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MANAGING STUDENT DIVERSITY FOR SUSTAINABILITY

EDUCATION IN HIGHER EDUCATION SETTINGS

(高等教育の場におけるサステイナビリティ教育のための学  
生の多様性活用)

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**MANAGING STUDENT DIVERSITY FOR SUSTAINABILITY  
EDUCATION IN HIGHER EDUCATION SETTINGS**

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MANAGING STUDENT DIVERSITY FOR SUSTAINABILITY  
EDUCATION IN HIGHER EDUCATION SETTINGS

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Dedicated to my beloved family,  
especially to my parents and parents in law who trust me unconditionally

## Abstract

Sustainability science and sustainability education have emerged as the need for them is rising in tackling with numerous complex issues of the modern world. The research argues that higher education should be the place where dialogs about sustainability are discussed by multiple perspectives and through the lens of different cultures. Therefore, the presence of various academic and cultural backgrounds, or diversity of students, plays an important role in advancing students' learning outcomes such as their communication skills, active thinking capacity or knowledge about democracy and real society. This study extends the researcher's prior work on examining the relationship between diversity of students and sustainability education by identifying proper pedagogical approaches for class instructors to nurture diversity as an internal strength in this education. Arguing that without proper attention and methods, the presence of structural diversity itself does not guarantee meaningful interactions among students, the dissertation aims at two goals within the scope of sustainability education: (1) to understand the mechanism of how diversity of students is beneficial and crucial to sustainability learning; and (2) to identify pedagogical/andragogical methodologies that could help taking advantage of diversity, which is assumed to have already existed.

Sustainability education in previous researches is featured as a context-based T-Shape discipline with lots of expected outcomes for learners, especially the ability for one to transform and change the society. We also learn that diversity of a group greatly affect members' efficiency through the theories of self categorization, similarity-attraction and information/decision making. Among a number of popular learning theories in higher education, constructivism and connectivism have mentioned the significance of the interacting environment (i.e. fellow learners or peers), which can possibly link the student diversity to enhancing the performance of such a transdisciplinary scheme. Besides, the needs for diversity is clearly stated in the viewpoint of four pillars by Delors (learn to live together) and multiple intelligence by Gardner (all types of intelligences, learning styles, skills are valued equally). It may be possible to clarify this by a profound study on real practices in higher education courses.

Therefore, a mixed triangulated methodology which includes a questionnaire survey (45 detailed responses from the network of ESDA, ACE, ICSS, IR3S and ProSPER.net) followed by five deep interviews with selected experienced teachers was conducted. The case study of IPoS, UDS, APIEL, UTokyo and especially an intense action research in Vietnam are materials for analyzing teaching methodologies applied in reality. Research tools involve Survey Monkey (for data collection), Excel and MaxQDA (for data analysis).

By asking about thirty questions of three categories: instructors' experience, attitude; their know-how and skills and their personal information, the questionnaire revealed different ways of valuing the diversity. There are three types of pedagogical approaches observed: constructivist, behaviourist and connectivist techniques. Looking at the three case studies of IPoS, UDS and APIEL which intentionally involve a great heterogeneity of learners, we find that their successful factors lie under the mix of disciplines and continuous efforts of educators. Interesting observations were also recorded when comparing feedbacks of students (in UTokyo case) in two discussions of more and less diversity. With changes in pedagogical components, that were suggested in the earlier stages, to apply at Vietnam National University, from a classical classroom (teacher-centered) to more learner-centered, collaborative, reflective (constructivism) and exchanged (connectivism) method, learners get better ideas of what sustainability science is by interrelating their prior experiences while learning.

Results show that student diversity is not the core reason for individual's failure or dissension. Adverse effect of diversity impact the education in the way that, it is common to remember conflict and disagreement longer and deeper than smooth problem solving process or relationship. According to information/decision making theory, diverse group has more profound and thorough working outcomes as group members tend to acquire the information from those in their own connection based on similarity. Although culture and personality diversity is valued roughly equally in the quantitative survey, their contribution to students' learning is not as obvious as diversity of academic background.

Multiple intelligence, information/decision making, constructivism and connectivism are recommended for class instructors when working with student of diverse backgrounds. Learners of higher institutions are considered to be adults and desire a self-direct learning rather than the traditional instructing methods. They are motivated by having more autonomy and interaction; insightful guidance; and award/rule. Those self-directed learning helps students to build their own knowledge structure (vertical T) and collaboration with various entity and experiences help enrich spacial understanding (horizontal T). In order to be prepared to tackle with future uncertainty, indigenous knowledge is also a valuable source for learning sustainability. In correspondence with lecturers' efforts, the role of students is to affirm their positions as a knowledge contributor (to class content) and active connector (with classmates). Last but not least, taking the most advantage of student diversity require both teachers and learners constructing and remaining alumni's network. Learning sustainability is not anymore simply the practice of receiving knowledge but it occurs just when we have diversity of opinions and ability to see and form connections between fields, ideas, concepts, according to the theory of connectivism.



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The production of this thesis is a long journey that I have more than once thought of giving up in the middle of the way. However, for roughly four years with so much encouragement from professors, staffs, friends and family; and especially great financial support from the Japanese Government and the University of Tokyo, rewinding is hardly possible.

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# Nomenclature

AASHE	Association for the Advancement of Sustainability in Higher Education
ACE	The Asian Conference on Education by IAFOR
AIT	Asian Institute of Technology
APIEL	Asian Program for Incubation of Environmental Leaders
CSF	Critical success factors
EE	Environmental Education
EFS	Education for Sustainability
ESD	Education for Sustainable Development
ESDA	Education for Sustainable Development in Africa
GMU	George Mason University
GPRD	Greater Pearl River Delta
GPSS-GLI	Graduate Program in Sustainability Science - Global Leadership Initiative
ICSS	International Conference on Sustainability Science
IPoS	Intensive Program on Sustainability
IR3S	Integrated Research System for Sustainability Science <sup>1</sup>
ISSS	International Society for Sustainability Science
MDGs	Millenium Development Goals

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<sup>1</sup> In this research, IR3S is used in parallel with SSC, indicating the same group.

## **NOMENCLATURE**

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MEXT	Ministry of Education, Culture, Sports, Science and Technology
NITE	National Institute of Technology and Evaluation
ProSPER.Net	Promotion of Sustainability in Postgraduate Education and Research Network
SDGs	Sustainable Development Goals
SE	Sustainability Education
SSC	Sustainability Science Consortium
TTFPP	Third Trimester Field Practical Programme
UDS	University for Development Studies (Ghana)
UNDESD	United Nations Decade of Education for Sustainable Development
UNESCO	The United Nations Organization for Education, Science and Culture
UTokyo	The University of Tokyo
VNU	Vietnam National University

# Chapter 1

## Introduction

### 1.1 Problem statement

The twenty first century has witnessed the increasing degradation of the environment due to too much damage against the needs for economic growth. Global warming, ozone depletion, loss of biodiversity, acid deposition, desertification, overpopulation and resource intensive consumption (Schmandt and Ward, 2000) have worsen the poverty of people in the Third World, who have little knowledge about livelihood rather than exploiting natural resources, and also affected the well-being of millions. Worse still, overpopulation may result in famine, disease, war and other social problems in the long term (Malthusian catastrophe). Sustainable development is therefore an urgent need, a 'do or die' movement that was triggered since the emergence of concern for natural resources limit and carrying capacity of the earth. Years of 1960s observed salient works and stories on serious pollution (Silent Spring, DDT controversy, Population Bomb). Following were the voice of the Club of Rome with Limits to Growth and Stockholm Conference on Environment and Development, which called for a development that takes environmental protection in sound consideration, in 1972. In 1980, the International Union for the Conservation of Nature and Natural Resources (IUCN) presented the World Conservation Strategy (WCS) the overall aim of achieving sustainable development through the conservation of living resources and then the official definition of sustainable development was coined in 1987 in the World Commission on Environment and Development (WCED). Since then, sustainable development has been flourished in a number of forms (such as sustainable goals, sustainability science, or sustainability education), and continuously been mentioned in international meetings such as Earth Summit (1992), UN Commission on Sustainable Development (1993), Kyoto Protocol (1997), World Summit on Sustainable Development (2002), and series of COP (Conference of the Parties). In the 1987 United Nations World Commission on Environment and Development, we once expected sustainable

## 1. INTRODUCTION

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development to be achieved by 2000. From the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), worldwide nations have progressively expressed deep concern about how to balance the growth with other social and environmental factors. However, it is considerably hard to foresee the realization of the SDGs even in 2030 unless researchers and policy makers strongly work on a global strategy to raise people's awareness and behaviors. Only the power of education could mobilize all available resources for making this proposal happen.

In the last two decades, nations worldwide have been observing increase in both diversity and recognition of diversity in many fields, including education (Banks and Banks, 2009). "The world's increasing social and cultural diversity, often characterized by extreme race-ethnic disparities, requires higher education institutions to become more responsive to diversity and inclusive of difference" (Allen et al., 2006).

In the Tremblay et al. (2012), it is said that:

A number of global trends have shaped the development and wide-ranging mutations of higher education over the past half century. Higher education today is characterised by massive expansion and wider participation; the emergence of new types of institutions (vocationally-oriented and private providers); more diverse profiles of institutions, programmes and their students; broader adoption and more integrated use of communications and educational technologies; greater internationalisation, competition and signalling mechanisms; growing pressures on costs and new forms of financing; as well as new modes and roles of governance, including increasing emphasis on performance, quality and accountability.

Due to the nature of sustainability (Kajikawa, 2008; Kates, 2011; Komiyama and Takeuchi, 2006), the inter-connected complexity cannot be solved dispersedly by certain expertise or at certain location. The research argues that higher education should be the place where dialogs about sustainability are discussed by multiple perspectives and through the lens of different cultures. This leads to the search for diversity of students, which has been emphasized as an important factor in improving education for decades, such as in Ely (2004); Gurin et al. (2002); Piland et al. (2000).

Previous researches (Dan, 2011; Dan and Mino, 2016) have fostered the debate on whether student diversity is significant in education for sustainable development or not, mostly drawn on the perspective of the students. It is affirmed that diversity of students is greatly beneficial for sustainability education although dissatisfaction in fact existed due to conflict in worldview, ideas or the way of explaining a problem. However, evidences also show that student diversity is not the only impacting factor. It is recorded from interviews with students that:

- *Sometimes I feel even though professors do not understand what is sustainability. I like studying with students with different background, but I have not satisfied with the classes in sustainability course.*
- *Sometimes it [difficulty that student met in a diverse class] was more because of the relation with the professors and how that shaped our relations*
- *Professor also need to have a interdisciplinary mindset, and not just stick to their own field if they must teach in the course*
- *Discussions' topics are most of the time too technical to understand*

In other words, structural diversity can be beneficial to the education but definitely not the fully sufficient condition for desired outcomes. Merely adding diverse people to a homogeneous environment does not automatically create a more welcoming and intellectually stimulating campus as diversity is just a means of achieving educational and institutional goals (Fine and Handelsman, 2010). Teachers are believed to be key persons in leading to an effectively learning but if they do not best employ student diversity, that might be a waste of resource. Questions like “What is the role of teachers or instructors in managing the class environment? Have they realized and taken the fullest advantage of the diversity? How to make use of diversity in class to the best extent possible? How to reduce the negative sides of the diversity? Or what is the limit of diversity of students to ensure the effectiveness of the learning outcomes? How to best apply the Systems Analysis for such a qualitative and long-lasting issue like education of Sustainability Science?” helps forming other research problems. A Master’s student at The University of Tokyo, “*I think the problem of sustainable program is not the diversity of students, but the concept of sustainability itself and the structure of the program. I mean the importance of the academic, sustainable science itself*” leads the way to initiating this treatise’s theme.

Approaching the issue of managing diversity, Cotton et al. (2007); Erkilic (2008); Hopkinson and James (2010); Redman (2013) are some of limited work that have discussed the pedagogy and instructing strategy in sustainability education but none of them mentioned the presence of various academic and cultural backgrounds or how to be effective in that environment concretely. This study extends the researcher’s prior work on examining the relationship between diversity of students and sustainability education by identifying proper pedagogical approaches for class instructors to nurture diversity as an internal strength in this education.

### 1.2 Objectives and presumptions

#### 1.2.1 Objectives

The dissertation aims at two goals within the scope of sustainability education: (1) to understand the mechanism of how diversity of students is beneficial and crucial to sustainability learning; and (2) to identify pedagogical/andragogical methodologies that could help taking advantage of diversity, which is assumed to have already existed.

Arguing that without proper attention and methods, the presence of structural diversity itself does not guarantee meaningful interactions among students, the dissertation targets in answering three sets of questions:

**Q1** What is the current instructing/teaching methodology for sustainability education? What does teaching sustainability mean and how has diversity been considered in teaching sustainability?

**Q2** What are the factors that lead to the success/failure of a practical program on sustainability that introduces diversity of students? How does student diversity impact the learning?

**Q3** Pedagogy of what educational theory or philosophy (Ashworth et al., 2004; Pritchard, 2009) could be best applied in dealing with diversity to improve the positive impact and effectiveness of having various disciplines and cultures in sustainability learning?

#### 1.2.2 Presumption

- Student diversity already exists in the classroom. What we need to study is how we could prove the importance of it in sustainability education and how to nurture it.
- Higher education faculty working in various fields could be valuable sources in giving hints and inputs for answering research questions.
- Due to limited existence of available sustainability programs for research, we assume that working on multiple typical case studies, at the same time as conducting survey and interviews can mutually complement and enrich the findings.
- By choosing some classes to apply the methodologies, results could be verified in reality.



## 1.3 Prospective contributions

**To the educators- class instructors** This research is hopefully a pedagogical material for the lecturers in sustainability courses. Firstly, it could make them realize the importance of having diverse academic background and culture so that they are optimistically prepared for both benefits and challenges brought by diversity. Then the suggestions provided by the end of the treatise could possibly help them to enrich their lectures by fully utilize the strength in each learner's background. All would results in better understanding about and better trained skills for sustainability.

**To the school leaders, curriculum designers, policy makers** For those who do not directly interact with students in classes, results of this research might contribute to the way the curriculum is designed and developed; the teacher/student are recruited; and how they could best collaborate with teachers in promoting diversity in sustainability education.

**To current literature** There has been relatively little research into the relationship of sustainability education and diversity. Although it seems that the benefit diversity could bring to the education is obvious and easy to accept, a logical, empirical way of explaining the linkage has not been well grounded. How we could mobilize student diversity as a collective power for the education, and then for a more sustainable society; as well as why we need more secured connection of different academic fields since school period would be clearly demonstrated.

## 1.4 Thesis structure

The Introduction chapter (Chapter 1) gives readers the whole picture about the research: why research problem is raised; the aim, hypothesis, scope and the originality of the treatise. Chapter 2 will be describing all key terminologies related to the research theme, such as sustainability (including sustainable development, sustainability science, sustainability education), diversity (multiple aspects of diversity and the impact in education), pedagogy/andragogy and learning theories. Chapter 3 guides readers to the theoretical methodology (qualitative research, case study, lesson study) and the rationale of each method. Steps of conducting each phase are also addressed in this chapter. Chapter 4 shares results respectively in five components of the study: questionnaire, interview, case study, comparative study and action research (lesson study). Analysis of the collected data will be discussed in Chapter 5, in parallel with evidences presented in Chapter 4. Discussion will cover three points: (1) the meaning of teaching and learning sustainability in this research context; (2) the significance of student diversity in sustainability education and its

## 1. INTRODUCTION

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mechanism in benefiting the education; and (3) how we could make the diversity more meaningful and the interaction more fruitful after learning about the point number (2). Chapter 6 concludes the research by restating main points that are relevant to the initial objectives. Limitations and fields for further research are also to be reported.

