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**Special Lecture**

**MAJOR CHALLENGES IN  
INTEGRATING SUSTAINABLE DEVELOPMENT  
IN TVET**

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*“Sustainable development depends critically on the competencies of all of our population --- with competencies understood to cover knowledge, skills, attitudes and values.”*  
(OECD Education Ministers)

## 1. INTRODUCTION

Sustainable Development (SD) is an elusive term, which many people misunderstand to only refer to environmental protection or economic development. Sustainable Development is more than that. It is about maintaining and improving the quality of life without compromising the ability of future generations to meet their own needs. It is also becoming an initiative to start fair and long-term transition to more sustainable production and consumption by the population. It is not limited to a concern for the natural environment or focused exclusively on economic development. Rather SD is a concept based on integrating socio-cultural, environmental and economic considerations [1]. Moving towards the goal of sustainable development requires fundamental changes in human attitudes and behavior--- in our personal lives, in our community activities and in the work place.

The earth summit (UNCED) conference which took place in Rio de Janeiro ,on 3-4, June 1992 was attended by about 120 heads of state and government together with delegates from over 170 countries. The centerpiece of the Rio agreements (Agenda 21) is a major action program setting out what nations should do to achieve Sustainable Development in the 21<sup>st</sup> century. One of the important outcomes of the conference for educators centered on the recommendation that environment and development education should be incorporated as an essential part of learning within both formal and informal education. A proposal has since then been made for governments to strive to update or prepare strategies aimed at integrating environment and development as a cross-cutting issue into education at all levels within the next three years (Agenda 21, Chapter 36). Increasing awareness was initiated following the Brazil conference and almost all countries started giving importance to sustainable development paradigm and injected the concept into the curricula at all levels. A key outcome of the 2002 World Summit on Sustainable Development was the establishment of a special United Nations Decade of Education for Sustainable Development from 2005-2014 with primary goal of making sustainable development central to all education and training in all sectors by refining and promoting the transition to a sustainable future through all forms of education, public awareness and training.

The international community, together with multi-sectoral stakeholders, is now championing dynamic development processes. Skills orientation and training are slowly being undertaken as immediate responses to global drivers of change, which include technology, trade and climate change and other persistent environmental issues. While addressing acute skills gaps, more and more efforts are likewise being directed to align education and training to emerging sustainable principles. Green economy, green-collar jobs, green society and even green technology have become more than just buzz words. They are maintained as major considerations in meeting skills needs within the dynamic process of mitigating environmental concerns and adapting social and economic orientation.

Successfully making these changes is critically dependent on education and training since trades taught in Technical Vocational Education & Training (TVET) are considered directly related to social, economic and environmental progressive or regressive developments in all parts of the world. Thus, TVET system requires deep immersion in the understanding and practices of SD. The changing nature of the world of work, especially due to globalization and technological changes, demands how these changes impact upon the quality of social, economic and environmental conditions. TVET can play an instrumental role in developing a

new generation of individuals who will face the challenge of achieving sustainable socio-economic development.

Unfortunately, Technical Vocational Education & Training in many countries remain locked up into the role of being a mere supplier of skilled labor to industry and is thereby unable to respond effectively to the needs of the sustainable development strategies. TVET professionals need to be called upon to reorient the TVET curriculum towards sustainability while maintaining the principles of 6R that is Reduce, Reuse, Renew, Recycle, Repair and Rethink perspectives. Therefore TVET system needed to be aware and deeply immersed in the concept and challenges of SD for applying in the work place urgently.

Discussion in this paper surrounds the many facets and challenges faced in integrating sustainable development in TVET, reinforced by the urgent need to invent and re-invent ways in infusing the concepts of sustainable development into the curriculum or diffusing SD principles from specific technical subject domains to create independent sustainable development disciplines or trades. One by one, the author will enumerate the imperatives of integrating SD in curriculum in progressive manner of discussing its real meaning, the skills that are oriented to SD, the generic knowledge that needs to be possessed as minimum requirements for understanding the process of SD integration to the curriculum and the underlying principles and models developed for applying this in TVET.

## 2. MEANING & DIMENSIONS OF SUSTAINABLE DEVELOPMENT

The growing concern about sustainable development has led present day policy makers, administrators, educators and managers to call for a more holistic and integrated educational approach for sustainable development touching upon environment, social, technological and economic priorities. These priority concerns and issues are posing as need-based focus of future educational initiatives.

In the Mid-Term draft review report on Decade of Education for Sustainable Development, 10 critical areas of concerns have been identified as priority if efforts have to be fast tracked. These areas include:

- Awareness, meaning and scope of ESD
- Re-orienting curricula, teaching and learning
- Capacity-building
- ESD-related research, monitoring and evaluation
- ESD synergy with other 'adjectival' educations
- ESD resources and materials
- International and regional cooperation
- National networking
- Coordination
- Financing

Based on the above critical priority areas recommended in the mid-term review of DESD, re-orienting curricula and teaching and learning come handy in the gamut of priorities that need to be acted upon urgently. Various concerns have now escalated the need from multi-sectoral stakeholders to pay attention to these key priorities to equip future generations with the right skills, knowledge and attitude that shape understanding and decisions for sustainable future.

Consequently, TVET needs to focus on the three dimensions of sustainability-**economic, social and environment**. These dimensions can be put in concrete terms in teaching

technical and vocational subjects and courses in terms of skilling the workforce to tap them to contribute to the economy, to prepare for gainful and decent employment and to minimize greenhouse emissions, for example--- representing a balanced approach to workforce development.

