International Journal of Arts and Social Science www.ijassjournal.com
ISSN: 2581-7922,
Volume 2 Issue 6, November-December 2019.

The roles and approaches of education to sustainable development

Haishang Wu
Waseda University, Tokyo, Japan

Abstract: *Sustainable development has become one of the prioritiesin this decade particular to those developing nations. This paper aims to achieve sustainable development (SD) through education, and propose 3-steps approach to investigate the interplay of environment, society, economy and SD in enabling international education. The study first identified impact factors and measurable metrics; in addition, itinvestigatesthe impacts of education for SD in several tactical areas such as; human capital, environment, library science and culture, to shed light on the SD roadmap.The study applies case study of international education program, as an example, to illustrate the feasibility of SD, and proposes global strategies and approaches.The principles of the global strategy are finally examined in the context of elemental characteristicsdetails necessary for internationaleducation for SD.*

Keywords*: Education, Sustainability, Global Strategies, Human capital*

I. Introduction

Concept of Sustainable Development. The concept of sustainable development was origin from theenvironmentalism.Consciousness toward the *environment* has existed almost ubiquitously in human history. As early as the 7th century, a Caliph in Arabia ordered the army to "bring no harm to the trees, nor burn them with fire." (Aboul-Enein, 2014). In Europe, "environmentalism" was conceptualized by intellectuals such as John Ruskin. The Industrial Revolution contributed to technological and economic growth, but severe pollution jeopardized both human and nature simultaneously, thus environmental issues began to surface. In the last decades of the 20th century, international organizations emerged and conferences onenvironmental subjects were held. Although the term Sustainable Development (SD) appeared prior to it, the WCED "Brundtland Report" in 1987 drew international attention toward SD and yielded the greatest impact of that time.

Sustainable development is a relatively new concept and retains flexibility in its definition. In the Brundtland Report, SD was considered as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (UN General Assembly, 1987). In a UNDSD report, it was interpreted as "the maintenance of aggregate stocks, inventories or qualities of economic, social, ecological or institutional assets over time. (Pintér, 2005).Through gathering concepts as well as referencing other

literatures, a preliminary definition of SD can be given as follows: "maintenance of global wellbeing on human and nature, over a timeframe depending on objectives and needs" (Fedosejeva, 2018). In the Brundtland Report, balance between human "needs" and the "capacity" of the environment to meet these needs was emphasized.

Three pillars approach.In this decade, the concept is widely recognized as "3 Pillars Approach," which is illustratedinfigure 1. This study first raises the issue of"what" to sustain. Prior to the Brundtland Report, the concept of segmenting SD into three elements—economy, environment, society—originated with French economist René Passet in his work "The Economic and the Living". In 1994, the similar "triple bottom line" framework was established in the accounting field by John Elkington.

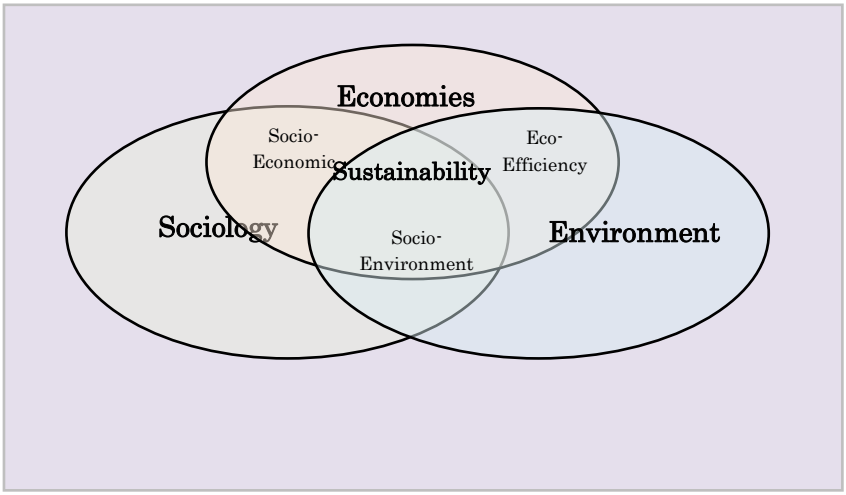

Figure 1. Sustainability impact factors

Education for Sustainable Development (ESD) was United Nations program that applied education to build up knowledge, enhance professional training, and spirit to construct a healthy society. ESD sets goals to establish foundation for current and next generations to recognize importance of sustainable development through education in environment, society and economy.

The term SD consists of two opposite concepts. "Sustainability" is nature-oriented, dealing with finite resources. Contrastingly, humans are the main players of "Development," and there exist no limits. As a result, identifying an optimizing condition for the two contradicting vectors might be a major and common task for SD. In the Report, inter-generational and intra-generational equities were also mentioned, but without specifying which targets fall inwhich of these categories. In the report for UNDSD, although the "3 Pillars" are covered, the terms "stocks,""inventories," and "assets" might generate the impression of human-oriented sustainability, also known as "weak sustainability," as these terms are often associated with economic ownership. Intersection of the three elements creates Sustainability,with "Economic" and "Social" concerning human development, and

"Environmental" relating to nature. However, each sector contains intersecting parts with the other two, forming "eco-efficiency," "socio-environmental," and "socio-economic" subsectors. The three subsectors can be further simplified as "viable," "bearable," and "equitable" in the same order (Circular ecology, 2016).As by its nature the term SD contains great flexibility, a similar but condensed definition such as "maximizing quality of life (QOL) while minimizing burden to nature and human society" may be used for simplicity of understanding, although the time dimension should also be touched upon.

In addition to elements of SD, Diversity, Inclusiveness, Innovation, and Resilience are identified as aspects which form the characteristics of SD. Similar to SD elements as a whole, each of these fourcharacteristics contain respective "Pillars" within each element. For instance, "Resilience" covers all three pillars, forming concepts such as economic, environmental, and Sociology resilience.To clarify each characteristic with an interpretation, "Diversity" concerns miscellaneous qualities of humanity, granted equal value and fair equity.Likewise, "Inclusiveness" calls for "fairness" of each individual's participation in SD, with the economic aspect incremented. Income, physical, or ethnic disparities might generate marginalized groups. Considering the fact that no one is equal from the starting line, creating societies in which "no one lags behind" could increase sustainability.