## Chapter 2

# Review: Sustainability, Education and Diversity

## 2.1 Sustainable development and sustainability education

### 2.1.1 Sustainable development: From MDGs to SDGs

#### 2.1.1.1 Sustainable development - an oxymoron

Sustainable development (SD) is a normative concept, which has been popularized since the launching of Brundtland Report from the United Nations World Commission on Environment and Development (WCED) in 1987.

Humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

or in other words, SD is an eco-development:

That development is about progressive transformation of economy and society...within the bounds of ecological possible.

However, that catchphrase contains minimum meaning or guiding about the practice of sustainability. Throughout the time, the notion of sustainable development has been learnt in various way. Mebratu (1998) arranges the understanding about sustainable development through three categories: institutional version, ideological version and academic version. Each version has its own way of breaking down SD and here are the popular viewpoints.

**The notion of two components:** Some groundwork on SD talk much about the two components: humans' needs and limitations, decided by life support systems of the earth.

## 2. REVIEW: SUSTAINABILITY, EDUCATION AND DIVERSITY

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Sustainable development is first understood as ‘a development that can be continued’, comprising of two parallel actions (sustaining growth while achieving traditional objectives and ecological sustainability) and based on three premises (environmental degradation, traditional development objectives and participatory process) (Lele, 1991). Sustainable development could be reached when environmentalists and development activists seriously co-work to jointly tackle emerging problems. The notion of two components is not on many recent discussions for the obvious fact that it lacks important factors like culture, human’s welfare or social equity although they anyhow underlie either environment or development component.

**The notion of three components or triple bottom line:** The three-component perception receives widest acceptance. It calls for the balance or trade-offs of economic (or ecological, biological), social, environmental objectives. Various shapes of illustration have been developed: the Venn model (three independent circles come together to share the common piece of ‘sustainability’), pillars (sustainable development is at the keystone of a structure resisted by three columns), nested model (cosmic interdependence with systemic cosmos inside others) (Mebratu, 1998). Other imaginable shapes like ‘Mickey mouse’ model (economy is the face of Mickey mouse while his ears are environment and society circles) or three-legged stool or the wheel are also employed for representing SD. Three-component diagrams are mostly used by United Nations and other related offices such as UNESCO or UNDP. In some occasions, it is translated to 3Ps: Profit, Planet and People for catching more attention of the public. Victor Anderson, a Senior Policy Officer for One Planet Economy at WWF-UK, criticized that by promoting this model, the wrong ‘sustainable development’ is being taken as it seems that we are pursuing a continuous development while keeping an eye on the environmental limits. “We should be aiming at development which combines economic, social, and environmental aims, not at development which compromises between them” (retrieved on August 6, 2015).

**More components:** Goals of food securities, energy, population or politics/governance are also added as the forth pillar/realm. In some versions, sustainable development is the central target surrounded by many supporting factors such as social, cultural factors, governance, services, economy, etc. This type of diagram varies depending on the use purpose of each institution. For example, James (2015) interprets sustainability process into a circle with multiple layers divided into four parts: economic, ecology, culture and politics. Each part is indexed by a list of indicators valued from vibrant, good to bad and critical in the circle of sustainability, the material of which is widely used by branches of the United Nations. Regarding economic factor, it involves production-resourcing, exchange-transfer, accounting-regulation, consumption-use, labor-welfare, technology-infrastructure, and wealth-distribution. Pawlowski (2008) mentions seven spheres that

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are related to moral, ecological, social, economic, legal, technical, political dimension in a hierarchy relationship and the author stresses much on the ethical aspect rather than the three basic domains.

**Criticism:** Sustainable development is obviously an oxymoron, like us saying phrases “ground pilot” or “more is less”. In the world with limited choices to make, what do we really want to: keep the world as it is or help humanity be more prosperous? Sustainable development’s answer is: we want a better world with progress made (as ‘development’ is the central word of the phrase) while keeping an eye on other factors to balance among us and with the nature. To a few conservative scientists, the response sounds too contradictory to be realized.

Sustainable development has weaknesses in justify the casual relations. For example, the connection of poverty and environmental degradation is not that straightforward: it involves other factors like (wrong) technology application, overconsumption due to culture/value or access to the resources.

There are also beliefs that terminologies related to sustainability should not be defined concretely as in many cases the value of it lies in its vagueness (Lele, 1991). One of the reason regards the handiness for development practitioners (Holmberg and Sandbrook, 1992) and a general definition is powerful as it could be apply to a broad variety of contexts (Hopwood et al., 2005).

### 2.1.1.2 Millennium Development Goals: a founding infrastructure of SD

United Nations Millennium Development Goals (often referred to as MDGs<sup>1</sup>), are eight points agreed by all 189 member states after the Millennium Summit in 2000 to achieve a better life, especially for the world’s poorest by 2015. Those goals are corresponding to eight chapters in the Millennium Declaration, addressing the interlinked challenges of

1. Eradicating extreme poverty and hunger;
2. **Achieving universal primary education;**
3. Promoting gender equality and empower women;
4. Reducing child mortality;
5. Improving maternal health;
6. Combating HIV/AIDS, malaria, and other diseases;
7. Ensuring environmental sustainability; and
8. Developing a global partnership for development.

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<sup>1</sup><http://www.un.org/millenniumgoals/>

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MDGs are reported to United Nations' members (2015) that it aims to “lift more than one billion people out of extreme poverty, to make inroads against hunger, to enable more girls to attend school than ever before and to protect our planet” and are recorded improvement in all goals although remains uneven and simplified (Fehling et al., 2013). The authors also believes in a better framework after 2015 that can overcome those criticisms.

### **2.1.1.3 Sustainable Development Goals: new plan for the changing SD from 2015**

By completing the MDGs in 2015, the United Nations, as stated by Secretary-General Ban Ki-Moon, “are forging a bold vision for sustainable development, including a set of sustainable development goals”. That set of Sustainable Development Goals (SDGs), the outcomes of the 2012 United Nations Conference on Sustainable Development (Rio+20), is another step towards worldwide sustainable development after the MDGs that converges with the Post-2015 Development Agenda until 2030.

A newest report to the Secretary-General of the United Nations by the Leadership Council of the Sustainable Development Solutions Network (2015) explains each goal quite carefully at a Special Summit on Sustainable Development. The committee of United Nations unanimously approved 17 goals for sustainable development pathway:

- Goal 1. End poverty in all its forms everywhere;
- Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture;
- Goal 3. Ensure healthy lives and promote well-being for all at all ages;
- Goal 4. **Ensure inclusive and equitable quality education and promote life-long learning opportunities for all;**
- Goal 5. Achieve gender equality and empower all women and girls;
- Goal 6. Ensure availability and sustainable management of water and sanitation for all;
- Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all;
- Goal 8. Promote Sustained, Inclusive and Sustainable Economic Growth, Full and Productive Employment and Decent Work for All;
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation;
- Goal 10. Reduce inequality within and among countries;

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- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable;
- Goal 12. Ensure sustainable consumption and production patterns;
- Goal 13. Take urgent action to combat climate change and its impacts;
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development;
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; and
- Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

At this time of this writing, those items are still in the process of debating and refining.

While MDGs aim at the poorest communities to somehow leverage the gap between nations, SDGs enlarge the scope to “all”, a redundant in almost every goal, to emphasize on an uniformly change in behaviors and actions globally. New goals, such as of climate change or protecting the ecosystems, are added, or in other words, the target of “ensuring environmental sustainability” is now streamlined in a more perceivable way. SDGs are even bolstered up with package of indicators (see The Leadership Council of the Sustainable Development Solutions Network, 2015).

Educational goal changes in the same way as MDGs to SDGs (Goal 2 to Goal 4). From stressing on to popularization of primary education only, Goal 4 extends to pre-school or early education throughout tertiary education, indexed by rates for girls and boys. Although the indicators do not make the point of “life-long education” clear enough, it is a sign of realizing the substantial role of education in sustainable development in this new era, as it is mentioned in the Muscat Agreement:

By 2030, all learners acquire knowledge, skills, values and attitudes to establish sustainable and peaceful societies, including through global citizenship education and education for sustainable development

(in another version, it is printed with “promotion of a culture of peace and nonviolence, global citizenship, and appreciation of cultural diversity and of culture contribution to sustainable development”).

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### 2.1.2 Sustainability science

**Sustainability:** We first come to know ‘sustainability’ through the needs for sustainable development, an inevitable process in economics when carrying limits are almost reached. When no ‘development’ attached, the noun becomes more inclusive, literally meaning the ability of something to be sustained. It is not only referred to as a reoriented growing pathway of an economy but embedded in a wide variety of contexts. In (already) developed countries like Australia (Tilbury and Cooke, 2005), the term sustainability has gained greater popularity than ‘sustainable development’ as it is seen as more relevant to their status of development. Some perceive sustainability the systems to be maintained indefinitely with certain limits (Voinov and Farley, 2006), the capacity to endure (Mark Bittman in New York Times), doing things in such a way that you could continue doing them in that way forever (David Friedman, Santa Clara University). Many have tried to redefine sustainability by adjusting the principle of three pillars like sustainable design (design objects to comply with social, economic, environmental sustainability), sustainable community (the community that is economically, environmentally, and socially healthy), or corporate sustainability, sustainable resources and so forth.

Sustainability is fashionable but often appears without being mentioned about the originality as long as it suits the users’ particular applications, goals, priorities, and vested interests (Voinov and Farley, 2006; Vos, 2007). Sustainability is even criticized to be almost ‘meaningless’ (Ozimek on Forbes). Hence, authors like Sutton (2004) suggested to approach the reverse, ‘unsustainability’ first. Any activity that is harmful to the balance of living system is considered as unsustainability: loss of biodiversity, human rights violations, extreme climate change (earthquake, heavy bleeding), deforestation, resources mismanagement and the like. A state of sustainability cannot be reached without continuously strong human effort.

**Sustainability science:** - Among numerous involving stakeholders, although government has the key role in moving towards sustainable development (Hopwood et al., 2005), science and technology, or R&D must always play a central role in realizing that process (Cash et al., 2003). Throughout many movements of research and applications in order to mobilize science and technology for sustainable development, a concept of a new discipline, sustainability science, have been realized greater and greater. It is dynamic and multi-faceted expressed under various forms. A movement of researchers for the science of sustainability; questions raised in international forums; thousands of papers published; lectures and graduate courses held; worldwide fellowship and alliance established; journals, conferences and societies emerged (Spangenberg, 2011) are signs of great concern about sustainability from the viewpoints of academia and policy makers.



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In one of the same-name journal, sustainability science is defined by Komiyama and Takeuchi (2006) as “the discipline that points the way toward a sustainable society”, approaching the problem of sustainability at three levels of global, social, and human systems. Sustainability science is an attempt to bridge the natural and social sciences for seeking creative solutions to complex challenges (Jerneck et al., 2011), focusing on the dynamic interactions between nature and society (Clark and Dickson, 2003). Clark and Dickson also note in their 2003 paper that “The term “sustainability science” has been controversial, connoting to some a mature discipline with shared conceptual and theoretical components that most certainly does not exist. One alternative descriptor is “the science of sustainability” which conveys the notion of multiple sciences addressing a common theme. Our use of sustainability science, like that of the National Research Council, carries this last meaning.” Sustainability science is an interdisciplinary process, combining, interpreting and communicating knowledge from diverse scientific disciplines and non-scientific sources in such a way that the whole cause-effect net of a problem can be evaluated from a synoptic perspective, providing added value compared to single disciplinary assessments and offering useful information to decision makers (Spangenberg, 2011).

Kates (2011) raises seven core questions in sustainability science, showing his serious concerns for structuring a strong framework:

1. What shapes the long-term trends and transitions that provide the major directions for this century?
2. What determines the adaptability, vulnerability, and resilience of human-environment systems?
3. How can theory and models be formulated that better account for the variation in humannvironment interactions?
4. What are the principal tradeoffs between human well-being and the natural environment?
5. Can scientifically meaningful “limits” be defined that would provide effective warning for humannvironment systems?
6. How can society most effectively guide or manage human environment systems toward a sustainability transition?
7. How can the “sustainability” of alternative pathways of environment and development be evaluated?

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Mebratu (1998) also states that instead of focusing on the semantics used in the different groups of definitions, the conceptual review focuses on: What is identified as the source of the crisis? What is the core approach to the solution? What is the proposed solution platform? What is the key instrument for the solution?. Or questions for sustainability science are simply asked that: What to be sustained? For whom? How long? as in Lele (1991).

No matter how it is structured, Spangenberg (2011) claims this science for sustainability must be at least interdisciplinary ready conducted with the broader picture of sustainability in mind, and therefore ready for integration with results from other disciplines.

**Versions of sustainability: weak-strong and thin-thick.** Other viewpoints on sustainability includes weak and strong sustainability or thin and thick sustainability. Experts have by some means tried to “measure” sustainability based on how we treat the natural resources, one of the most discussed factors in sustainable development.

The conception of weak-strong derived from endogenous growth model of Solow and Swan (1956) using neo-classical economics framework, which is also examined in Hartwick rule (Hartwick, 1977). Solow believes that natural resources are substitutable and can be replaced by man-made (manufactured) capital. Weak sustainability follows his model economic growth model, assuming that human receive the same kind of well-being from whatever kind of resources and hence we expect no problem to use up the natural resources to increase productivity or total stock of capital. Because of this assumption, Neumayer (2013) called it as ‘substitutability paradigm’. Yet Solow, Swan and their followers were not able to include the planetary boundaries, its limits and its resiliency since the model serves the economic growth and uses monetary units to look at long term. ‘Can we really safely run down the natural resources and use it for the sake of human welfare?’ or ‘is natural resources abundant enough and technology changes could cover the loss?’ are among the fundamental questions raised in emergence of another form of sustainability.

One ecology system cannot survive as it is when a component is absent or not be able to be renewed which may cause serve problems to human such as biodiversity shrinking or loss or even breakdown. Strong sustainability conception is proposed to criticize weak sustainability but not to oppose it. Basically strong sustainability is weak sustainability, adding that the natural resources cannot be (totally) substituted and economic growth is not the prioritized goal of development. It requires sound reinvesting for the resource stock and the accounting of social cost and benefit, a prominent argument of environmental economics studies like of Barbier or Pearce, as well as proper preservation. Therefore it is sometimes called ‘a stronger version of sustainability’ or ‘series of thresholds that must not be crossed’. It is strong in the sense that human’s existence is inevitable impossible without natural capital (Edward B. Barbier, 1994) and that technology advancement

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will not help replace the what is lost in the ecology (Daly, 1997; Kuhlman and Farrington, 2010; Neumayer, 2013; Victor, 2005).

Economists, of course, prefer the weak paradigm while ecologists favour the latter. The biggest questions after these two paradigms is that what can be substituted, what cannot, to what extend we can exploit the environment and how much we would like to bequeath to our future generations. The notions like carrying capacity or maximum sustainable yield may correspond but the answers remain abstract for specific cases.

