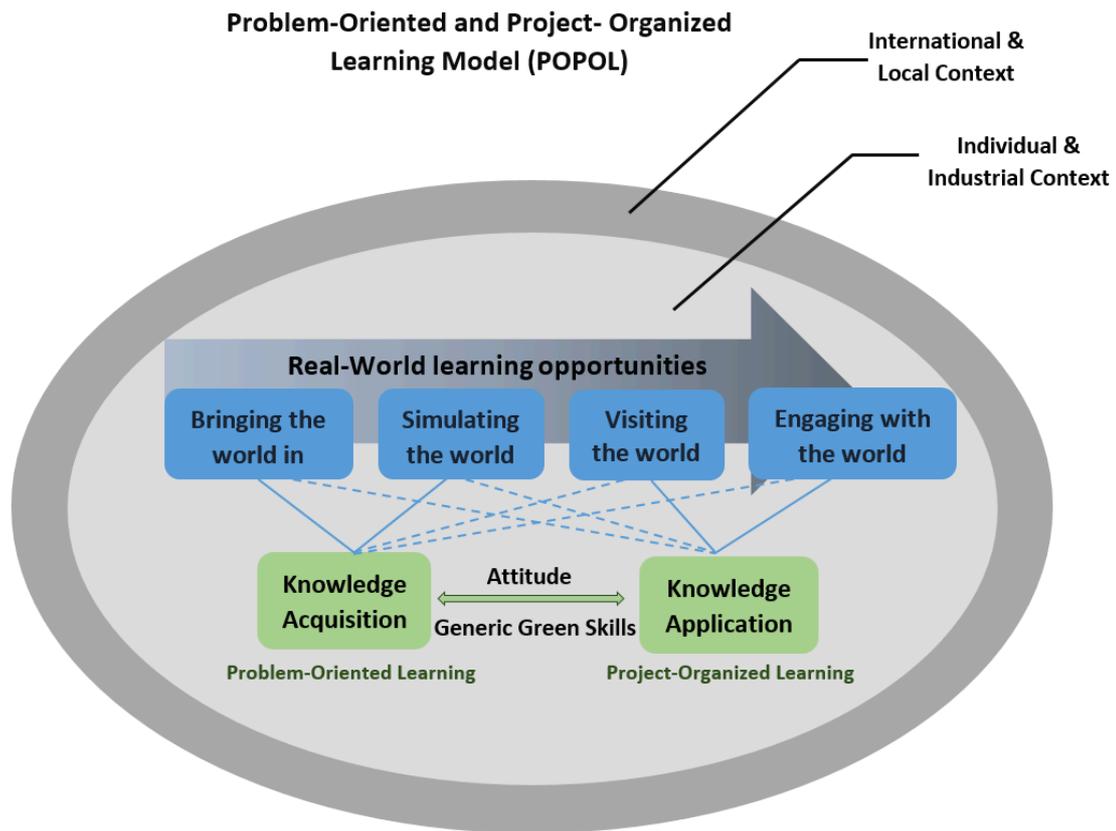


Figure 1 Problem-oriented and Project-organized Learning Model (POPOL)
Source: Author

3.2 Suggested pedagogical strategies and learning activities based on POPOL model

The pedagogical strategies and activities in table 2 are suggested based on the review on ESD pedagogical strategies and the consideration of the learning setting within the involved TVET institution. Each pedagogical strategy suggested in the framework is based on specific learning objectives and their corresponding green skills within different learning phases. Both pedagogical strategies and learning activities can include additional forms of learning, which provide ESD learning opportunities for students and encourage them to engage in the exploration of sustainable development issues.

| Learning Phases | Learning Objectives | Generic Green skills | Pedagogical Strategies(e.g.) | Learning Activities(e.g.) |
|--------------------------------|---|---|--|---|
| Bringing the world in | <ul style="list-style-type: none"> • Identify and formulate the real-world sustainability problems; • Understand the key concepts and current situation related to the identified issues. | Cognitive competence | <ul style="list-style-type: none"> • Lecturing • Case study (problem-oriented) | Draw a concept map; Analyze the critical incidents within international and local context (e.g. compare different solutions). |
| Simulating the world | <ul style="list-style-type: none"> • experience the dynamics of communication; • Learn how to deal with various perspectives and conflict resolution. | Cognitive & interpersonal skills | <ul style="list-style-type: none"> • Stimulus activities/ discussion • Debates • Peer-review activities | Reflection on related videos, photos and documents |
| Visiting the world | <ul style="list-style-type: none"> • Connect students' learning and working experience to the identified issues. | Intrapersonal & interpersonal competencies | <ul style="list-style-type: none"> • Group discussion • Case study (Industrial context) | Poster presentation (present a real-world sustainability problem explored in the group project); |
| Engaging with the world | <ul style="list-style-type: none"> • Propose potential solutions and strategies for the identified issues | Cognitive, Technological & interpersonal skills | <ul style="list-style-type: none"> • Group project | Interview Questionnaire Field- observation |

Table 2 Pedagogical Design framework for classroom practice

Source: Author

Conclusions

In summary, the study has reviewed the relevant key concepts and identified the gap of ESD pedagogical approaches and strategies, which identify the lack of ESD pedagogical study in TVET context and the gap between approaches suggested in literature and practical situation in universities and institutions. Moreover, it illustrated the findings of a pilot study and revealed its implication on intervention planning, which together with literature review to facilitate the formulation of a theoretical framework for a preliminary ESD pedagogical model.

This study has a potential to contribute to both the theoretical and practical developments related to the use of ESD pedagogy for developing generic green skills in the TVET. It enriches an understanding of ESD pedagogy and its role in facilitating effective implementation of green modules and developing students' generic green skills. It also responds to the research gaps by providing empirical evidences on employing ESD pedagogy in TVET context. However, the data collected for this pilot study may be not rich enough since the pilot study was conducted only in one institution. In addition, based on the findings, a subsequent study will focus on exploring the ways on how the developed ESD pedagogical model can contribute to greening the curriculum within TVET institutions.

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