The three elements, or "3 Pillars," are often compounded andinterdependent in reality. Issues such as health, resources efficiency, and employment might rely on more than one element. Furthermore, pillars beyond the conventional three, such as "Institutional," "Cultural," and "Political" sustainability, could also be included. Issues such as governance, diplomacy, justice, and cultural diversity could be applied in real situations. Nevertheless, the nature of interdependence remains, since "sustainability" serves as the mainstay and intersects with all sets of elements.Observing from reality, the "Environmental" aspect could create the greatest impact, since all human activities rely on environmental sustainability and wellness is indispensable for both society and economy. The "Social" element could package not only "Economic" features but also various rights of humanity.

II. 3-steps approach

Revision of 3-pillars approach.3-pillars approach can be the foundation of ESD however, as the approach did not oversee the priority and sequence, the randomly launch of the approach may cause drawback as strategic planning, tasks' sequence and systematic implementation are not fully planned in 3-pillars approach. This research foresees the importance of sequential implementation, and proposed 3-steps' approach as revision of 3-pillars approach. The concept of 3-steps approach is shown in figure 2, which is the framework that enhances 3-pillars approach.

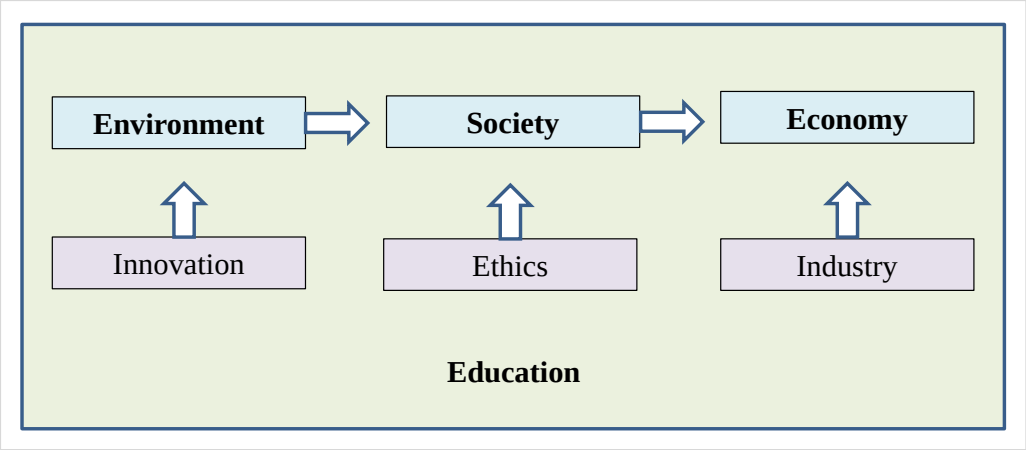

Figure 2. Framework of 3-steps' approach

The reasons of 3-steps approach. The reasons this research proposed a revision (from 3-pillars to 3-steps approach) are as followed;

1. By nature of impact factors and their interoperability, environment can be the first factor needs a consideration. Educators shall encourage students' innovation, to protect environment, effectively utilize natural resource, and concept of recycling to sustain our environment in resource optimization. Followed by environment, society can be the second factor that educators shall launch program of ethics to encompass the society impacts, based on the knowledge of environment. In this stage, education in ethics covers policy, regulation, and spirit that any global citizen has responsibility to follow the rules, to build a healthy society. In the final stage, educators empower leaders of industry, and apply technologies and management to realize SD through the enhancement of each "end-point".

2. In consideration of students' age of learning curve, elementary school students are full of curiosity and environment protection and recycling process can be best topic for children. Society impacts to SD is better fit to high school students as students in this age already gain sufficient knowledge in environment, and start to raise their concerns for how the society apply ethics to better control of environment and resources, so the regulation and policies can effectively work on environment protection, recycling process and resource sustainability. Finally, when students attend university, college or continuous learning in society, the foundation they already built about environment, and society will be moved into reality, and create opportunity of economies. The learning about industry such as technologies, management, business and communication are very useful to their career. The concept about industrial structure, and the recycling economies and ethics support their contribution to economy. Hence, the allocation of 3-steps approach in different stage can streamline the program and commit the goal of ESD.

3. From risk management perspective, 3-steps approach minimizes risk and prevents potential failure of program's launch. Due to the dependencies between environment, Sociology and economy, regulation, policy, industry and economy are none tactical issues furthermore, economy need all relevant policies be sort out, then industry can plan economical metrics on top of well-established regulation and policy. Minimum risk implies the executable sequence follows dependences. Hence, 3-steps' approach, starting with environment of less dependency, followed by Sociology and economy, can be risk minimizer which prevent potential failure due to uncertainties.

III. Education for 3-steps approaches

III-1. Environment Impacts

Environment sustainability. Environment sustainability refers to nature system that managing natural resources. It can be the tactical factor that maintains a healthy environment, promotes quality of human life, improves Sociology environment, and impacts economic sustainability. Without this foundation, society and economies have no opportunity to establish impacts to SD.