Not as many literature mention about thin and thick versions of sustainability as the weak-strong paradigm. Umair Haque discusses the thick and thin value of the profit-oriented economy through a series of his review blog and especially in Haque (2011) that the value creation process is so far a mirage which will finally evaporate. Instead he suggests reconceiving the process to be ‘thick’ with sustainable and meaningful value. When most of his arguments serve the sustainability of organizations, Vos (2007) builds a better defined framework for it. The central discourse is also about “how much the nature is valued intrinsically” and the substitutability of technology for the services of nature, remaining no sharp distinction with the weak-strong paradigm. Besides thin-thick versions, he describes the dominant paradigm as unsustainability “nature as raw materials for the human economy, no limits of economic and population growth and the market-driven activities predominate”. Population is also said to be a contributing factor of sustainability, and is insisted to decline once we move toward the thickness.

**Special features of Sustainability science:** As a summary, sustainability science is different from other fields of study in a number of ways:

- Besides systems analysis, it does not have a set of well-developed methodology to guide practitioners with solving a problem. It has to resort to other field’s method once needed in specific context;
- Sustainability science is holistic and transdisciplinary: A research cannot be claimed as a working under the umbrella of sustainability science if it only looks at the problem from one viewpoint or use a single method. Without considering (almost all) aspects of a problem, we cannot make any statement about the how to improve it towards sustainability. Individual efforts are obviously contributing to the growth of sustainability science, but according to Cash et al. (2003) effective knowledge system should facilitate communication across boundaries and that could enhance the salience, credibility and legitimacy of the output information;
- Research problems of sustainability science are sustainability problems, which already means all systemic issues that could happen in our interconnected lives;

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- Until now no concrete set of sustainability indicators is universally recognized;
- Besides key words of Resilience, Transboundary, Holistic, I would also stress on the importance of Balance. Sustainability science always seeks for a balance in its solutions: objects, participants, ratio of factors... so that no realm is recorded as superlative representation in the system; no stakeholder is disregarded. Otherwise, it can be named as other fields. To optimize the balance, sometimes we have to compromise to a win-win solution, even win-lose but all aspects and results (scenarios) should be recognized.

Against the eagerness of progressive scientist to develop a new research field, there are adverse criticism about sustainability science and the most-mentioned is the justification of forming a new discipline that have equal position as current ones. Main reason include sustainability science does not start with a set of methods and specific objects but it is more problem-based.

### 2.1.3 Sustainability education

“Education is the most powerful weapon which you can use to change the world”- Nelson Mandela

Education, from the receivers’ view, is the activities of learning and teaching for acquiring new things and from the policy makers’ view, is the tool to diffuse the knowledge and to train people to acquire a normative set of value for strategic purposes. No matter how it is defined, education is always seen as a crucial process for growth and development, personally and socially.

Sustainable development must be constructed by education or ESD in order the reach its goals. “Necessary knowledge is available for them to call upon when they are ready to act” (Holmberg and Sandbrook, 1992); and it requires a population that is aware of the goals of a sustainable society and has the knowledge and skills to contribute to those goals (McKeown et al., 2006). Besides, as “Education is held to be central to sustainability” (McKeown et al., 2006) and “Sustainable development is basically about learning” (Combes, 2005), a concept of an supporting parallel educational scheme emerged and has continued to change since the introduction of sustainable development.

**Education for Sustainable Development:** The first official name coined by the United Nations in supporting sustainable development scheme is Education for Sustainable Development (ESD), actually a shift from environmental and its alike that had been studied many years earlier (Kopnina, 2012). Environmental education (EE) is a new philosophy emerged from the environmental movement of the 1960s (Gerhard Schaefer, 1980; Palmer, 1998).

Environmental education is, like health, peace or sex education, a field of education that has to do with strong emotions on the side of the learners as well as the teachers. So,

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in environmental education we can prove every day: Man is more than just a rational being!

It does not only deal with study on the biology and nature but also involves other aspects like religion and culture. In the same collection of Gerhard Schaefer (1980), Ben-Peretz characterizes EE as interdisciplinary; encompassing all ages and educational levels; changing citizen's attitude and behaviours; and accompanying with a continuous evaluation process.

Followed is the establishment of United Nations Environment Programme (UNEP) in 1972 to deal with environmental challenges, the framework in which defines environmental education "as a means of helping individuals obtain an understanding that man is an inseparable part of an environmental system". However, since the notion of ESD has been popularized, environmental education is less mentioned in UNEP schemes or mentioned with a special linkage to sustainable development that is quite similar to ESD such as

promotes attitudes and value systems that influence environmentally ethical behaviour by developing understanding, skills and values that will enable people participate as active and informed citizens in the development of an ecologically sustainable and socially just society. (in <http://www.unep.org>)

IUCN in cooperation with UNESCO (1970) promote their definition as

Environmental education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture, and his biophysical surroundings. Environmental education also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality.

Following years of 1970s witness the of the dynamics of EE in various international gatherings such as Stockholm (United Nations Conference on the Human Environment, 1972), Tbilisi (1978) and in Belgrade Charter (1976), EE's goal is

to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones,

aiming at providing conditions to nurture individuals' and social groups' awareness, knowledge, attitude, skills, evaluation ability and participation.

According to Victor O.I. Johnson, the former Chief of Environmental Education and Training Unit of United Nations Environment Programme in Nairobi Headquarter,

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In as much as the ‘environment’ has been regarded, not as a discipline, but as a “dimension which must be brought to bear on a whole range of activities”, even so ‘environmental education’ should be defined not as a discipline like physics, geography or history, but as an environmental dimension or component which should be added to existing disciplines, educational courses, programmes and systems in order to reflect adequately all the environmental concerns of contemporary society as appropriate to the content and methodology of such systems. (Gerhard Schaefer, 1980)

Withrington in (Hughes-Evans, 1977) stated that “Environmental education is essentially a practical process for equipping man with the knowledge, skills and commitment to improve his environment” while Kelly (University of London) associated it with four facets:

- to aim for correctness in judgement, but to reserve judgement and accept indefiniteness and uncertainty if a valid level of correctness is not achieved;
- to be integrative and flexible in approaching a problem;
- to accept conflict in argument;
- to have a sense of responsibility; a feeling of trusteeship for human affairs which involves commitment, not just the recognition that human affairs are important.

In the era of EE, key words of *interdiscipline*, *change*, *system science*, *complexity*, *critical thinking*, *problem solving*, start to be recognized and it seems sharing many similarities with the nature of discussed later on ESD.

Agenda 21 of 1992 in Rio de Janeiro, after the UN General Assembly in 1987 with the milestone of common agreement on sustainable development, is one of the first official documents on promoting a form of education for sustainable development, using ‘education for all’ as a grounding message. It recognizes the principles of environmental education in Tbilisi declaration while trying to reorienting education towards sustainable development, saying

Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues.

UNESCO, the leading agency for the UN Decade of Education for Sustainable Development DESD<sup>1</sup> and beyond (after 2005-2014) has been actively working on evolvment and diffusion of ESD to all nations in the world.

The official page for ESD in UNESCO’s website<sup>2</sup> describes ESD as

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<sup>1</sup>(at <http://www.desd.org/>)  
<sup>2</sup>(<http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/>, retrieved October, 2015)

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## 2.1 Sustainable development and sustainability education

**Meaning** Education for Sustainable Development means including key sustainable development issues into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption.

**Methods** It requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. It also requires far-reaching changes in the way education is often practised today

**Skills and Competencies** Education for Sustainable Development consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way.

Key roles for education in sustainable development are (Tilbury and Wortman, 2004):

- Education is the primary agent of transformation towards sustainable development, increasing people's capacities to transform their visions for society into reality.
- Education fosters the values, behaviour and lifestyles required for a sustainable future.
- Education for sustainable development is a process of learning how to make decisions that consider the long-term future of the equity, economy and ecology of all communities
- Education builds the capacity for such futures-oriented thinking

Beside ESD, other terminologies such as Education for Sustainability (EFS); Education (or Learning) for Sustainable Future; Sustainable Education; Learning for Sustainability; Learning for Sustainable Development; Co-learning for Sustainability; Education as Sustainability and so on are also observed.

**Education for Sustainability (EFS)** is known quite as much as ESD, meaning:

Education for sustainability helps people and communities to examine critically the technologies, systems of economic production, cultural systems of reproduction, laws and politics, and ideas and ideologies they currently employ for living with the rest of nature. It also helps them reflect and act on viable alternatives (Huckle and Sterling, 1996).

Sustainable education is a change of educational culture, one which develops and embodies the theory and practice of sustainability in a way which is critically aware. It is therefore a transformative paradigm which values, sustains and realises human potential in relation to the need to attain and sustain social, economic and ecological well being, recognising that they must be part of the same dynamic (Sterling, 2001). It

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implies four descriptors: educational policy and practice which is sustaining, tenable, healthy and durable.

In explaining EfS, Sterling in his book *Sustainable Education: Re-Visioning Learning and Change* (2001), points out differences between modes of science that serves EfS as well as between the choice of a preposition for the terminology. Sterling starts with education FOR change and education IN change at the current circumstance, to say that changing education through policies and theories (the paradigm of IN) in a way that it could support more progressive change (the paradigm of FOR) in human and society is the true goal of the education. Education ABOUT Sustainability is the activities of learning and attaining knowledge related to sustainability problems. Practicing this by integrating that learning into current curriculum or forming a dependent subject is not hard to carry on, referring to the first-order learning. In Education FOR Sustainability, in addition to acquiring knowledge, students are also expected to acquire values and capabilities that could help them adjust and better manage future uncertainty. In order to realize the scheme of FOR, we need to change our current institutions' structure to support the second-order learning but just limit itself in learning FOR change. Last but not least, although objectively described, Education AS Sustainability (EaS) is said to be an educational system that could dynamically change itself to adapt the needs of the changing society, a most "creative and paradigmatic response to sustainability". In this case both individuals and institutions have to switch to another mode which calls for substantial and continuous efforts.

The idea of Education AS Sustainability is also shared by Foster (2001) with the statement that the relation between education and sustainability cannot be an external. It refers to a readiness to understand and undertake living as learning - not just a matter of accepting the old platitude that we live and (often somewhat reluctantly) learn but a positive, eager commitment to the heuristic creativity of intelligence in encountering each emergent tomorrow.

**ABOUT, FOR and AS.** Education ABOUT Sustainability is not discussed or recognized much in books and journals as interchangeable for sustainability education for its limitation in envisioning a transformative society. However, it is the most widely accepted and practiced because it provides the essential part of every major: the knowledge. In other words, Education ABOUT Sustainability cannot substitute SE, it is a part of SE. Education FOR Sustainability is what we are aiming at at this current stage. A lot of institutions, especially in developing countries, remain status quo against the movement towards sustainable development and much endeavour should be invested in (e.g. UNESCO's DESD and beyond) to promote a new form of education. Education AS Sustainability, as a result, is our future reach, a true vision of sustainable development.



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The roles of education, according to Sterling (2001) are socialization (replicate society and culture and promote citizenship), vocational (train for employment), liberal (develop the individual's potential) and transformative (to encourage change towards a fairer society and a better world). The last two make up a large part of sustainable education. In another speech in 2009, he reconfirmed the four descriptors of (what he called) sustainable education, which are:

- Sustaining (sustain people, communities and ecosystems);
- Tenable (ethically defensible, working with integrity, justice, respect and inclusiveness);
- Healthy (SE itself is a viable system, embodying and nurturing healthy relationships and emergence at different system levels); and
- Durable (work well enough in practice to be able to keep doing it).

**Sustainability education (SE)** is one of the most common educational term when thinking about one of sustainability paradigm. If sustainable development is widely recognized as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987), I would embed SE as “the education (or the practice of teaching and learning) that meets the needs of sustainable development”. It sounds like playing a pun but the main purpose is to connect SE to the widely accepted word for initial understanding and consistency.

Although several distinctions were made as above, I would use them quite synonymously and interchangeably throughout the later part of the thesis, especially the term ESD and SE, although the most preferable meaning and the newest meaning to SE is EaS. John Huckle (2006) uses the term ESD and Sterling in his recent 2010 book with his cohort namely Sustainability Education - Perspectives and Practice across Higher Education, attaches both ESD and EFS as sustainability education (Jones et al., 2010). Since little distinction made between/among them, though conflating these terms might give uneasy feeling for critical educators but this would reduce unnecessary confusion for terminology.

### 2.1.3.1 Skills and competencies for SE

In response to the goals and roles of SE, there are a number of views on sets of skills (or competencies, learning outcomes, expectations) projected for learners of SE.

As a very basic one provided by UNESCO, which we can call either educational goals or expected outcomes, the four pillars of Delors (1996) - learning to know, learning to do, learning to be and learning to live together - are widely known. In order to be more valuable in response to the change of ESD, a number of versions of fifth pillar have been added, such as *learning to transform*

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*yourself and society* (Black, 1999), *learning to change* (Li and Tsai, 2007; UIE, 2003), *Learning to live a legacy* (Gokhool, 2005), *learning to live sustainably* (Hargreaves and Fink, 2006) or *learning to transform society and change the world* instructed by DESD. Another labeling is *Learning to live together sustainably, Education for Sustainable Living* given by UNESCO, or *learning to respect the planet* “for it is our home and the home of our children and our children’s children” (Jarvis, 2008, pg. 150, 218).

Svanstrom et al. (2008) examine SE’s learning outcomes by discussing the Tbilisi declaration, the Declaration of Barcelona and the sets of values initiated by various institutions. Their talk covers four areas of learning outcomes:

1. Systemic or holistic thinking (interdependence, interact, dimensions, comprehensive and complex relations);
2. Integration of different perspectives (inter- and multi-disciplinarity);
3. Skills that are emphasized (problem-solving, critical thinking, creative thinking, self-learning and skills related to communication, teamwork and becoming an effective change agent to shift policies, practices and societal norms); and
4. Awareness, attitudes and values in sets of learning outcomes.

The last point, ‘sets of learning outcomes’ include what have been required/expected for students upon graduation of the program, mostly related to what they need to know, for example regarding the ACPA (College Students Educators International), each student will be able to define sustainability, to explain how sustainability relates to their lives and their values, and how their actions impact issues of sustainability, to utilize their knowledge of sustainability to change their daily habits and consumer mentality, to explain how systems are interrelated, and so on. Other programs also propose the ability to establish the connections to the triple bottom line (TBL); to apply assessment criteria or sets of principles or available tools or ability to implement the needed actions to foster sustainability in their professional and personal life. This way of categorization is strong and inclusive for its openness but confusion may exist due to overlapping between the forth and the first three areas.

In the same manner, Wiek et al. (2011b) report five key competencies for graduate students to possess by compiling related publications and clustering the skills for sustainability research. Five competencies are:

1. Systems-thinking competence, important for building transition strategies toward sustainability (Systemic thinking, interconnected thinking, holistic thinking);

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2. Anticipatory competence, important in conjunction with sustainability assessments of future trajectories (Anticipatory thinking, future thinking, foresighted thinking, trans-generational thinking);
3. Normative competence, important for constructing direction and orientation about deliberative change (Value-focused thinking, orientation thinking/knowledge, ethical thinking);
4. Strategic competence, linked closely to the previous three competencies as strategies for transformative change attempt (Action-oriented competence, transformative competence, implementation skills); and
5. Interpersonal competence, closely linked to all other competencies, as all rely on collaborative approaches to create ownership for the (intermediate) results, to leverage implementation, and to build joint capacity to cope with complex sustainability challenges (Collaborative, participatory, interdisciplinary, civic competence).

Among the five competencies, Wiek and his cohorts (2011a) highlight systems thinking and anticipatory competencies in practical application. The capacity of systems thinking enables graduates to comprehend complex relations and tradeoffs, especially in large organization structures; while anticipatory skills would help them to build scenarios encompassing a wide range of impacts and outcomes.