Recycling process.To envision the key processes of metrics of environment recycling process, a few terminologies are introduced to leverage the facilities and nodes to the processes. Education in this stage need to simplify quantitative analysis into conceptual level, and to apply Q&A to raise concerns and curiosity to learners. The main facilities and nodes being used in recycling processes are;

- Collection sites (**CS**) such as kerbsides, civil amenity sites or other bring sites
- Data processing unit (**DPU**) to collect data for governance purpose
- Material recovery facility (**MRF**)
- Waste transfer stations (**TS**)
- Final destinations (**FD**) of recycled materials

Waste will be collected at **CS**, so the waste can be transported to a **TS** or directly to a **MRF**. At **TS,** general waste and recyclable materials are bulked up before being transported to a **MRF** for further treatment. After processing at a **MRF**, the waste stream will be sent to other MRF, or TS for further processing, or to **FD** for recycling. According to the source information, **97%** of the recovered products are within the comingled waste stream and sorted out at MRF. If TS has capacity to sort the waste and the accuracy pass certain level of threshold, then MRF can be distributed to different location as the waste sorted at TS, can be transported to the exact MRF for further processing. However, if TS is lack of capacity to pre-screen the type of waste, it is recommended the distance between MRFs shall be minimized to eliminate transportation between MRFs.At zone i, facility (MRF or TS) j is established with cost M_j of MRF setup fee (of total number of facilities: m)

M_j : MRF facility j setup fee including land cost

f_j : binary (1/0) possibility that facility j is setup

$s_{i,j}$: binary (1/0) possibility that facility j serves for i zone

$l_{i,j}$: location (azimuth) of facility j (MRF or TS) associated with waste collection site of zone i

$d_{i,j}$: distance (km) for the original waste site i to travel from facility j-1 to j

d_i : distance (km) between the original waste site i and FD (distance between source and sink)

w_i : weight (ton) of recycle materials of the original waste site i

w_j : weight (ton) of recycle materials of the intermediate sites (TS/MRF) of j step and FD

$c_{i,j}$: unit cost of transportation (USD/ton-km) for original waste site i to travel from facility j-1 to j

$e_{i,j}$: gas emission caused by transportation (l/ton) for original waste site i to travel from j-1 to j

t: type of materials (t_i : type at source, t_j : type at intermediate sites and sink)

Δt: time duration

Our objective is to achieve $\min\ (\sum_{i=1}^{n} f_i * M_i + \sum_{i=1}^{n} \sum_{j=1}^{m} (f_i * s_{i,j}) * (c_{i,j} + e_{i,j}) * (w_{i,j} * d_{i,j}))$

1. We seek max i and min j values (maximize distributed TS/MRF sites, and minimize steps)

2. ∀ i $(c_{i,j} + e_{i,j})$ can be replaced by (1+γ) * $c_{i,j}$ (γ> 0 denotes the compared weight to transportation cost)

Our constraints are;

1. In initial state: $d_{i,1}$=0 (at waste collection site)

2. In direct connect: $d_i \leq \sum_{j=1}^{m} d_{i,j}$ (when m=3 $d_i = \sum_{j=1}^{m} d_{i,j}$)

this happens when no further TS or MRF is required between source-MRF-FD

3. All sites are direct connect:

$\sum_{i=1}^{n} d_i \leq \sum_{i=1}^{n} \sum_{j=1}^{m} d_{i,j}$ (m=2 ∀ i $\sum_{i=1}^{n} d_i = \sum_{i=1}^{n} \sum_{j=1}^{m} d_{i,j}$)

this happens when the above scenario applied to all waste sites

4. Source = (interm. + sink) $\sum_{i=1}^{n} w_i(t_i, \Delta t) = \sum_{j=1}^{m} w_j(t_j, \Delta t)$

5. Policy based (example): m ≤5 and $d_i \leq$ 100km individually.

Recycling and Educational action research.As indicated in figure 3, environment engineering experts shall initiate strategy and evaluation with associated organization of government, to lead the construction of process. Meanwhile, facilities such as recycling collecting pot, recycling factory, and transportation are all the factors need extensive evaluation. From the other side, educational facilitators need to work closely with volunteers of society, to guide residents in transformation process of SD.

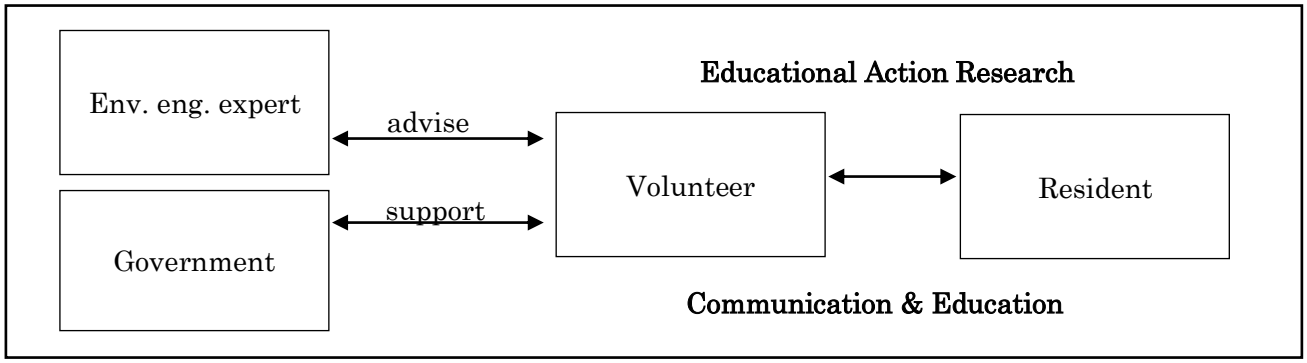

Figure 3. Educational action research in Recycling and Environment sustainability

Recycling process and recycling economies are crucial to environment sustainability. To strengthen education foundation in environment, this research proposed educational action research to form collaborative model across multi-entities. Educational action research can also bridge the transformation from environment to Sociology sustainability. Educational action research has been a key factor in maintaining consensus and effective interoperability across multi-entities within designer, stakeholder, consumer, and distributed in recycling process. First, the consumers' concept needs a change as consumers need to understand the invisible values are hidden inside the waste. Recycling play key role in waste management as it recycles the value and protect environment. Second, the stakeholders need to be involved in the recycle process of their products, and build the recycling process to fabricate products through recycling route. The third, government need to reevaluate the waste collecting topology, the supply chain and connectivity between source channel and products channel.

III-2. Sociology Impacts

Sociology sustainability. Sociology sustainability is usually achieved through policy, project, and regulations as tool for SD. It guarantees the minimum requirements of human life such as clean air and water, to sustain healthy environment. The interoperability between Environment sustainability and Sociology sustainability is indicated in figure 4, the average lifespan has been increased from 70 to 79 in past 6 decades in US according to policies change. The regulation and policy changes are related to living environment, and the changes took decision based on long-term studies in environment and sociology sustainability.

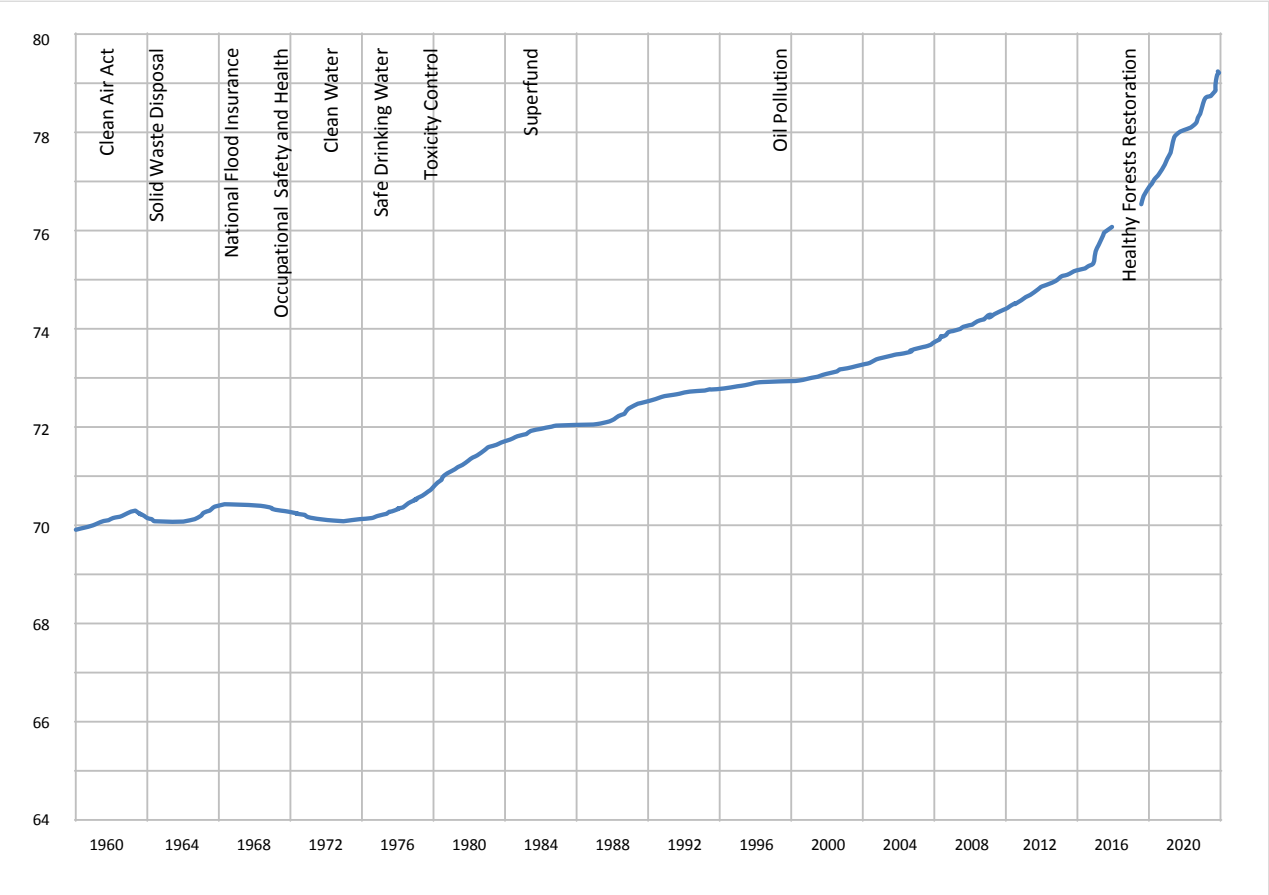

Figure 4. Statistics of lifespan against policy in sociology

Sociology impacts through Library science. Different from schooling and other forms of education, most libraries allow people regardless of age, ethnicity, income and other social-economic background to participate for free or with very little cost, without time limitation. Libraries compensate shortages of schooling in terms of early-childhood education, inclusive education, vocational training, lifelong learning, and for other Sociology groups which requires additional assistance. Usually, the condition of ailment in people who require inclusive education differ from an individual to another, thus a customized support would be required to maximize their learning. In libraries, learners can customize and optimize learning patterns which are most effective to them. Moreover, libraries are crucial for democratization, as Andrew Carnegie stated that "There is no such a cradle of Democracy upon the earth as the free Public Library, this republic of letters, where neither rank, office, nor wealth receives the slightest consideration". According to library science studies (Wallace, Fleet, 2005), libraries carry the greatest force for democratization of information. Separated from school curricula and texts provided, users are able to access to information without guidance of policy-makers and interest groups. Finally, libraries allow customized learning for individuals depending on their interest, needs, and talent. Usually, each person has different tendency and preference of perception among the 5 senses, and has different orientation of learning such as "visual", "auditory" and "kinetic" learning styles, known as "VAK". Libraries have almost no

systematic redundancy such as fixed time schedule or ceremonies, creating a sustainable environment for studying.

Sociology sustainability indicators selection. To cope with "goal-oriented policy-making" may require global cooperation to strengthen political will and create common goals without disharmonizing respective interests. Participation of non-governmental players such as civil society entities may create more "ears" to listen to the public's voices. Lastly, relevance of indicators to reality should be considered. Indicators selected by international organizations are often miscellaneous, creating long "shopping lists". For instance, coastal and marine indicators are irrelevant for landlocked countries (Pintér, 2005).Hence indicators are suggested to serve as evidence and to be customized according to regions and conditions, to meet the objective of "universally applicable." With a bottom-up approach, evidence-based indicators collected from localities can "measure locally, and integrate globally."