Obtaining these attributes highly requires the understanding, or at least being aware of a broad field of study related to sustainability (physics, energy, agriculture, social science and the like), often known as T-shaped capabilities. Tamura and Uegaki (2012) interpret this T-shape into four main components: expertise, holistic knowledge, skills and mind, which include students' motivation, beliefs, generational and inter-generational consciousness. Through this way of structuring, the learning of sustainability is much depending on students' culture and status background in a relationship with the surroundings.

The United Nations Economic Commission for Europe (UNECE) Expert Group on Educator Competences for Education for Sustainable Development, co-chaired by Roland Tormey of Ireland and Michael Scoullos of Greece published a report (2011) on how educators could response to the needs of SE's expected learning outcomes, including three main points:

- A holistic approach: integrative thinking, inclusivity, dealing with complexities;
- Envision change: learning from the past, inspiring engagement in the present, exploring alternative futures; and

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- Achieving transformation of people, of pedagogy and of the education system as a whole.

Besides, educators also need other skills, such as critical thinking and reflection, dialogue and negotiation, collaboration and building of partnerships (Tilbury and Wortman, 2004).

Although there have been lively talks about skills and competencies, commenting on the application of sets of competencies for sustainable development in higher education, Mochizuki and Fadeeva (2010) argued that there is no single universal set could be applied in every case. Using illustration of PRAM model, the authors showed the needs for incorporate a wide variety of contexts process into learning, stressing on the differences of each local studying ESD. The point is also agreed by Barth et al. (2007) that the existence of various and manifold contexts, both formal and informal, is important. They added that learners individual responsibility can lead to a maximum of possibilities for learning and acquiring competencies. Many authors refer to this activity as real-world learning as what we really expect is not always fixed as a set of unchanged goals.

Here in this thesis, I call it as “expectations” for SE graduates. What we want the learners (as well as the prospective educators) would gain while and upon studying sustainability, based on previous literature, involves three points:

- 1. Knowledge - the essential** What students need to know about the world, current local issues, tools and measures to solve it, what sustainability is and its demand.
- 2. Competencies - the connectors** Personal and interpersonal skills. Personal skills are those could be developed within oneself and is good for him/her to build own’s vision/scenario on the problem. Interpersonal skills are those nurtured to be effectively communicative with interdiscipline counterparts in order to solve problems smoothly at the best possible pace. Both sets of skills help learners to take real action efficiently.
- 3. Values - the framework** The general norm that one should follow and behave, very much related to what is stated in ‘learning to be’ of Delors (1996): “to enable every person to solve his own problems, make his own decisions and shoulder his own responsibilities. Education’s essential role seems to be to give people the freedom of thought, judgement, feeling and imagination they need in order to develop their talents and remain as much as possible in control of their lives. The diversity of people’s personalities, their independence and initiative, and even the desire to provoke - these are all safeguards of creativity and innovation. The aim of development is the complete fulfilment of man, in all the richness of his personalities, the complexity of his forms of expression and his various commitments”.

### 2.1.3.2 Special features of SE:

In summary, sustainability education is different from other types of education in a number of ways, corresponding to the specialty of sustainability science:

- The presence of many research disciplines (Kajikawa, 2008; Lawrence and Despres, 2004; Padurean and Cheveresan, 2010; Ramadier, 2004) or T-Shape: Multidiscipline is the prerequisite, and transdiscipline, or “beyond discipline” (Nicolescu, 2005) is the ultimate integration of knowledge that SE has to equip its learners. T-shaped people, who have deep understanding on at least one discipline and are capable of handling dynamic skills on general schemes, is the widely-known term when referring to sustainability and sustainability education.
- We expect a lot of outcomes from SE graduates, particularly in higher level of education. This kind of change is institutionalized in learning outcomes, competencies or values. Systemic thinking is the essential, agreed as the first skill for a learner in SE, followed by a number of descriptors like critical thinking, communicative, anticipatory, collaborative skills and the like.
- Whichever requirement of capability that graduates should acquire, the eventual mission of SE is to help students transform themselves, transform the community/society they live and change the world to a better place.
- Informal and practical learning, or context based learning play a considerably important role in teaching and learning sustainability for sustainability itself involves a great variety of problems. As we cannot find a single set of disciplines or goals for this education, we have to put it in contexts and learn a lot from real experiences.

With the assistance of technology, science, governance and other innovations, sustainability education could lead our humanity to transform themselves and the whole society to the sustainable state.

## 2.2 Diversity

“Diversity is the art of thinking independently together” (Malcolm Forbes)

### 2.2.1 Understanding diversity

We all understand when hearing ‘diversity’ but our background and the context decide exactly what it means. The starting point of definition can be found almost every dictionary “Diversity means differences”, “the state of being diverse”, “a range of different things or people”, “a situation that includes representation of multiple (ideally all) groups within a prescribed environment”, or “an instance of being composed of differing elements or qualities” (Oxford, Merriam-Webster, U-Maryland, Cambridge).

**Implication:** The layer under that general definition is the recognition of various entities, seeing the uniqueness of individuals, whatever origin each one come from. We say “a great/wide/rich/poor diversity of [...]” since we see the availability of things that is dissimilar from each other, mostly implying we respect it.

**Diversity of non-living things** is about the variety of materials and properties. It is less mentioned for its limited impacts on except it help enrich the choices that human and species can make to lead to a better decision.

**Diversity of living things: Genetic diversity** refers to various types of those can grow, function and change, including

**Biological diversity** (biodiversity) is the diversity of species in five (protists, bacteria, fungi, plants and animals) or more recently, six kingdoms. According to Gayford (2009, Understanding in relation to the eight doorways), “Diversity, particularly biodiversity, is still largely considered in terms of endangered species, with emphasis on large and exotic animals in distant places. However, habitat preservation is more firmly established as a supporting concept in maintaining biodiversity”. And since “diversity is still seen largely as a matter of biodiversity, with more emphasis now on the maintenance of habitats that will sustain diverse animal and plant populations”, we have to count it, as well as the diversity of non-living things, here although they are not going to be mentioned in this treatise.

**Human diversity** Human are the smartest and the most complex ‘living things’, because of not only the body’s structure but also the behaviors, emotions and humans’ interrelations. The topic, usually coupled with ‘inclusion’, have spent plenty of ink and time of researchers to know how diversity works in workplace, organizations, educational institutions. From this moment on, whenever ‘diversity’ appears, it refers to the diversity of persons, more concretely, almost all are the diversity of students in higher education.

### 2.2.2 Dimension

Dimensions can be listed such as: sex, race, (age), education, (personality), (tenure), values, (functional background) and previous experiences. For example, Sonnenschein (1997) labels diversity as significant differences among people, regarding race, culture, gender, sexual, orientation, age and physical abilities. Other descriptions include differences in ethnicity, nation of origin, class, religion, learning, communication styles, where people come from, and occupation as aspects of diversity.

Noticing that almost all diversity types associate with cultural aspects is not difficult. The well-known Diversity Wheel, created by Loden (1996), engages two concentric circles. The smaller pie is cut into six primary dimensions of diversity: gender, mental/physical ability and characteristic, race, ethnic heritage, sexual orientation and age. The outer are secondary dimensions: military experience, work experience, income, religion, first language, organization role and level, communication style, family status, work style, education, and geographic location. The primary aspects are somehow visible and apparent while most of the secondary (background, experience, style, position) cannot be detected right at the first sight. Because the detectable characteristics often cause bias once the persons have not had good acquaintance with each other, they attract more discussion in literatures.

Loden also commented that “the goal for an organization is to create an environment where, regardless of one’s diversity profile, everyone feels welcomed and where everyone’s skills are leveraged” and “the Diversity Wheel is useful in explaining how group-based differences contribute to individual identities.”

Another way of categorization is the two schools of diversity: visible characteristics (such as sex, gender, age, skin colour and other informational characteristics) and invisible characteristics which are educational background or years of work experience (Dietz, 2009; Thatcher, 1999). How we understand it really depends on which situation diversity is seated. In Western countries where have been attracting millions of immigrants and facing culture conflicts, the gender and skin color aspect of diversity are of the most concerned. In work place, authors like Ely (2004) choose tenure, age, sex and race.

### 2.2.3 Diversity in education

Cushner, McClelland & Safford (2012) have identified 12 sources of cultural identity (race, ethnicity/nationality, social class, sex/gender, health, age, geographic region, sexuality, religion, social status, language, and ability/disability) that influence teaching and learning. Besides, there are several other angles of diversity which need particular concerns in post-secondary education

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such as diversity in background knowledge or prior experiences. The individual is said to be affected by a number of agents, but does not mean by all, including family, school, church, community, neighborhood, peer group, media, sports, arts, work place, and technology. Huddleston and Unwin (2007) added that it is not only the ability of the students which differs, however, but also their motivation, prior experience, expectations and the way in which they are funded (page 35). In education researches, diversity is often assumed to be about who goes to school/university, where means students of various national origins, or various racial origins, or of various class origins, all attending standard, state-sponsored institute (Winchester, 2002). Along similar lines, students of special circumstances or with disabilities (Anderson et al., 1998; Piland et al., 2000) are also mentioned. Diversity in education is often coupled with the notion of 'inclusive' (Loreman et al., 2010; Ryan, 2006; Verma et al., 2007).

In short, this list can be considered for reference of aspects of diversity (in alphabetical order):

1. Age diversity;
2. Background knowledge diversity;
3. Belief/ideology diversity;
4. Ethnicity diversity;
5. Experience diversity;
6. Gender diversity;
7. Geographic region diversity;
8. Language diversity;
9. Personality diversity;
10. Physical ability diversity;
11. Race diversity;
12. Sexual orientation diversity;
13. Socio-economic status diversity and other types.

In this research, the central topic is about diversity of students. Two aspects are looked at: culture and background. Culture regards a regional/ethnic/religious/linguistic affiliation, gender level, generation level, social class level and organizational level (Hofstede, 1991, pg. 10) and Background implies academic background, not to mention work, functional, intellectual outlook,



cognitive style and other knowledge-related experiences. Personality is sometimes seen as a third aspect as it is different from the above two but not to be independently valued in this research. In fact, even in the most homogeneous group, personal characteristics naturally create individuality diversity as human are fundamentally different from each other. A certain person's behavior depends on the structure of their biological body (genetically) and growing/education environment (Feldman, 2006), thus personality (or individuality) diversity more exactly the human genetic diversity that could be used to differ from culture and background diversity. Individuality diversity is sometimes treated as the origin of culture diversity, then considering the notion of two aspects, culture and background, can somehow cover 'diversity'.

### 2.2.4 Diversity: Deleterious or valuable?

**Adverse effects:** Through the view of ecological study, Lietaer shows in his joint paper with Ulanowicz and Sally Goerner (2009; 2009) the position of diversity/interconnectivity, considering sustainability as a function of efficiency and resilience. Diversity could be a booster of sustainability through expanding the resilience, but at the expense of efficiency. More diversity may lead to stagnation of the system. The same kind of trade-off exists within human relation, which itself is complex in nature. The more differences exist, the more difficulties might happen.

Adverse impact of diversity is usually seen in work place, where efficiency or performance of participating members are highly concerned. Communication barriers (language, tone, accent, talking style), culture differences (habit, belief, norm), discrimination, time-consuming for finding solutions are some of the prominent observed difficulties or even negative outcomes in line with high level of diversity. Additional costs may arise in order to support the management process such as training, ice-breaking activities or costs related to negotiation (Konrad et al., 2005). Team diversity may cause dissatisfaction, lower levels of perceived employee performance and objective performance (Thatcher, 1999; Williams and O'Reilly, 1998). If work environment does not accept and encourage tolerance of differences, diversity could lead to tensions and conflict, seriously affect the final working outcomes. The similar problems occur in schools and institutions but its levels vary. Minority sometimes has to suffer from harassment, isolation or inequities. Sometimes, diversity is treated not as an educational opportunity but as the educational enemy, especially if the diversity of too great (Winchester, 2002).

**Diversity's benefit:** Despite numerous surface challenges, the outlook for diversity is very bright. Sonnenschein (1997) considers diversity as differences, and though differences create challenges, differences also open avenues of opportunities. Diversity may

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- enable a wide range of views to be present in an organization, including views that might challenge the status quo from all sides;
- focus and strengthens an organization's core values;
- be instrumental in organizational change;
- stimulate social, economic, intellectual, and emotional growth; and
- help an organization understand its place in the global community.

The Universal Declaration on Cultural Diversity UNESCO (2002) insists that diversity is widely recognized to be of great positive impact on the development of a system. As part of that, cultural diversity widens the range of options open to everyone; it is one of the roots of development, understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence.

Again, regarding sustainable maximization for a network system of Lietaer, Goerner and Ulanowicz (2009), we can put forward the view that the higher level of diversity or interconnectivity correlates with greater resilience and augments sustainability at certain points.

As obvious impacts, diversity in a working/studying group brings about new knowledge for group members so that they can learn and growth in both profession/education as well as being a socialized person. Especially when one could manage over the obstacles of having unpleasant differences, he and the whole unit can enjoy the new interesting ideas, can at the same time improve communication skill, self-confidence and better social skills. The WISELI institute of University of Wisconsin-Madison (2010), by synthesizing previous researches, concludes that diverse working groups are more productive, creative and innovative for both faculty and students; furthermore developing a diverse faculty will enhance teaching and research. Diversity leads to an increase in the variety of perspectives and approaches brought to a problem and to opportunities for knowledge sharing, and hence lead to greater creativity and quality of team performance (Mannix and Neale, 2005). Heterogeneous groups are likely to be more creative, make higher-quality decisions, and perform better than homogeneous groups (Ely, 2004; Wanous and Youtz, 1986). In groups with a collectivistic culture that valued teamwork, and rewarded cooperation and team performance, diversity of nationality, sex, and race was more beneficial to performance than in groups with an individualistic culture that valued individual effort, and rewarded competition and individual performance (Chatman et al., 1998; Ely, 2004).

Hurtado and Gurin (2004; 2002; 2003; 2001; 1999), who among the most active authors in studying (racial/ethnic/social) diversity in higher education, agree that in educational context, diversity education and diverse environment is critically important "because student experiences

with diversity can promote more active, more complex thinking and prepare students as citizens in a diverse democracy” (Gurin et al., 2003). Also, “diversity in the composition of the group is proposed to increase the information available for problem solving and in turn enhance the ability of the group to generate correct or creative solutions to problems ... the positive impact of diversity can be expected when the task can benefit from multiple perspective and diverse knowledge, such as innovations, complex problems, or product design” (Williams and O’Reilly, 1998). The results from (Bacon et al., 2011) confirm that interdisciplinary student projects are a useful pedagogical tool to teach students through experience.

### 2.2.5 Reasons and theories behind

*“As we disentangle what researchers have learned from the last 50 years, we can conclude that surface-level social category differences, such as those of race/ ethnicity, gender, or age, tend to be more likely to have negative effects on the ability of groups to function effectively. By contrast, underlying differences, such as differences in functional background, education, or personality, are more often positively related to performance - for example by facilitating creativity or group problem solving - but only when the group process is carefully controlled”* (Mannix and Neale, 2005)

Sonnenschein (1997) and Mannix and Neale (2005) wrote very worth-reading papers on summarization trends of diversity evaluation since the mid-twentieth century. Based on their findings, aspects that catch the most attention in research trend are tenure, (knowledge) background, age, sex and racial/ethnic diversity. Three most common theories underpin diversity research are

**Self-categorization/Social identity** Individuals are assumed to have a desire to maintain a high level of self-esteem. Each one classify oneself and others by using salient (visible) characteristics. For this naturally divided group, internal members often see outsiders as less attractive, less trustworthy, honest and cooperative; leaving large ground for stereotyping and prejudice. This theory explains why negative effects often observed on diverse group’s outcomes and process.