The selection of indicators is discussed as well as problems and potential solutions. However, some aspects of SD might be difficult to measure in reality. An example can be the concept of "critical threshold" which links to the notion of "resilience." In many cases, the existence of a critical threshold is not possible to confirm. Even if verified, such thresholds may differ across regions, appearing as discrete or continual quantities. Moreover, they might not be quantified. Next, the emergence of new inventions may dismantle functions of current indicators and urge creation of new ones. For instance, elimination of electricity usage, such as through devices like "Mitticool"—clay refrigerators that require no electricity—may bypass the SDG indicator "Percentage of population with access to electricity" in the future. Thirdly, some indicator results may show high performance at the expense of others. In 2010, Japan ranked second in fish consumption, although merely ninth in production. This may imply the effect on other regions despite the country's relatively high performance on environment indicators. Also, favorable results on economic indicators are sometimes attained at the expense of Sociology and especially environmental qualities. Finally, aesthetic qualities are also often immeasurable. In many cases, beauty has been replaced by development. Several World Heritages sitessuch as Cologne Cathedral have become "endangered"whentheir scenic settingis spoiled by surrounding high buildings. Along with the "3 Pillars," "aesthetic sustainability" might also enhance QOL to a considerable extent, although we often do not know how to measure beauty.

Identifying indicators and implementing measurements are indispensable tasks, thus we could set individual timeframes and simulate each scenario for implementing in practice, based on the results after measuring. During implementation, reviewing the progress regularly and evaluating with participation of third parties might also be necessary.

III-3. Economy Impacts

Economies sustainability impacts. UNESCO defines ESD as "a vision of education that seeks to balance human and economic well-being with cultural traditions and respect to the earth's natural resources." The program contributes to SD, especially in cultural and environmental aspects.In the 2005 high-level meeting on ESD

strategy held by the UN Economic Commission for Europe (UNECE, 2005), suggestions included to promote SD through formal (schooling) and non-formal (domestic and social) learning; "equip educators with the competence to include SD in their teaching"; and "ensure that adequate tools and materials for ESD are accessible." Various inequalities of which we are increasingly aware, such as economic and ethnic, could be alleviated if *fair* education is provided.

Economicsustainability through innovation ."Innovation" combines *arts* with science. Many fields such as technology or administration require innovative ideas to renew and improve for future generations. Finally "Resilience" can be understood as "Power of Recovery" when encountering economic, environmental, or Sociology emergencies, such as natural disasters, economic shocks, and terrorism. In the case of 3.11 incident, resilience may affect the efficiency of reconstruction after the out-of-threshold situation, recognized as "unprecedented".

Industry sustainability measurement methods.The measurement of SD may include a wide range of methodologies such as benchmarks, metrics, and auditing. In this study, indicators are used in SD measurement. In reference to "Sustainable Measures," indicators could be defined as a "quantitative and qualitative method of measurement for helping us understanding where we are, which direction to improve, and how far our goals are (Sustainable Measures, 2016)." Often, indicators forecast problems.The selection of indicators begins with "What to measure?"The selection method is based on the fact that those indicators matching current situations and meeting current needs could be prioritized. For instance, to tackle climate change, SDG measures "Number of least developed countries and small island developing States that are receiving specialized support, and amount of support, including finance, technology and capacity-building".

According to the UN's report on SDG indicators, the selected 230 indicators were considered to be "action oriented, global in nature and universally applicable." (UN Report, 2016). Another prerequisite characteristic might be "measurable," and some qualities of SD cannot be manifested.When selecting indicators, it is possible to arrange them according to geographical levels (global, regional, national, local), methods (statistics, survey, case study, interview), and timeframe (short term/long term, temporary/permanent).

Although quantitative methods are adopted in most current SD indicators, qualitative measurements such as by case study may help understand special cases in detail. For instance, the 3.11 incident could be approached in this manner. To enhance understanding, disaggregation and visualization of data can be incremented. In referencing to the United Nations Environment Programme, selection of indicators should meet "qualitative properties" such as resource and critical thresholds/ carrying capacity; decoupling between economic growth and environmental degradation; Sociology benefits; universality and linkages to other targets. After indicators are selected, they are described in the following order: indicator title, definition including measurement process, unit of measurement, and data quality and availability (UNEP, 2015)..

Indicators are often not directly applicable after selection. They must be reviewed and examined. Thus resolutions are initiated to cope with potential issues.First, the data should be viable, which relies on technological advance. Viable data contribute to higher accuracy and practicability. For example, to measure the

extent of eutrophication in waters, density of Nitrogen and Phosphorus can be an indicator. The colorimetric method (whereby colors of samples reveal density) is often adopted in this measurement, but technological devices serve as sine qua non for the examination. Secondly, vagueness in terms used for indicator titles might lead to misconception, thus clarified definitions should be provided if complex terms are unavoidable. During indicator selection, some organizations may tend to focus on easily achievable targets, in order to display finer results.

Industry impacts through Professional training. Education and Learning in 21st century calls for skills that enables one to be competitive in 21st century's societies. One of the most widely-recognized framework may be "21st century skills" which basically consists of "creativity and innovation", "problem solving", decision making", "communication and collaboration", and "ICT literacy". With abundant multimedia resources - both physical and virtual, and wide space for discussions and group works, users are able to cultivate the "21st century skills" accompanied by their families and friends with library education. According to American Library Association, 62% of libraries in United Stated reported that they are the only source of free public access to computers and internet in their communities, and some 90% of libraries offer technology assistances to library users.

Industry impacts through Creativities. The concept of human capital is the core of creativities. Human capital can be defined as 'the set of skills which an employee acquires on the job, through training and experience, and which increase that employee's value in the marketplace. Creativity of talent is the root of industry and culture. The creative class including designers, artists and high-skilled intellectual workers, acts as an engine of innovation and urban development, structuring creative hubs and networks for the economic, Sociology and cultural development of their cities and regions.

In addition to creativity, human capital requires skills, motivation and entrepreneurial attitude to streamline creativity to the industry. This implies, role-based educational systems are required to improve a mixed-up situation. From the environmental perspectives, a well-organized policies structure is necessary and the authorities need to plan ahead, to train people, to provide sufficient resources, and to minimize insecurities.

From productivity and quality perspectives, figure 5 demonstrates the state transfer from supply-demand equilibrium.

E_1: $P(y_1) \,.\, Q(x_1) = c_1$

E_2: $P(y_2) \,.\, Q(x_2) = c_2$

Education for professional and highly-skilled workers promotes the productivity-quality equilibrium from E(1) to E(2), to achieve continuous improvement.

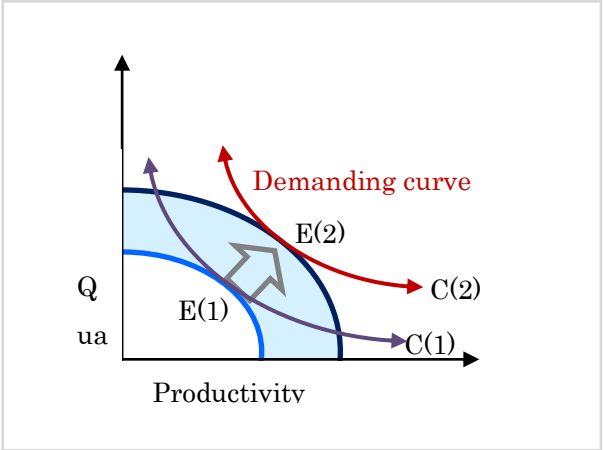

Figure 5.Productivity and Quality

IV. Case Studies of the Role of Education

In the following paragraphs, a case studies of Japan-U.S. ESD, and survey of education to career were illustrated, to oversee the ESD impacts.

Case Studies of Japan-U.S.Education is critical to sustainability, and the concept of human capital is at the core of education. Human capital is viewed as "the set of skills which an employee acquires on the job, through training and experience, and which increase that employee's sustainable value in the marketplace to maintain a stable sustainability".An annual, cross-sectionalstudy conducted by Stern and Maskushas indicated that net exports of the United States from year 1958 to 1976 had a positive correlation with human capital, while negative results were found for unskilled labor. In their measure of human capital Stern and Maskus state that"the wage of unskilled labor was taken as the median income of all persons aged 25 over of all races and both genders, with 8 or less years of schooling."Notable in a historical review of the role of education in SD isthe "Agenda 21" meeting when UN members gathering in Rio de Janeiro in 1992. For the first time, education was urged to serve as a cornerstone for "Sustainable Development," which mainly included economic, social, and environmental sustainability.

The "Japan-U.S. Teacher Exchange Program for ESD was initiated in 2009, with the cooperation of the Asia-Pacific Cultural Centre for UNESCO and Fulbright Japan (Japan-U.S. Educational Commission). In the program, teachers from Japan or the U.S. travel to their partner country, to gain understanding of international ESD circumstances and to enrich ESD curricula. The reason this program is selected to illustrate SD in this paper is that, first, there is a substantial natural and cultural distance between Japan and the U.S. Differences exist in tangible forms such as language, food, and architecture, as well as implicit forms such as tradition, lifestyles, values, and governmental policies that can only be discovered and acquired from personal experience. Learning about different dimensions and potentials of human cultures can increase enthusiasm for mutual respect, understanding, and collaboration, leading to harmonization in societies. Secondly, teacher training and

cultivation contributes to improvement in pedagogy, curricula, and school organizations after returning to their countries. Effective education can be crucial to socio-economic and environmental development.

According to ACCU, the program "aims to raise awareness of ESD-oriented school programs and deepen a sense of global interconnectedness between teachers in Japan and the U. S. in areas of ESD focus." Each year, 12 teachers from Japan travel to the U.S. in late April, participate in a joint conference, and return to Japan in early May. Twelve U.S. educators then visit Japan in late June, participating in a joint conference in Tokyo and returning to the U.S. in early July. During their stay in the partner country, cultural exchange, communication and collaboration are encouraged, and the teachers experience the local food, lifestyle, and natural environment. After the experience, an impact report regarding the progress of ESD curriculum is submitted by all participants.According to UNESCO Pakistan, "Education is the best investment for Sustainable Development."However, the significance of education for SD was not emphasized until Agenda 21 took place in 1992. In the publications of this action plan, it is stated that "education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues" (Tomonori, 2017).

Impacts of Education to Career. Higher human capital leads to higher labor productivity and contributes to stable SD. As employees obtain knowledge and skills from education and experience, they may produce more outputs in a given time, or same amount of outputs in a shorter time. When efficiency of employees increases, marginal cost reduces, and more products exist in a market. Along withthe shrinking price of commodities and increasing quantity, comesmore consumption and more export. Thus, reinforcing human capital ultimately results in higher global competitiveness, since the country has gained a relatively higher comparative advantage.