**Similarity-attraction** More or less an extension of social identity, similarity-attraction see people in groups where members share common points. Individuals can express preferences for particular groups even though they have not interacted with members of that group before. Similarity in background may help exchange life experiences, value as well as keep communication more smoothly; in attributes such as attitudes, values, and beliefs will

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facilitate interpersonal attraction and liking. Vice versa, heterogeneity leads to fragmented interaction and message distortion.

These first two theories predict that those who are most different from the others, are likely to leave the group or not as integrated as others.

**Information/decision making** Based on the assumption that diverse groups may have greater access to information networks outside of the work group, this perspective support the presence of various types and styles in the group, saying that the variance can have a direct positive impact through the increase in the skills, abilities, information and knowledge and that diversity creates an atmosphere for enhancing group performance. From this theory, diversity is valuable when it adds new information even though it might create coordination problems for the group.

Table 2.1 shows how aspects of diversity influence the group process and performance in various situations. From those researches, human diversity definitely has important role in interacting process and working outcomes. It is obviously seen that diversity under any dimension may impose unwanted effects like less integrated, less communication, more conflict, vulnerable risks particularly towards the minority although the evidences are not strongly given in all cases. However, two points are interesting: (1) Background diversity is the factor that create most positive impacts through providing various insights to solve a problem; and (2) if controlled and managed in a good manner, or in other ways, having a deliberate leader might clear the border between different individuals, turning the obstacles into advantages of a heterogeneous group. It should be noted that, under different conditions, the impact varies. Statement about the impact of diversity is stated cautiously as “some researchers have argued that diversity, when properly used, can be beneficial for organizations and ultimately improve performance, also known as ‘value-in-diversity’ hypothesis” or “diversity in ascriptive characteristics can be beneficial to groups” (Williams and O’Reilly, 1998). Working and learning environments enable colorful views on what is called ‘positive’ and ‘negative’. Mere structural diversity does not guarantee anything for the outcomes, as good chairs and desks do not automatically provide students with good education.

Table 2.1: The impact of diversity to group process and performance. Adapted from Williams and O'Reilly (1998) and Mannix and Neale (2005)

Type of diversity	Positive impact (+)/ Negative impact (-)		Why?
	Group process	Group performance	
Tenure (the similarity in time of entry)	(-) less effective integration, communication, conflict; higher turnover	(+) diverse ideas useful for problem solving, a more complete analysis of issues, more creative outputs (-) gaps may increase (relational, emotional) conflict, slower implementation. Individuals who most different likely to exit	(1) Self-categorization; (2) Similarity; (3) Information/ decision making  (1) and (2) lack of social integration
Background (knowledge, function, education)	(+) higher quality decision (-) lower cohesion but no effect on social integration or communication	(+) relate to innovations, prosocial org. behavior, (-) able to use the unique information when they are familiar and in open debate. Slower implementation	(2) (3) contain more relevant experts, increase frequency of contacting outsiders
Age (generation)	(+) relates to less conflict  (-) slightly lower level of effectiveness	(+) provide a greater access to wider information but the relation is not strong (-) sometimes decrease innovation; bias evaluation among members; lower intent to remain	(2) individuals born similar times may develop similar outlooks; (3) more frequent communicate with people of different group and age
Sex (gender)	(+) weak evidence on process loss  (-) higher level of conflict, interpersonal tension, lower friendliness (but depend on proportion F/M). Female minority face hostility while male minority feel less satisfied	(-) negative impacts, esp. to male. Higher turnover (those most different) (-) mix group produces small proportion to new solutions, less effective than homogeneous one; not high prosocial org. behaviors	(1) and (2)
Race and Ethnicity (mostly about skin color)	(+) more cooperative  (-) lower level of group committment	(+) same number of idea but of higher quality  (+) need time to overcome negative process and good leader; but once done, more creativity recorded  (-) minority likely to have less committment and often absent or even quit (Whites experienced more negative)	(1), (2) and (3)  decrease interpersonal attraction, increase cognitive biasing. Minority likely choose same-race friends

### 2.3 Diversity of students and SE

Researches about diversity in working environment are quite controversial, where assessable efficiency and outcomes are seriously pertained, especially in short term. The case in education is not the same, as education is more of a long term investment, then one cannot expect all effectiveness immediately. Furthermore, the goal of education is to train people so that they can inclusively know, do, learn, be, and fully be prepared for a vibrant real society. Educators see diversity quite differently, and it is more and more meaningful in the changing time of education.

Because “diversity has been identified in the higher education literature as one of the major factors associated with the positive performance of higher education systems” (van Vught, 2008), its presence contributes to the prestige of institutions.

*In addition to issues of access, retention, and climate, there has been an increasing recognition by colleges and universities that if they are to educate students to assume leadership in an increasingly diverse society and the internationalized context in which we function, the educational process, the campus community, and the curriculum must reflect that mission. Education that does not engage these issues, may become increasingly irrelevant to the current and future world which we inhabit. Thus, providing students with knowledge about diversity has been incorporated into the vast majority of college and university mission statements within the past two decades. (Wood, 2003)*

Knowing about differences can help to avoid conflict in international management (Hofstede, 1991). Students’ prior experience of education will shape their attitudes to learning, to teachers and to their fellow students (Huddleston and Unwin, 2007); or peer learning becomes more important as a wider variety of viewpoints become available through immigration and global communication (Green and Perlman, 1997) are among main explanations for diversity’s value.

In the movement of sustainable development, the need for cultural diversity and diversity in social arrangements as necessary preconditions for the survival of the planet (Mebratu, 1998) is indispensable in a way that “we are determined to ensure that our rich diversity, which is our collective strength, will be used for constructive partnership for change and for the achievement of the common goal of sustainable development” (United Nations, 2002).

More importantly, the concept “transdisciplinary” is the key to relationship between diversity and sustainability education. “Sustainability science is not yet an autonomous field or discipline, but rather a vibrant arena that is bringing together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine” (Clark and Dickson, 2003), therefore inter-disciplinarity,

trans-disciplinarity and cross-disciplinarity are closely attached with sustainability researches. It was even agreed, by most commentators, inter-disciplinarity, trans-disciplinarity and cross-disciplinarity, which are underpinned by the diversity of students' academic backgrounds and experiences, lie at the heart of successful ESD as it could enable more holistic thinking, helping students gaining a sense of environmental responsibility, and their involvement in making critical judgements and becoming involved in organisational politics (Dawe et al., 2005).

To restate, multidisciplinary concerns studying a research topic not in just one discipline but in several at the same time. "While interdisciplinarity concerns the transfer of methods from one discipline to another and its goal still remains within the framework of disciplinary research, transdisciplinarity concerns the dynamics engendered by the action of several levels of Reality at once - the discovery of these dynamics necessarily passes through disciplinary knowledge. All of the four, including Disciplinary, are like four arrows shot from but a single bow: knowledge" (after Nicolescu, 2005). Transdisciplinary here means breaking free of disciplinary perceptions and traditions to create new meanings, understandings, and ways of working (Huckle and Sterling, 1996, Chapter 2). Of course, transdisciplinary is not sum of the parts, meaning simply putting disciplines together. Word cloud of Clark and Dickson (2003) and citation map of (Kajikawa, 2008; Kajikawa et al., 2014) show the significance of academic integration and the trend is growing towards the mergence of disciplines with faded borders. An education in sustainability has the capacity of increasing awareness of the complexity and interrelationships of environmental, economic, social, political and technical systems. This can be achieved via a transdisciplinary approach to teaching and learning, which could provide transdisciplinary skills that cross disciplines, cultures, and institutions (Padurean and Cheveresan, 2010). Trans-disciplinary is even praised as key players in reforming the higher education system the cardinal points for successful sustainability education are student focus engagement in real environmental issues, improved transdisciplinary approaches and curriculum reform (Pearson et al., 2005).

Diversity actively contributes to transdiscipline paradigm by providing variety of different angles, each one legitimate in its own right and capable of contributing partial knowledge of the object, but none able to define the problem as such from a disciplinary perspective (Spangenberg, 2011). Diversity of knowledge and value nurture the ability to work in teams, and graduates have better chances to understand, embrace, and facilitate diversity among cultures and social groups when they actually enter their working lives (Wiek et al., 2011a).

Although many educators agree that a holistic, transcultural learning environment is desired and needed in colleges, very few research has been conducted to determine how much of this education students are actually getting in the classroom (Piland et al., 2000). Of course, inter- and trans-disciplinary approaches could blossom the most only when be seated in higher educational

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systems, where disciplines are formed and followed by learners. Multi-culture is also observed here more, as colleges and universities do not anymore follow the local-based structure of K12 education and students as adults have a freer choice of institutions. For it to be meaningful, the thesis base its ground at higher education institutions to watch the linkage between SE and diversity of students.

### 2.4 Learning theories and pedagogy for sustainable development

The above section gives us information about the important linkage between sustainability education and diversity, also leave questions on how could diversity be recognized and utilized to be more meaningful and valuable in higher education. Educators, including institution managers, staffs, researchers and particularly instructors/lecturers, are the first and foremost persons in charge in realizing the fact even though the notion of ‘anyone can teach and has the ability to influence knowledge’ has a very reasonable ground and gained more and more popularity (Patton, 2008; Swann, 2012; Szucs, 2009; Thomas, 2012). Assuming that the curricula and class setting are supportive to nurture diversity, we would like to review the teaching methodology that provide hints for improving the value of diversity.

#### 2.4.1 Teaching methodology: Pedagogy and andragogy

Pedagogy and andragogy, simply speaking, are both the theory and practice of education. Andragogy is seen as a step upon pedagogy, a word modification from pedagogy to andr- + (ped)agogy. Andr- is a Greek prefix means man (in compare to pedagogy - child leading) referring to a learner-focused approach for life-long learning. The term pedagogy has longer history of use by educators and trainers than the latter.

**Pedagogy** is said to be an art of teaching (Webster), or science of teaching (Mortimore, 1999).

Pedagogy as a discipline extends to the consideration of the development of health and bodily fitness, social and moral welfare, ethics and aesthetics, as well as to the institutional forms that serve to facilitate society’s and the individual’s pedagogic aims’.  
(Marton and Booth, 1997)

Including the perspective of not only the persons who teach, but also the one who learn, Mortimore (1999) defined pedagogy as

“any conscious activity by one person designed to enhance learning in another”

The main target of developing pedagogues, according to Saljo, 1979 and Marton et al., 1993 in (Mortimore, 1999) are:



1. Getting more knowledge;
2. Memorizing and reproducing;
3. Acquiring and applying procedures;
4. Making sense or meaning; and
5. Personal change.

These targets have been changing a lot under various types of educational philosophies which are to be discussed right later on. Interesting theories and application about “higher education pedagogies” can be found more in Walker (2005).

**Andragogy or adult education:** The first usage of andragogy recognized is from a German high school teacher Alexander Kapp in 1833, who tried to use the word in describing the educational theory of Plato. After more than a century left fuzzy, andragogy started to receive attention from scholars as it appeared in Malcolm Knowles’ writings under the meaning of the art and science of helping adults learn. He developed four (plus one) assumptions based on the process of being mature through time:

1. The self-concept moves from dependency toward self-direction;
2. The reservoir of experience accumulated becomes an increasing resource for learning;
3. Readiness to learn is increasingly oriented towards the person’s social roles;
4. The orientation towards learning becomes less subject centered and increasingly problem centered; and
5. The motivation to learn is internal (added in 1984).

Along similar lines, Group (1983) offer a brief definition for their students as

Andragogy can be defined as an approach, i.e. the total embodiment and expression of a philosophy of education for adults. This approach is aimed at enabling people to become aware that they should be the originators of their own thinking and feeling.

Followers of andragogy name it an approach, not simply a method as it is embedded with three headings: expository methods, direction methods and discovery methods (Group, 1983). More discussion about can be found at works of Group (1983), Merriam (2001), Knowles (1968, 1970); Knowles et al. (2005), or Reischmann (2004).

**Andragogy or Pedagogy?** Having andragogy developed, many believe that it is the substitute framework for pedagogy when students graduate from high school and become an adult

## **2. REVIEW: SUSTAINABILITY, EDUCATION AND DIVERSITY**

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learner. If compare the history and effort of researching of the two, that belief is partial. When andragogy first came to public, pedagogy started to be restructured to adapt the more active role of learners. If based on the Greek meaning of each word then considering andragogy broader is not persuasive. From the beginning the word ‘pedagogy’ was not taken its bare meaning ‘guider of a boy’ but it refers to boys and girls or all humankind, especially from childhood.

Secondly, taking the book edited by Mortimore (1999) and more recently, Thomas and Muga (2014) as examples: they describe how pedagogy is applied from childhood to adult and life long learning with a wide possibility of application in practice. Pedagogical talks also cover work place situations. This interpretation allows us to say that andragogy is one of the disciplines of pedagogy, which is everything about doing education in a logical way (Savicevic, 1991).

In fact in 1980, Knowles changed his emphasize from contrasting the two paradigms to acknowledging the appropriateness for both children and adults, depending on the situation. His key argument is basically about methodology: new approaches should be supportive to student-directed than teacher-directed learning (Merriam, 2001).

Researchers about pedagogy in universities prefer the term ‘critical pedagogy’ to discern with those applied for children (Ellwanger and Cook, 2009; Kincheloe, 2008). McLean (2006)’s version of critical pedagogy aims for the transformation of individuals and society by preserving its traditional functions (technical, professional, cultural and critical) and by focusing on a broad definition of citizenship that is yoked to those functions. Critical university pedagogy would take up the function of universities to educate citizens and professionals who can tackle injustices and social problems, the current socio-historical conditions carry constraints on achieving this ambition (McLean, 2006).

In this research, what I mean by saying pedagogy is the way of carrying out educational activities, the methodology of the instructors, teachers, professors, advisors and the like to guide and facilitate students learn better.

### **2.4.2 Classical educational theories in higher education**

From Driscoll (2002, 2005) and many other sources, we could find schools of education that can be explained by various learning theories, such as nativism (Chomsky); associationism (Plato, Aristotle, James Stuart Mill); behaviorism (Pavlov, John Watson, Skinner); cognitivism (Chomsky, Bruner, Simon); constructivism (latter half of 20th century: Piaget, John Dewey) or social cognition of Vygotsky (sociocultural theory). Other way of calling out learning philosophies for the sake of sustainable development is written in Erkilic (2008)<sup>1</sup>.

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<sup>1</sup>which includes Perennialism, Essentialism, Existentialism, Experimentalism, Progressivism, and Reconstructionism

## **2.4 Learning theories and pedagogy for sustainable development**

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Among those mentioned, most applied classical theories in education from K12 through higher education system we should count are behaviourism, cognitivism and constructivism (Schunk, 2012; Pritchard, 2009). Table 2.2 summarizes main theories partly by using the five questions from Schunk (1991), which are

1. How does learning occur?
2. Which factors influence learning?
3. What is the role of memory?
4. How does transfer occur? and
5. What types of learning are best explained by the theory?

Table 2.2: Major learning theories applied in higher education

	<b>Behaviourism</b>	<b>Cognitivism</b>	<b>Constructivism</b>	<b>Connectivism</b>
Key word	observable behavior, stimuli, responses	process, symbol, memorization	interact, problem-solving, experience, reasoning, socialize,	autonomy, diversity, openness, and interactivity
Mind is	as a black box	as a computer/processor	as rhizome	always ready for new knowledge
Learning is	regular, expected response, creation of habitual response	recall of stored information	building knowledge by doing and practicing, experiencing	Formations of connections in a network (literally). It's a knowledge creation process...not only knowledge consumption
Knowledge is	instructed	instructed, interpreted and internalized	is assigned internally, and by social networks	know-how, know-what and know-where: externalized
Learning occurs when	operant conditioning, learner is presented with rewards and consequences	we can recall stored information through memorization (presentation and testing)	given the right circumstances	we have diversity of opinions and ability to see and form connections between fields, ideas, concepts. It could be informal but networked and technology-based
Evaluation through				recognition of expertise by other participants inside the network
Position of learner-instructors	Learners are empty, instructors can shape what they want	Learners are empty	Learners have experiences so they have more active role to self-lead	self-control and can even change role with instructors
Application	Small children who are eager with rewards	Important to develop a learner (toward a student)	to a mature learner, life-long learning	those who are eager to learn and master technology, those who have capacity to study more
Instruction should be	repetition and reinforcement/punishment	graps someone's attention and help them make sense of information and record it. (we provide input in a disciplined way for students to memorize and then create opportunities for that memory to be practiced)	create meaningful context; guiding problem solving, leading and facilitating	Facilitation: Nurturing and maintaining connections is needed for continual learning

Continued on next page

Table 2.2 – continued from previous page

	<b>Behaviourism</b>	<b>Cognitivism</b>	<b>Constructivism</b>	<b>Connectivism</b>
Pedagogical approaches	behavior modification, classroom management, instructional objectives, contingency contracts, computer-based instruction. Online quiz (facts, concept, skills), drill, practice	organized instruction, extensive and variable practice, encoding memory by figures, charts, pictures, recordsrehearsal, review, mind-mapping tools	group discussion, role playing, debating, reasoning, critical thinking, understanding and use of knowledge, ill-structured curriculum, learner-centered, collaborative learning, real-world internship	"Our ability to learn what we need for tomorrow is more important than what we know today" Email, forum, blogs, google, Youtube, Moodle
Criticism made by later theory	How does reward stimulate behaviour?	How is transferred information stored in the brain?	What is a model and how is it created? (A vague concept?)	
	developed in the time not impacted by technology, learning occurred inside a person			A pedagogical view, not a theory. And that knowledge is stored in non-human appliances was not new (books, calculators)
Authors	Skinner, Pavlov, Watson	Piaget, Bruner	Piaget, Vygotsky (social constructivism), Glasersfeld (radical constructivism), Dewey	Siemens, Downes

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### **2.4.2.1 Behaviourism**

Behaviourism is understandable from its label: the theory based on the notion that a behaviour or reaction being made by conditioning. Behaviours can be formed, changed and monitored regardless of learner's backgrounds, emotions or moods. Learning for grown adult means getting to know new behaviour from the environment through forms of conditions, rewards or punishment. Different behaviour will be shaped under different condition or environment.

A very famous saying of the 'father of Behaviourism' about our blank minds since we were born is the exact illustration of behaviourist teaching perspective

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select - doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors (John Watson, Behaviorism, 1930)

The main principles of behaviourism have a visible impact on third level education, producing the appearance in the curriculum of behavioural objectives/outcomes, the importance of feedback, skills development and training, computerised and programmed instruction, competency-based education, and constructive pre-alignment of content, teaching methods and assessment (Ashworth et al., 2004).

### **2.4.2.2 Cognitivism**

While behaviourism does not value the internal process of understanding as much as the outside stimulus, "Cognitive psychology is the scientific study of mental processes such as learning, perceiving, remembering, using language, reasoning and solving problems" (Pritchard, 2009). The process of cognitivism is looking at how information is received, organized and stored by one's mind. A student's mind acts as a 'knowledge processor' therefore it is easy for him to perceived structured instruction through 'schema theory'. Therefore, changes in learning and mental process according to cognitivism are not simple to observe or evaluated. Example of cognitivist tools in classrooms are tables, lists, quizzes, and other visual aids that could help students to learn difficult concepts step by step from the basics. Cognitivism sees that what learners already know is of large significance to his learning process. James Hartley (1998) puts cognitivist educational activities as 'learning results from inferences, expectations and making connections. Instead of acquiring habits, learners acquire plans and strategies, and prior knowledge is important. Additionally, individuals have different strengths and are likely to perform very differently.

### 2.4.2.3 Constructivism

Humanism, although not very immensely developed, worths mentioning before constructivism as an important philosophy in valuing human being individually and collectively. Learners are the center of the classroom while teachers only play the role of facilitators.

Constructivism and other progressive learning theories obtain the idea of learner-center from humanism and employs reasoning of mental processes and prior experiences from cognitivism. Recognized from latter half of 20th century, constructivism seems to be a step forward from cognitivism because it also stresses on the process of knowing. Jean Piaget with four stages of growth is a researcher of both schools of thoughts for this reason. However, instead of examining only individual cognitive structure, constructivism values the interactions with the environment.

According to constructivism, learning is the process of building and adding new information to learnersknowledge, based on their own prior understanding (experiences) and surrounding environment. Students therefore could understand the perspective by themselves and could even transfer it to another new intelligence. Using interactive teaching strategies in meaningful actual contexts will engage, motivate and empower students with communication skill, collaboration skill, critical thinking and problem solving since they are active contributors to the problem or concept. Constructivism is exclusively suitable to apply in subjects related to developing thinking skills and problem solving skills and sustainability issues is definitely among these subjects. The implication for higher education students are numerous, as narrated by Ashworth et al. (2004), including learning to learn, experiential learning, shared and negotiated learning, social contextualisation of learning, self-directed learning, group work, creative problem solving, guided discovery, and reflective practices. Role play, debating a current issue, cooperative learning, internship as real world experiences is part of applied techniques derived from constructivist theory.

There is a branch of constructivism called social constructivism which is made famous by Vygotsky (with the Zone of Proximal Development) and Bruner (Pritchard). It insists that working collaboratively, in pairs or small groups, and dialog with peers is an obvious socially constructive approach to learning. All of these arguments are very useful in concluding a proper pedagogical approach to utilize diversity in sustainability learning.<sup>1</sup>

### 2.4.3 Newer theories that support the idea of diversity or sustainability

Nowadays, there are a number of learning theories that emphasize on the activeness of the students and we are able to use them to analyze how constructive of students' component could be for modern education. Specific methodologies employed might include or emphasise experimental and

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<sup>1</sup><http://people.uncw.edu/huberr/constructivism.pdf>

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co-operative learning; systemic thinking patterns, soft boundaries and ‘fuzzy logic the clarification and judgement of values; ideology critique; critical reflection and creative thinking; the envisaging of sustainable futures (Huckle and Sterling, 1996).

**Four pillars and the fifth** By adding the fifth pillar to learning to ‘know, do, be, live together’ of Delors (1996), researchers have put forward the claim about the changing in patterns of teaching and learning (2.1.3.1). The knowledge is not limited in each student’s own world but it should be transferred to a part of power for changing the society. By reaching that point, students must be able to well manage the resource for themselves (to know, to do, to be) and for collaborating and sharing with others (to live together).

**Multiple intelligence** With criticism to the IQ test, which has tried to measure logical analytical or spacial ability, Gardner argued that human beings have a wider variety of intellectual capacities. Multiple intelligences theory (Gardner, 1983, 2011; Pritchard, 2009), which was as a result developed with seven basic types of intelligences: verbal-linguistic, mathematical-logical, visual-spatial, intrapersonal, bodily-kinaesthetic, interpersonal, and musical-rhythmic. A few years later, he added naturalist intelligences and then proposed two other possible intelligences: existential intelligence, the intelligence of ‘big questions’; and pedagogical intelligence, the intelligence that allows human beings to convey knowledge or skills to other persons. These intelligences (or sometimes being referred to as competencies/capacities/biopsychological potential) value every capability of a human being as a resource for the sake of learning, regarding those who are good at music, sports, crafting, working/talking with other people, etc as much as those who are good at maths and literature as long as they can solve certain problems. Besides, being strong in one capacity has no correlation to strength of weaknesses in other platform.

**Connectivism** as referred to Siemens (2004, 2005, 2006) and Downes (2007, 2012); Dunaway (2011). Connectivism provides another interesting points about evaluating an educational system. The theory is recently developed, in the circumstance of rapidly changing society, when technology can take over and explore so many new things that people were not be able to achieve before. Sustainability education can be placed here, as it shares the same characteristics: broad and changing. Because one cannot acquire all information himself, he needs networks; and as long as he could form connections, that is when learning occurs. One central argument is that, what we learn today is not as important as acquiring the ability to learn what happen in the future. It is exactly true when we think of uncertainty of sustainability problems. Therefore, as no one is the master, SE needs connections between



multiple entities. Educator's role is sometimes flipped, from teaching to facilitating, which is to nurture and maintain connections. Connectivism is compared with traditional theories in Table 2.2.

**Peeragogy** is recently developed exclusively for self-motivated students who are interested in learning, collaborating and advancing.

Participants must bring self-knowledge and no small measure of honesty to the peer-learning project in order to accurately enunciate their motivations. If everyone in your peer learning project asks “What brings me here?”, “How can I contribute?” and “How can I contribute more effectively?” things will really start percolating. Test this suggestion by asking these questions yourself and taking action on the answers! (Rheingold et al., 2015).

It focuses on peer learning (or co-learning) and quite similar to connectivism, it bases participants mostly in the space of online programs. Materials about peeragogy is an open source<sup>1</sup> where anyone can access and contribute, which is also a form of mutually learning and teaching. It is still at the early stage with little empirical evidences as well as practices but many of the learning technology that peeragogy introduces and its real-time suggestions from practitioners are very helpful in applying at schools.

**Adult learning, Heutagogy, and further** are in line with Andragogy (Section 2.4.1). Adult learning, sometimes referred to as life-long learning, is reflected in a set of methodology designed for the special characteristic of grown-up people:

Adults are characterized by maturity, self-confidence, autonomy, solid decision-making, and are generally more practical, multi-tasking, purposeful, self-directed, experienced, and less open-minded and receptive to change<sup>2</sup>

Heutagogy as well as flipped classroom, as at the same ground, is the recently developed philosophy about self-directed learning and self-determined learning (Bidokht and Assareh, 2011). These theories are specially significant reference resources when we think of teaching and learning methodologies in higher education.

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<sup>1</sup><http://peeragogy.github.io/>

<sup>2</sup><http://elearningindustry.com/>

### 2.5 Conceptualize sustainability education from pedagogical point of view

Both classical and modern learning theories have implications for pedagogy in sustainability education. Learning sustainability is a process of acquiring knowledge and training oneself to a set of skills and values (Section 2.1.3.1) and the appropriate pedagogy should closely serve those goals. The discipline of sustainability is featured by the presence and collaboration of earlier disciplines, in depth and breadth, that forming the shape of T. This shape of T, requiring learners to find deep understanding on at least one discipline and be capable of handling dynamic skills on general schemes, suggests us to think of constructivism as the nearest methodology to share the world of sustainability knowledge. Constructivist theory is built upon the criticism towards behaviourism that the mind is a blank slate or cognitivism that it merely processes internally logically just like a computer. Learners are said to be already filled with understanding about certain matters prior to class attendance, especially true in higher education, and therefore learning can be originated from instruction but nurtured from experiences and reflection within a dynamic environment. Constructivism values both individual efforts and the surrounding human resources (learning environment) that without one of the two, one cannot learn to his best. In short, four factors lead to an education, according to constructivism, are instructed information, prior experience and knowledge, continuous reflection, and an interactive environment. Bruner said that mind is active, constructive and participatory and perception is not passive. Instructional knowledge is not the most significant part of the learning process, meaning instructors should be a facilitator or guide instead of the leader and commander. Studying sustainability through constructivist pedagogy would help learners understand the subject matter to the fullest because of contribution from different disciplines and locals. In this research, the attendance of student diversity is strongly believed to greatly enhance the ability to advance one's knowledge of complex problems like of sustainability.

Among the newer learning and teaching strategies for adult education, connectivism is very prospective as it mentions the type of learning in which modern learners are placed in a flat world. Noone is the master of the knowledge when everyone have their own skills that they can actively bring to the table. The component of "instructed knowledge" seems fading as learner can easily resort to a great variety of learning tools like Google or Moodle. The problem of the society, also one of the sustainability problems, is that communities are fragmented and persons are too independent to solve common disturbances, despite the fact that contemporary world is closely interrelated. These two factors lead to the idea of learning by forming conceptual connections and forming networks. The collapse of networks and collaboration may cause unsustainability,

## 2.5 Conceptualize sustainability education from pedagogical point of view

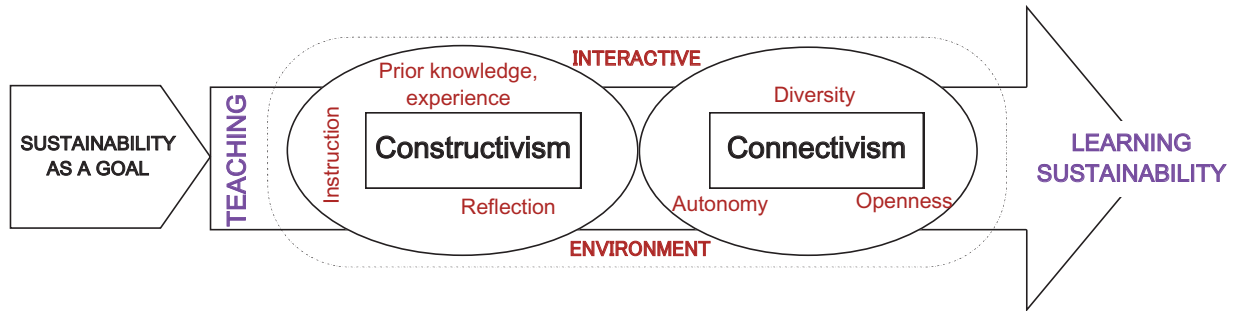


Figure 2.1: The concept of sustainability education and its pedagogy

or in other words, creating and maintaining networks are vital to the development of the society. Siemens says that education is not about building a better Googler, or a better worker for the cooperate's sake, but for a better society. Our citizen nowadays are assumed that once we know about where the source of knowledge is (the expert, the search tool), we would be able to master the knowledge. Forming connections are also the way to train one's collaboration skill and the ability of tackling with multi-faceted issues for both present and future.

As a combination, Figure 2.1, constructivism is for forming the building of knowledge (vertical T) and connectivism helps with broadening one's vision and outreach (horizontal T). However, it should be noted that, the structure is not exactly like T-shape, which means after knowledge construction we will start to connect it. These two process should be conducted almost at the same time, integrated into the whole process of learning. Through constructivism and connectivism, we are more or less able to see how the diversity of student could contribute to sustainability education. The presence of multiple types of knowledge, both academically and culturally, is hypothesized to enrich the learning process of the students. What teachers should do to enhance this resources could be probably related to this two pedagogical views.

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## Chapter 3

# Methodology

### 3.1 Methodology introduction

#### 3.1.1 Background of main methodologies

##### 3.1.1.1 Qualitative and quantitative data collection

Social educational type of research often requires the practices of qualitative methods. As adding quantitative data is always recommended, this research utilizes a mixed methodology supported by technique of triangulation.