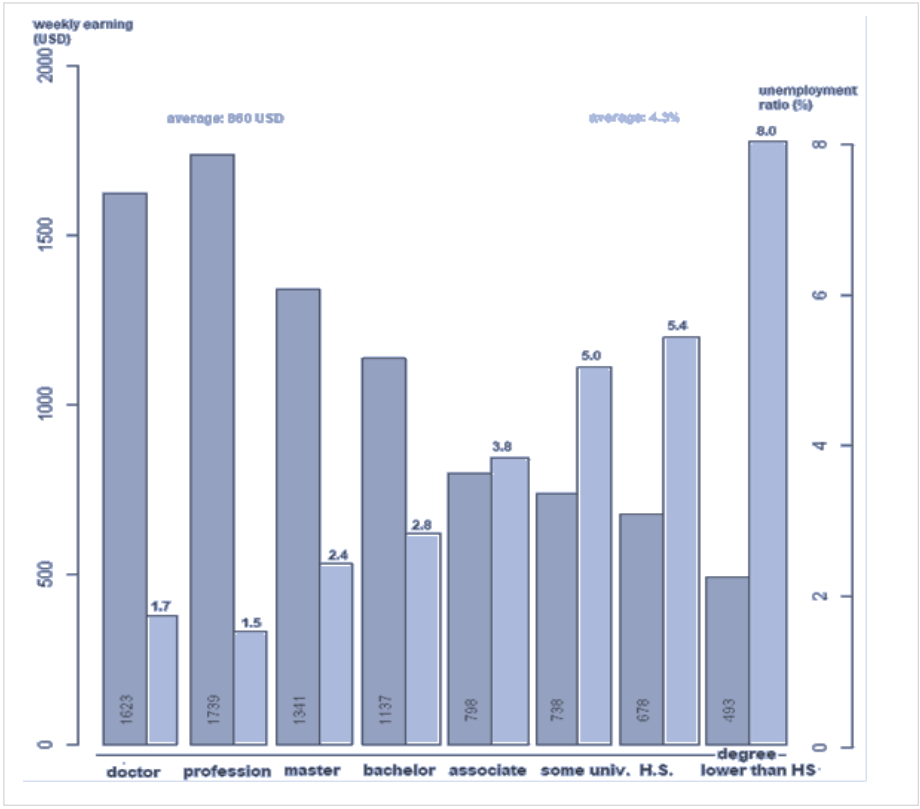

Figure 6. Impacts of Education to career

As indicated in figure 6, employees' income increased and unemployment rate decreased when employees promote their academic degree.From the perspective of SD of economies, education is essential to economic growth. According to UNESCO's Global Education Monitoring (GEM) Report, "earnings increase by 10% for each year of additional schooling" in some countries. UNESCO Islamabad also noted that "education is best investment for sustainable development." The impacts of education might not appear instantly, but could last long into the future. This is the reason that in ancient Chinese philosophy "It takes a year to grow grains, ten years to grow trees, and a hundred years to foster humanity." With help of education, people are anticipated to gain higher skills, efficiency, and morale, which influence SD and economic growth directly.UNESCO reports are an excellent source of information on education in relation to sustainable development. The UN organization has published reports on education investment annually since 2002. Titled "Education for People and Planet," the 2016 report suggested strategies toward sustainable development from numerous dimensions, and education was highlighted. The report consists of 24 chapters, with respective sub-topics. It is notable that the connection between education investment and long-term economic growth was mentioned repeatedly, especially in sub-topics such as "education and lifelong learning contribute to long-term economic growth" and "education improves labor market and decent outcomes."

Metrics for the role of education in SD have been produced in recent years. Statistical data from the World Bank shows that GNI per capita (Atlas method, current USD) of high-income countries from year 1962 to 1980 grew from

1,542 to 9,998 USD, almost seven-fold expansion in 18 years.

However, from 1981 to 2015, it grew to 41,690 USD, only around four times the 1980 figure, in 34 years. The analysis produces a clear picture that stagnation in economic growth in high-income countries has occurred in recent decades. Especially, from 2008 to 2015, growth was tranquil and decline can even be observed, such as in years 2009 and 2015. By contrast, low- and lower-middle-income countries tell a different economic story.

In the case of low-income countries, economic growth was sluggish and even backsliding in the 20th century. Data of GNI per capita in those countries first appeared in 1988, registering at 344 USD. It was not until the latter half of the first decade of the 21st century that economic expansion began. From 2006 to 2015, it increased from 331 to 619 USD, almost tripling. The figure for lower-middle-income countries is also unique. From 1967 to 2000, GNI per capita increased from 140 to 551 USD, but it reached 2,032 in year 2015. This astonishing pattern of growth contradicts that of high-income countries, with slow improvement in the beginning and rapid increase recently.

V. Global strategies for ESD

Concept of global citizen. One of the critical interplay of global strategy to SD is to develop global citizens to sustain current and future environmental, social, and economic development.ESD, also named "sustainability education" or "education for sustainability," indicates education aimed towards SD. Agenda 21 specified that "to be effective, environment and development education should deal with the dynamics of both the physical/biological and socio-economic environment and human development, should be integrated in all disciplines, and should employ formal and non-formal methods and effective means of communication." The concept of SD was conceptualized in the 1987 Brundtland Report as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Often, SD concerns sustainability of current and future environmental, social, and economic development. Therefore, ESD—education for SD—could be defined as "enabling one to fulfill responsibilities as global citizens to sustain current and future environmental, social, and economic development."

Compared with education in general, ESD has the merit of meeting current and future needs. Traditionally, education aimed at attainment of cognitive skills, which relied on memorization to a large extent. Non-cognitive skills and application of knowledge were not much emphasized, and the knowledge learned did not necessarily apply to daily lives, creating inefficiency. In recent decades, growing awareness of SD gains awareness calls for additional and different educational processes than those traditionally implemented.Tilbury suggested that "the quest for sustainability demands new approaches to involve people, rather than convey just a body of knowledge (Tilbury, 2002).Tilbury and Wortman suggested a "new form of education" in their book *Engaging People in Sustainability* (Tilbury, 2004). The authors criticized the traditional Environmental Education (EE) for not being practical, as it focused merely on "teaching and learning" about the environment. They stated that "education for sustainability seeks a transformative role for education, in which people are engaged in a new way of seeing, thinking, learning and working." They urged the existing education system to fortify active participation and

decision-making "in the change process." In practice, the authors called for attainment of non-cognitive skills such as "*envisioning*, *critical thinking and reflection*, *participation in decision-making*, *partnerships* and *systematic thinking (problem-solving)*" for learners as well as educators. These five qualities should serve as core objectives of ESD. With *envisioning*, we imagine future situations and know our goals. This enables us to predict possible issues and thus tackle them in effective ways. Starting from the last decades of the 20th century, information technology has become a major trend in most human societies. When one is bombarded with information, the ability to make appropriate *decisions* and reflect *critically* becomes critical in modern life. *Partnership* and *systematic thinking* are also indispensable in many situations since there are growing international and cross-sectional alignments.

From the viewpoints of organization and management, ESD shall be offered universally regardless of age, race, income, and other conditions. In fact, in 2015, 17 goals for SD (SDGs) were set up, the fourth of which concerns "quality education." The 4th goal aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." The program for U.S. teachers in Japan offers many sessions to experience Japanese culture and education, to attend lectures by ESD professionals, to visit cultural sites and ESD-focused institutes, and homestay with a Japanese family. After returning home, the educators engage in individual activities including organizing field-trips to the lake with students to convey the significance of water resources, or sending "symbols of Peace" to Hiroshima Peace Memorial Park. With this program, not only do educators in two different cultures have opportunities to share and exchange experience, communications within SD learners can also be realized, and all of the students are provided with very comprehensive knowledge.