Qualitative data is a powerful tool to richly understand the social context of every case study, such as how the numbers are collected, how one situation is judged or how a person reacts/behaves (Lichtman, 2010; Silverman, 2006). However, qualitative research is criticized as easy to cause ambiguity, confused structure and word-finding difficulties (Lichtman, 2010), cannot either control and predict the trend of the population or produce precise findings (see Merriam, 1998).

Quantitative data, on the other hand, are very logically persuasive with clear tables, figures, numbers and statistics but it cannot explain complex relationships and intangible future impacts. Quantitative research often provides reliable knowledge and strong evidence to objectively report phenomena. However, using mere statistical information often leaves gaps between its measures and reality especially when applied in educational practice (Krenz and Sax, 1986; Lichtman, 2010; Savenye and Robinson, 1996). Qualitative research can overcome this drawbacks by providing contextual information and reasoning with sharp criticism, but then always criticized as being reflected subjectively from the insiders' opinions and prejudices (Merriam, 1998). Then mixing multiple methods arise from the weakness of each method.

Among the three main ways of combing quantification and qualification, this research follows the second instruction of Silverman, as beginning with a quantitative study in order to establish a sample of respondents and to establish the broad contours of the field, then using qualitative

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research to look in depth at a key issue using some of the earlier samples. There are several ways to obtain primary data like focus group discussion, interview, questionnaire survey, participant observation, field work, case study (Bogdan and Biklen, 1998). Depending on what results are needed, it could be qualitative or quantitative methods, for example closed (or structured) interview is to collect quantitative but semi-structured or open-ended interview provides us qualitative information.

#### 3.1.1.2 Case study

A case study is an empirical inquiry that investigates a contemporary phenomena within its real life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 1994). Case study method is widely said to be a common and appropriate tool for research in education, especially sustainability education in higher education (Corcoran et al., 2004), which can help describe, understand, explain and compare multiple cases (Rowley, 2002; Tellis, 1997) and to develop a better understanding of the dynamics of a program that could convey a holistic rich account of an educational program (Kenny and Grotelueschen, 1980; Merriam, 1998). Two types of case study are known: exploratory and descriptive cases, different from each other regarding the way theoretical framework is defined. This part of research is conducted more as a descriptive case as it begins with research questions and defined theory, then observe the cause-effect of the educational programs. This study utilizes almost all six sub-methods that Robert Yin developed for a case study, which are documents, archival records, interviews, direct observation, participant-observation, and physical artifacts (Tellis, 1997; Yin, 1994, 2003).

In studying the cases, supporting approaches like theory of change (a logic model), critical success factors and observational comparative study would be used.

Theory of change (Beisser, 1970; Rogers, 2014; Weiss, 1995) describes and illustrates how changes happen in a particular context. The model helps researchers mapping out the structure of the educational process in a logic way so that desired learning outcomes could be observed and adjusted accordingly. It also serves the goal of evaluation and assessment. Sometimes the term is used generally to refer to any version of this process, including a result chain, which shows a series of boxes from inputs to outputs, outcomes and impacts, or a logframe, which represents the same information in a matrix (Rogers, 2014). More discussions about the theory could be found at its community's website<sup>1</sup>. This research uses the preconditions, causal pathways, interventions (activities), outcomes with some assumptions to examine similar programs related to research topics.

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<sup>1</sup><http://www.theoryofchange.org/>

Critical success factors (CSF) (Rockart, 1978; Selim, 2007; Slevin et al., 1991) is a method originally used in organization management, proposing the elements that are vital for successful business operation and guidance for proper policies and strategies. To Howell's point (2009), CSF is simple to understand as they draw attention on concerns and factors critical to the success of the initiative regardless of what that initiative may be. They can be a part of the strategic planning process, system, or program implementation and are easy to monitor. CSF helps us to find why a factor is important to an organization. Therefore, CSF is applied in seeking what and why makes the educational program be sustainably continuing.

Comparative study is a technique that mostly use observations to compare certain aspects of two or more groups. Both qualitative or quantitative data could be involved, for example comparing household responses to poverty and vulnerability in four poor urban communities (Moser, 1996) or comparing various tests for normality (Shapiro et al., 1968). Whenever more descriptive details are preferred to have better insights about some problems, this type of observations and discussions with participants is of great useful.

#### 3.1.1.3 Lesson study

*“Lesson study is a professional development practice in which teachers collaborate to develop a lesson plan, teach and observe the lesson to collect data on student learning, and use their observation to refine their lesson. It is a process that teachers engage in to learn more about effective practices that result in improved learning outcomes for students”* (Stepanek et al., 2007)

Lesson study is one of the goal-driven action-research activities aiming at improving the quality of teaching from the collective effort of teachers, researchers and even students. Stepanek et al. (2007) suggest a circle of steps including five core elements:

1. Setting goals (a research theme identified based on demands of stakeholders-school managers, parents, students or teachers themselves or on problems needed to be solved);
2. Planning the lesson (the lesson study team develops a classroom lesson, called research lesson, including specific lesson goals);
3. Teaching, observing, and debriefing (One teaches, others observe and serve as data collectors. Observers take note student thinking, gathering data about the effectiveness of the lesson, not to evaluate the teacher. After that, a debriefing, sharing the evidence of student learning is done);
4. Revising and reteaching (After addressing students' problems and misunderstandings, the lesson is revised and taught to new groups of students while the processes of observing and debriefing are still going on);

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5. Reflecting and sharing results (Materials of before and after revision are presented/published with reflections and group discussion summary);  
and then back to setting goals again for further round of improvement.

Sometimes exist the experts or researchers join, also known as the outside examiner, invited advisor, or reactor to share the work or provide extra insight to the process of doing lesson study.

Lesson study is very useful tools for school education (primary and secondary basically) and gain specially popularity in Japan (Fernandez, 2002). Although lesson study in higher education does not attract much investigation, some techniques of it could be the essence to conduct research in local area, especially places like Vietnam where majority of lectures are conducted as traditionally as classroom-based lecture.

Other related tools include action research, study groups, curriculum development, peer coaching and mentoring and examining student work (Mitchell, 1999). Action research is to examine teachers' own teaching and their students' learning by engaging in a research project in the classroom, simply involving four stages: 1. Clarifying vision and targets; 2. Articulating theory; 3. Implementing action and collecting data; and 4. Reflecting on data and planning informed action (Sagor, 2004). To determine what is currently occurring and to test a hypothesis (theory) is the two key targets of action research which very much suit the aims of this research. Using both techniques of action research and lesson study would set smooth fundamentals for understanding the case in Vietnam.

#### 3.1.2 Research design

As stated in the introduction part, the treatise will be designed in a way that best answers to the research questions and objectives.

Firstly, research questions are raised after considering objectives of the whole research. Literature helps build up preliminary study and a questionnaire followed by interviews are central data collection sources. Research questions are partly answered through these first two steps and then verified by a number of case study. Finally what is suggested after obtaining those results will be applied/tested in a study case in Vietnam. Along the way of doing the research, the research questions and objectives are constantly adjusted to fit in the contemporary situation (real-time study) and methods are ensured to correlate to make the most use of triangulation.

A five-component methodology is developed as following to support the logic flow:

- A questionnaire to some worldwide networks of educators;
- Some deep interviews to selected respondents;



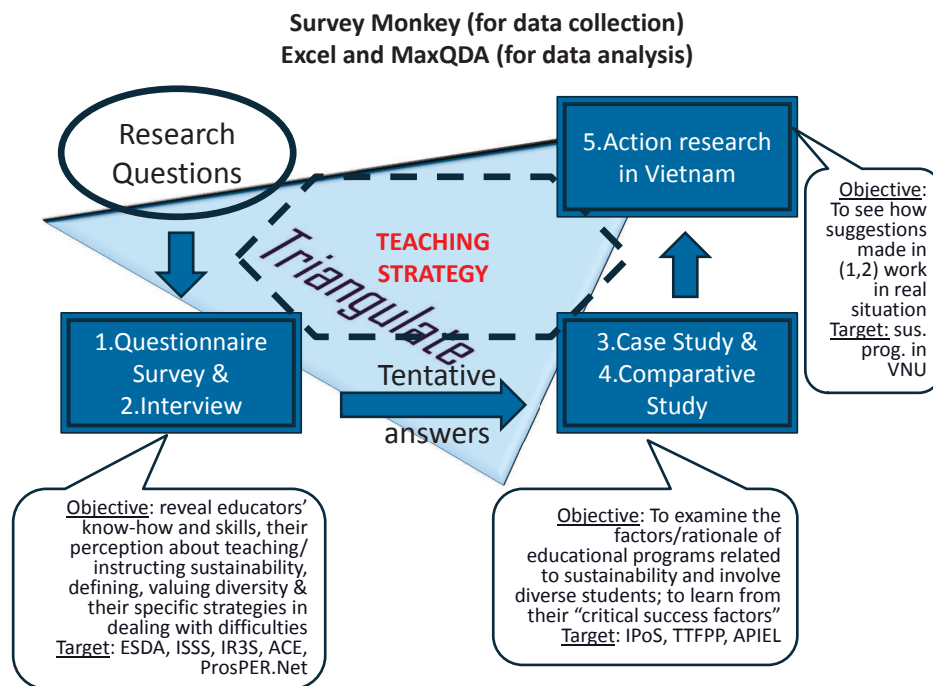


Figure 3.1: Methodology framework of the research

- Three case studies: IPoS, TTFPP, GPRD analysed under the theory of change;
- An comparative study to see students' feedback; and
- A lesson study in Vietnam as an action research.

Again, the study relies on a qualitative research but uses mixed data and analysis on all accounts. Figure 3.1 is an overview of the research design. The details will be explained in the following sections.

### 3.1.3 Supporting techniques

Triangulation is used for cross-checking results in components, which is quite popular in social research. Although both Bogdan and Biklen (1998) and Silverman (2006) pointed out the challenges of using mix methods, using a wide variety of methods to collect data, usually known as triangulation of methods, is effective in cross-checking the results from different sources. Triangulation is used to strengthen the discussion logic and verify the conclusions, especially in case one single method does not provide enough data; or the possibility of having bias/subjectiveness is high; or the research matter is too complex (Savenye and Robinson, 1996; Tashakkori, 2006).

### 3. METHODOLOGY

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Jick (1979); Morse (1991) point out some benefit from triangulation of methods, such as it allows researchers to be more confident of their results; it helps to uncover the deviant or off-quadrant dimension of a phenomenon and divergent results from multi methods can lead to an enriched explanation of the research problem. However, it should be noted that triangulation technique cannot be applied in all cases, depending on time and resources used, as well as on overall goal of the research (to be precise or holistic). Widely-covered research problem such as sustainability education definitely need the contribution of triangulation.

Other tools include Survey Monkey, Excel sheet and MaxQDA. Survey Monkey is a questionnaire tool for creating and publishing online surveys. Subscribed with a professional plan, the researcher is able to customize the questions for the comfort of respondents as well as to retrieve real-time results, text analysis, an integration with SPSS under high privacy protection (Finley, 2007). It is good for conducting a worldwide survey as in this research, enabling respondents to answer or come back to the last point anytime they prefer. Microsoft Excel Spreadsheet is used for arranging quantitative data and MaxQDA is for the qualitative. MaxQDA is one of the popular computer-assisted qualitative data analysis softwares that help users with coding, aggregation, query, visualisation for a better arrangement of data. It is recommended as a professional software for mixed methods data analysis, including unstructured data like interviews, articles, media, surveys and so on (Kuckartz, 2007; Schönfelder, 2011).

## 3.2 Questionnaire survey

**Objective:** The questionnaire, one of the two survey studies, is the very first stage to acquire general answers to the central research questions. It is designed in order to reveal educators' general knowhow and skills, their perception about teaching/instructing sustainability, defining or valuing diversity as well as their specific strategies in dealing with difficulties caused by heterogeneous students' interaction.

**Hypotheses:** In developing the questionnaire, it is hypothesized that:

- Diversity helps promoting skills needed for sustainability education;
- More experiences in sustainability teaching and instructing means more value for diversity of students;
- Well done class interaction will be the key of an effective education;
- Inputs from experienced teachers in various study fields give hints for developing pedagogy/methodology in SE towards diversity.

### Questions assumed to be answered:

- Meaning of teaching sustainability and how it is different from teaching other subjects to see whether knowledge or skills on sustainability or others is regarded;
- The most popularly applied pedagogy for teaching sustainability;
- Solutions for typical difficulties caused by diversity.

**Targeted respondents** are educators (mostly lecturers or instructors) have working experiences related to higher education, who have had certain concern about diversity and/or sustainability. Some international networks are taken into account for collecting data, such as:

- **ESDA**: The **E**ducation for **S**ustainable **D**evelopment in **A**frica is a project sponsored by the United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS), aiming at developing graduate-level education programme for professionals to be engaged in sustainable development in Africa. The project does not only involve African partner universities in, for example Kenya, Ghana, South Africa and Nigeria, but is also contributed by Japanese, United Nations (UNESCO, UN-HABITAT, UNEP) and other international experts<sup>1</sup>.
- **ISSS**: The **I**nternational **S**ociety for **S**ustainability **S**cience (ISSS) was initiated through the annual meetings of International Conference on Sustainability Science (ICSS) since 2009. It is the collaboration of strong academic institutions of diverse academic fields worldwide to foster a sustainable future based on scientific promotion<sup>2</sup>.
- **IR3S**: The **I**ntegrated **R**esearch **S**ystem for **S**ustainability **S**cience is an initiative from 2005, run by the University of Tokyo in collaboration with five big universities in Japan (Kyoto University, Osaka University, Hokkaido University and Ibaraki University) and numerous cooperating institutes. From 2013, it joined the Todai Institutes for Advanced Study (TODIAS) which combines the world-leading research institutes within the University of Tokyo and has been actively involved in international meta-network of sustainability science<sup>3</sup>.
- **ACE**: The **A**sian **C**onference on **E**ducation is an event organized by IAFOR. By 2015 ACE marked the seventh conference which are gaining more and more popularity among educators around the world. Having had a chance to join the conference, ACE is one of the channel to enlarge the respondent population<sup>4</sup>.

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<sup>1</sup>More at <http://isp.unu.edu/research/esda/> retrieved November, 2015

<sup>2</sup><http://sussci.org/> retrieved November, 2015

<sup>3</sup><http://en.ir3s.u-tokyo.ac.jp> retrieved November, 2015

<sup>4</sup><http://iafor.org/conferences/ace2015/> retrieved November, 2015

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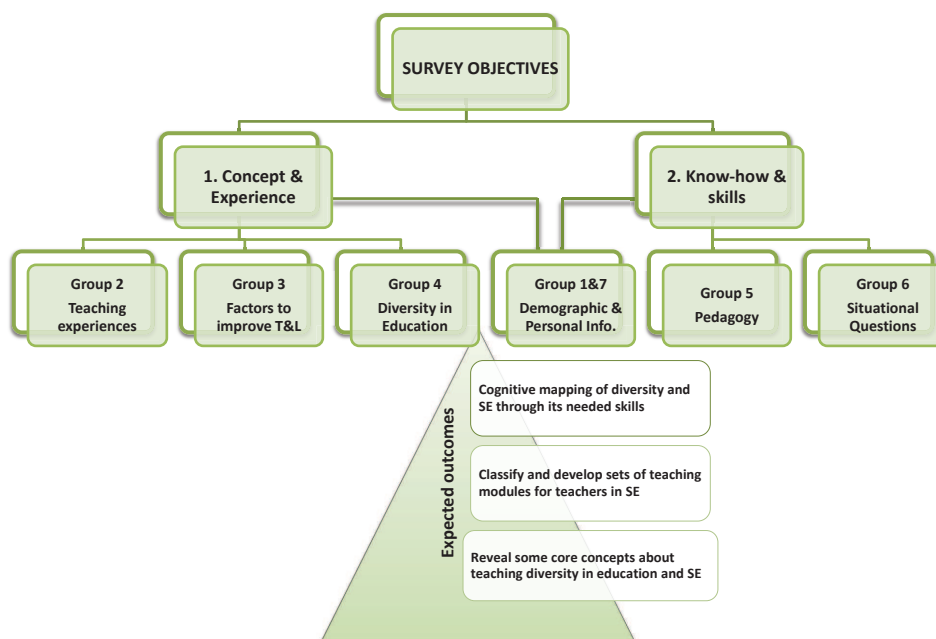


Figure 3.2: Structure of the questionnaire

- ProSPER.net: The (**P**romotion of **S**ustainability in **P**ostgraduate **E**ducation and **R**esearch **N**etwork) is an alliance of leading universities in the Asia-Pacific region from 2008, aiming at nurturing a new generation of leaders to tackle with environmental challenges for a more sustainable society and at guiding better teaching strategy for sustainability in higher education institutions. Its diverse list of members could be found at its webpage<sup>1</sup>, including universities from Australia, China, India, Indonesia, Japan, Malaysia, the Philippines, Korea, Sri Lanka, Singapore, Thailand, and Vietnam.