VI. Discussions

ESD realizes SD in environmental, social, and economic aspects. Through education,SD heightenslearners' consciousness toward the protection of nature. In societal aspects, SD concerns peace and harmony within human society. Arguably, communication and experiencing the culture, arts, and food can be among the most effective ways to promote peace between countries. Economically, education augments scarce human resources. Individual talents and interests can be converted into craftsmanship and professions and thus create higher value. Education might play a more important role than merely granting aid in the context of international support to developing countries.

Methods of foreign aids can be various, but monetary and commodity funding are most commonly implemented by large world organizations. According to Easterly (Easterly, 2008), "aid practices like money going to corrupt autocrats and aid spent through ineffective channels like tied aid, food aid, and technical assistance" can be inefficient and affect recipient countries negatively. In such cases, foreign aid does not always succeed. If funds aincomere controlled by autocrats, it may further foster dictatorship. Mostly granted by bilateral donors, "tied aid" reduces value of assistance by applying conditionssuch as asking recipient countries to purchase goods from donor countries.

Food aid causes a negative impact on the local agriculture sector as donor countries tend to dump their

agricultural production and cause price instability. According to OECD, technical assistance is anticipated to "augment the level of knowledge, skills, technical know-how or productive aptitudes of the population of developing countries." However, technical assistance could unintentionally harm local markets in practice since consultants are frequently hired from the donor countries.In these decades, some powerful international organizations such as the UN often turn a blind eye to national affairs, such as practices of politicized religious law adopted in several countries. In the official UN publications there are issues relating directly to human rights that are hardly mentioned, such as terrorism, genocide, usage of nuclear power, and artificial intelligence (AI), probably due to fear of alienating some veto players among the members. To gain certain benefits from the developed countries, such as compensation, governments in developing nations cannot help but mask the facts to civilians.

Developing countries are beset by the phenomenon of "poverty trap," (Azariadis, Stachurski, 2005) defined as a "self-reinforcing mechanism which causes poverty to persist". Reasons behind poverty itself can be various, in global, national, and micro scales, but factors of "poverty trap" mainly include "unproductive industries," "difficulty of finding business partners", "limited availability of technology", "high population growth and low per capita income."(Matsuyama'2005) Introduced by Rosenstein-Rodan, the "big push" theory insists on "publicly coordinated investment" for market growth and thus as a solution for the poverty trap. Provided with ESD, with the non-cognitive skills mentioned above, experience can be accumulated for employees as well as entrepreneurs.

Fostering skills of *critical thinking, decision-making,* and *partnership,* effective collaborations can be realized, and labor training can progress efficiently. If provided fairly with contents linking to practical needs, education creates a positive long-term effect, and the knowledge and skills can be inherited over generations. As for suggestions toward ESD and the program selected for study, this research suggests stronger global integration and cooperation between ACCU and Fulbright Japan as well as among the participants, to prevent dispersion. In each joint conference, kernel targets should be identified. Regarding the outcomes of ESD curricula enrichment after participating in the program, regularand continuous tracking would be useful to confirm the effectiveness of the program.The post-program activities should also be evaluated from the viewpoint of current and future needs. Results-based management curtails redundancy in time, effort, resources, and costs. Since the program is organized by two government-centered units, this study recommends monitoring the transparency of money flow by the civil sector, and increasing opportunities for feedback.

VII. Conclusions

In this researchSD is first defined, and indicators and measurable factors are identified to analyze the criticality and impact factors of education for SD. The two basic components of sustainable development, nature and human, are discussed in terms of their interoperability.

A 3-steps approach was introduced to fill-in the gap of realization of 3-pillars approach and the reasons and resolutions were addressed. Within SD, global strategies in terms of measurable factorsand approaches are

identified such as systematic thinking, human capital, environment, library, and culture exchange to investigate the interplay of strategy to SD.Education envisions key factors of sustainability and empowers roadmap of development. It provides knowledge, skill, and spirit to transform poverty to prosperity, and takes momentum to continuous development.

International education plays a critical role to SD influence human society as human being is a major player in environmental and socio-economic activities. Through elemental aspects of environmental, social,and economic, the global strategy can be continuously monitored and tuned to impact SD.

References

[1.] Fedosejeva, J., Boče, A., Romanova, M., Iliško, A., Ivanova, O., (2018). Education for Sustainable Development: The Choice of Pedagogical Approaches and Methods for the Implementation of Pedagogical Tasks in the Anthropocene Age.*Journal of Teacher Education for Sustainability. 20(1),* 157-179.

[2.] Aboul-Enein, J., (2004). *Islamic Rulings on Warfare*.Darby: Diane Publishing.

[3.] UN General Assembly, (1987). Report of the World Commission on Environment and Development

[4.] Pintér, L.(2005) Sustainable Development Indicators - Proposals for a way forward

[5.] UN Report, (2016). Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators

[6.] Pintér, L. (2005). Sustainable Development Indicators. *Proposals for a way forward*

[7.] UNEP Discussion Paper, (2015). 'Sustainable Consumption and Production Indicators for the future SDGs'

[8.] Ichinose, T. (2017). An Analysis of Transformation of Teaching and Learning of Japanese Schools that Significantly Addressed Education for Sustainable Development, *Journal of Teacher Education for Sustainability 19(2) 36-50*

[9.] Azariadis, C,,Stachurski, J. (2005) Poverty traps. *Handbook of Economic Growth*. 295~384

[10.] Easterly, W., Pfutze, T.(2008). Where Does the Money Go? Best and Worst Practices in Foreign Aid,*Journal of Economic Perspectives*,22(2),29-52

[11.] Durlauf, S.,Blume, L.(2005). *the New Palgrave Dictionary of Economics*.UK: Palgrave Macmillan.

[12.] Tilbury, D., Wortman, D. (2004). Engaging people in sustainability, *Commission on Education and Communication*,: Gland, Switzerland and Cambridge, UK:IUCN 9~11.

[13.] UNECE Strategy for Education for Sustainable Development, (2005). UN

[14.]