From the above description, although the chosen networks sound more ‘Asian’ than ‘Western’ but it does not mean shortage of American and European delegate recorded. Sustainability education has not been a mature discipline itself yet, therefore limitation of the choice of respondents is that it does not make sure the coverage of all educators of research concern. However, the strong point is current respondent networks meet the requirement of representativeness, inter-nation and multi-discipline as well as it can. Besides, succeeding studies would make up what is unclear in this questionnaire survey.

**Procedure:** When the final draft of the questionnaire is done, it is consulted with professors

<sup>1</sup><http://prospernet.ias.unu.edu/about-prosper-net-page/current-members> (retrieved November, 2015)

and colleagues for revision. After that, sending out for pilot survey is one of the critical factor before the official launching. Post-revision is done at the same time as finding the targeted respondents through related networks. The key point of conducting this survey is to contact the respondent individually to increase the sample to the best extent possible since most of the prospective informants are highly packed with multiple tasks (at their host institutions and within the networks). The answers are collected through online service of designated website (Survey Monkey).

**Structure of the questionnaire:** Questionnaire comprises of two parts, looking for answers about the educators' concept/experiences and their knowhow/skills (see Figure 3.2). Questions are arranged in two categories:

- Perceptual Questions
  - Gender, organization, position, background
  - Tenure, sustainability concept, teaching and research plan regarding sustainability
  - Important factors of education, class setting which affects instructing methodology
  - Perception of Diversity
  
- Practical Questions
  - Choose one course and describe content, structure, teaching methodology and observation of students
  - Provided with five situations within three settings (lectures, group-working and final outcomes) and, respondents are required to provide reactions to each situation related to difficulties caused by diversity.

Questions in full can be seen at Table 3.1.

### 3.3 Interview

**Objective:** Conducting deep semi structured interviews to some experienced teachers are effective way to understand more about what they answered in previous questionnaire by clarifying their real experience with diverse class and their notion about sustainability. Interesting examples and stories were also expected to be provided. Contents of the questions to be asked involve but not limited to:

- Facts and Background: Experience with ESD, how they actually teach the class;

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- Knowledge: Further opinion or perception about ESD and diversity;
- Opinions/values: towards the presence of mixed students, what happened in reality;
- Behaviors when facing troubles by diversity and explanation.

**Targeted respondents:** Questionnaire’s informants who have long experiences with ESD or diversity and are willing to provide more inputs to the research.

**Methods:** face-to-face individual meeting by semi structured questionnaire and email-exchange afterwards.

#### 3.4 Case study research

**Objective:** To examine the factors/rationale of educational programs related to sustainability and involve diverse students and to learn from their “critical success factors”. In conducting case studies, main points to be revealed are:

- How is the program operated?
- What factors make the program last over time? How does it gain the popularity and acceptance from stakeholders?
- Does diversity play any role in helping the students learn better and how have lecturers/instructors perform over the hardship that may cause by diversity?

**Targeted cases:** Three cases are picked up, representing three study programs of different institutions. The common point of these cases is that they enable learners to gain more understanding and competencies of solving sustainability problems. Furthermore, participants come from various backgrounds and spend a concentrated time to co-work toward a shared proposal. Hardship, enjoyment, tiredness as well as new experiences may all arise at the same time, leave space for such kind of research.

1. IPoS (Intensive Program on Sustainability) is a short term ‘centralized’ course providing various conditions to learn more about sustainability from a certain perspective. This program is joined by (mostly) graduate students of the University of Tokyo (UT), the Asian Institute of Technology (AIT) with participation of partners like Alliance for Global Sustainability (the AGS), the Sustainability Science Consortium (SSC) and the Nissan Science Foundation. IPoS was partly inspired by an earlier initiative in 2001 Youth Encounter on Sustainability (YES)<sup>1</sup>.

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<sup>1</sup>More information at <https://actis.myclimate.org/>

2. TTFPP (Third Trimester Field Practical Programme): The University for Development Studies of Ghana has been implementing TTFPP for years with the vision of blending academic programmes with local communities to provide students with more holistic viewpoints upon graduation. The case is chosen to study in this research for the reason that mixing students and take advantage of every participating discipline is believed to be beneficial to learners and many other parties.
  
3. APIEL-GPRD (Asian Program for Incubation of Environmental Leaders, Greater Pearl River Delta Unit): APIEL is an educational program designed for students of two departments, the Graduate Program in Sustainability Science (GPSS-GLI) and Department of Urban Engineering of the University of Tokyo, in collaboration with universities in Asia such as Sun Yat-sen University, China; Mae Fah Luang University, Thailand; Asian Institute of Technology, Thailand; Chulalongkorn University, Thailand; Kasetsart University, Thailand; Asia Institute of Energy, Environment and Sustainability (AIEES), Seoul National University, Korea. GPRD is one of the unit organized by APIEL that takes place in Hong Kong and Guang Zhou.

**Methods:** Theory of change and critical success factors will be the foundation for understanding and comparing the cases. Data are collected from websites, official reports, field photos, interviews with practitioners, observation, discussion but not to be applied to all case equally.

### 3.5 Comparative study

**Objective:** To learn about differences between working groups with and without being attended by diverse students under comparatively similar content and context.

**Implementation:** Observation and interviews are the main means to examine the case. The researcher participates in two discussions led by the same presenter: One includes members who share roughly the same research topic and already understand the background of each other prior to attending the discussion; one includes members who are from different social and natural backgrounds and not all participants are familiar with the presented research problem. Two presenters are picked up to study, which means four discussions are observed. After attending the presentations, the researcher performs interviews with presenters to know their reception of inputs from two different group settings and how they can learn from each of those.

#### 3.6 Action research: Lesson study

**Objective:** Conducting survey study and case study, tentative answers for overall research questions can be acquired. Upon these findings, methodologies to recommend for educators are also extracted, which are then used for testing in a specific situation. The purpose of lesson study is to verify and contextualize what is gained after above steps or in other words, to see how those findings can change students' learning in reality. This is the last step in those of triangulation.

**Research field:** Vietnam is chosen as a field research for being a developing country with early establishment of sustainability education and having space to be improved. Vietnam National University (VNU) has just launched a VNU Master Program in Sustainability Science (MPSS) and claimed itself to be the first in South East Asia, therefore it would be the right time to further study about sustainability education through this case. First, I went to Vietnam to conduct a general study of young faculty's perception about sustainability education as well as doing interviews with some experienced professors to get the overview picture about this emerging field in Vietnam and its prospective. In the second visit, I propose what is suggested in previous study that fit the context of Vietnam and discuss the changes with the professor in charge so that he can apply these changes in the lectures. I myself am responsible for instructing workshop and work with students to understand them better. Followed by talks with students as well as faculty members about pedagogy and curriculum improvement, the experiment is fulfilled to be input in final results of whole research.

Details of survey and lesson study (questions, steps) are provided along with results.



### 3.6 Action research: Lesson study

Table 3.1: List of questions in the questionnaire

QUESTIONS		
Part I. Attitudes and Experiences	Group 1: Demographic Information	1. What is your gender?
		2. What organization are you affiliated with?
		3. What is your current position?
		4. Please list your main fields of research and education
	Group 2: Teaching Experiences	5. How many years have you been teaching, both formally and informally?
		6. (Definition given as suggestion) What is your concept or idea regarding teaching sustainability?
		7. Have you ever taught sustainability from that perspective? (Yes or No)
		8.1 If Yes: How long is this experience of teaching sustainability?
		8.2 If No: Do you have any intention/plan/interest in teaching sustainability or in relating its content to your current courses?
	Group 3: Factors to improve teaching and learning	9. In your experience, to what degree do these factors bring about effective teaching and learning?
		10. Please elaborate on your response to the question above, if you find any factor that has special role in leading to effective teaching and learning.
	Group 4: Diversity in Education	11. How do you concern about a class setting? In other words, do you find it necessary to learn about the class component, students' background or their attributes prior to deciding the appropriate pedagogy for every course?
		12. Among numerous dimensions of diversity of students [Examples given], three groups could be formed: Group 1. Background diversity of student (including background knowledge, prior experience... diversity) Group 2. Cultural diversity (including ethnicity, race, ideology, language... diversity) Group 3. Individuality diversity (such as age, gender, personality, sexual orientation... diversity). Does this grouping make sense to you?
		13. The effectiveness of education itself depends on many factors as discussed in the previous section. If only take the "diversity of students" factor into account, in higher institutions, how significant are the following types of diversity for student education?
14. Concerning some certain learning outcomes for students in higher education, does diversity play any role in improving these two skills (personal and interpersonal) exclusively?		
Part II. Knowhow and Skills	Group 5: Pedagogy  (teaching methods)	15. Please recall ONE specific course that you have taught before. To what extent did that course have the following characteristics? (Sustainability in contents/pedagogy, student's majors and student diversity)
		16. Name and brief content of the chosen course
		17. How did you develop the structure (lecture, group discussion, home assignment) of the course?
		18. Are there any special features of [the course you mentioned] that encourage you to apply different pedagogy as compared to your other courses? (Yes or No)
		19.1 If No: Could you please briefly narrate your most applied pedagogy?
		19.2 If Yes: Could you please briefly show the special features in this course and your corresponding pedagogy?
		20. How often do you observe/sense student reactions or ask for reflection from the students about your lectures in that course?
	Group 6: Situational questions	(State the frequency in encountering these following situations and your corresponding reactions)
		S1. A student asks a question, makes a comment or uses gestures that you infer it as being disagree with what you are lecturing about, despite your whole efforts in instructing the content
		S2. A student/students seem(s) not to understand the contents of your lecture(s) or some messages that you try to deliver during course
S3. Students fail to achieve a consensus after a given time of discussion		
S4. Some students do not join the discussion or some seem to be left behind in the discussion		
	S5. Students do not acquire the minimum expected knowledge/skills.	
Group 7: Personal Information	Name, contact address, email, phone number (optional)	

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# Chapter 4

## Results

### 4.1 Questionnaire survey

#### 4.1.1 Demographic information

The considered networks consist of about 200 members. After constant effort made to expected informants individually, as many as 45 full responses are collected.

General information of respondents could be viewed at Table 4.1. Three fourths of them are male, only 23.8% are female educators. Two thirds of the respondents are professors and associate professors in various institutions all over the world, such as in the U.S. (Georgia Institute of Technology, Arizona State University, George Mason University, East-West Center in Hawaii), in Italy (Sapienza University of Rome), Germany (Leuphana University Lüneburg), Sweden (Lund University), Japan (Kanazawa University, Hokkaido University, Tohoku University), Thailand (Chulalongkorn University), Nigeria (University of Ibadan), etc... Their majors are not limited to one or two fields but ranged from fields of sustainability (Sustainability Science, Sustainable Energy, Engineering and Sustainability Education...), environment (Applied Ecology, Geochemistry, Environmental Policy...), economics (CSR & Business Ethics, Applied Economics, Political Economy...), to education (Teacher Education, Lifelong Learning, Language teaching/learning...) and many other natural as well as social sciences. “Others” (regarding positions of respondents) in table include Researcher, Education Project Specialist, Associate Professor (fixed term), and other types of lecturers depending on the country. “Other social studies and methodologies” refer to majors on Gender Studies, Psychotherapy, Art Therapy, Music Therapy, Discourse Studies, Framework and Research, Public Management and so on.

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# Chapter 5

## Discussions

### 5.1 Teaching and learning sustainability

Results from the questionnaire tell us how sustainability is instructed. Teaching sustainability means differently from case to case and mostly agreed by respondents that the content (direct objects or integrated issues) and skills of sustainability are two important components that needed to be instructed to students (Figure 4.1). Skills for sustainability cover but not limit to leadership, innovation, technical application, transdisciplinary thinking, critical thinking, systems thinking. Besides, they do not ignore the simple role of sustainability education as doing any discipline in a sustainable way, or creating the environment so that students can learn to take action, to get adjusted with life challenges related to changing societies, act sustainably or even change the society they live.

Indeed, interviews with experienced professors also show that sustainability education is not merely about knowledge provided, is three folded: interest, local community, critical thinking. Both learners and instructors should first be interested in the problem they work and how it could help them in their future life. Critical thinking is improved by interaction. Figure 4.2 demonstrates the importance of interactions among students and with lecturers to the effectiveness of every type of education, just after the role of faculty members. Evidences also support that field trip to local community is very crucial in learning ESD and its values, motivating student to think and act and understand the respect for diversity (for example: internship in Satoyama or nursing houses in the case of Kanazawa university). Sustainability education should enable learners to realize and respect the differences by exposing them to various ways of thinking and interaction with different minds.

ESD is not a far away concept but as simple as realization the education for the sake of both students and local people. In TTFPP case, in order to cope with very complex social problems

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# Chapter 6

## Conclusions

### 6.1 Findings and recommendations

The research brings us better understanding about sustainability education with concern to student diversity. Sustainable development is a dynamic notion without any specific understanding about its mechanism, its forms or its concrete steps to realization. Sustainability education or ESD should serve the duty of educating and training human resources for realizing that desired development outlook. On one hand, SE has to equip learners with enough basic knowledge for understanding our surroundings' movement (the earth, nature, human relationship, development laws). On the other hand, it has to prepare learners with enough capacity to adjust and even manage all scenarios that could possibly happen whenever risk might occur. Teaching sustainability is not necessary to have students learn some knowledge or skill, but to learn how to get adjusted to changing society. The ability to communicate, negotiate, or understand the diversity of values is very much considered among sustainability learning outcomes. In that sense, looking at student diversity as a learning resource, we understand more about how the education is beneficial.

#### 6.1.1 Regarding the mechanism of how diversity impact on sustainability education

Student diversity is not the core reason for individual's failure or dissension. In the first survey to students about how diversity impact their study about sustainability, apart from many benefit, a number of obstacles was recorded. In fact, from teachers' side, factors like students' willingness to involve in the class, basic foundation knowledge, or the class content, also contribute to the misunderstanding or conflict in discussion as well as to degrading teacher-student interaction.

Adverse effect of diversity impact the education in the way that, it is common to remember conflict and disagreement longer and deeper than smooth problem solving process or relationship

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