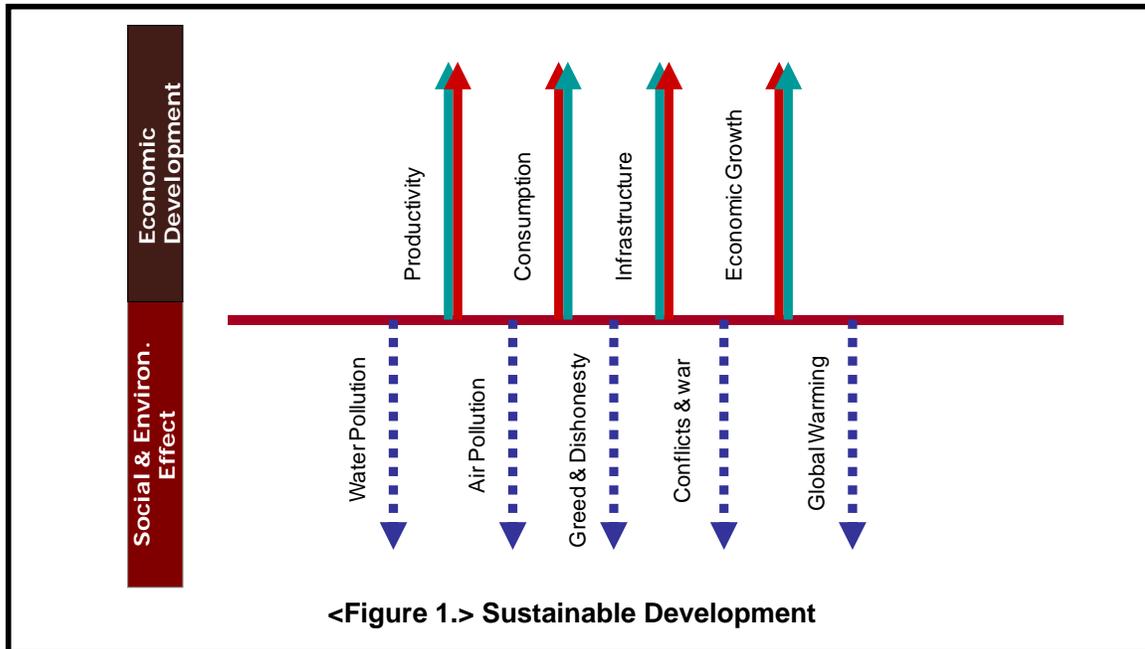
*Pillars of Sustainable Development*

Environmental sustainability is the first pillar of SD It requires a change from “business as usual approach” to Sustainable Development approach of using natural resources wisely, minimizing waste and limit damage to atmosphere and check harmful climate change. This involves the responsible use of raw materials; energy, water etc. and awareness of the impacts of production processes and environmental auditing system.

Economic Sustainability is the second pillar of S.D. It requires a different and wider, set of economically related knowledge, skill and attitude regarding economic literacy, sustainable production and consumption and management of small enterprise.

Social Sustainability is the third pillar of SD On both the global and local scale, social sustainability involves ensuring that the basic needs of all people are satisfied and all, regardless of gender, ethnicity or geography, have an opportunity to develop and utilize their talents in ways that enable them to live happy, healthy and fulfilling lives.

In collectively assessing the three dimensions of SD, one can surmise that economic development taking place can be mapped with social and environmental effects, or vice versa, thus the inter-relatedness of these dimensions and the apparent integrated protocol is required to study them in holistic approach in terms of curriculum reforms. Figure below illustrates the underlying causes and effects of development in various fronts.



In revisiting TVET curriculum, it appears that that these observed changes need to be reflected by providing academic provisions for acquiring knowledge, skills and values that will help technician students cope with and adapt to these changes. The focus of this may revolve around how TVET will respond to the demands for change so as to incorporate societal issues and introduce and integrate related environmental concepts into the curriculum of TVET programs.

### **3. CHALLENGES IN INTEGRATING SD IN TVET CURRICULUM**

In an attempt to have meaningful discussion of the solutions, identifying major challenges would be the first method to understand the underpinnings of SD-oriented interventions. In this paper, the following six challenges being identified by the author are needing urgent attention.

#### **3.1 CHALLENGE 1: Understanding the Meaning and Scope of ESD**

Limited awareness and understanding of ESD at all levels are still fundamental challenges resulting in a limited societal and governmental support base for ESD. This limited awareness and understanding may keep people from recognizing the presence and value of existing ESD, with activities taking place that may not carry an ESD label. Efforts need to be made to better communicate ESD more effectively so that full diversity of ESD and SD is fully understood.

More over, regional national and local differences mean that ESD may be interpreted in many different ways. These differences in interpretation are often rooted in a country's specific tradition in governance but may also derive from the concrete challenges a country or region might be facing. As a result, there is a wide range of interpretation of ESD. The tradition in governance, for instance, affects whether a country adopts a more pedagogical orientation towards ESD emphasizing (social) learning, participation and capacity building emphasizing changing people behavior. On the other hand, countries facing extreme poverty will look ESD from different angle, different than those countries characterized by high-oil dependency.

Although there should be space for multiple interpretation and meanings of ESD, there is a common understanding that education and learning in the context of sustainable development can not ignore the inter-connection between the environmental, social, economic and cultural aspects of SD. During the remaining half of DESD, a multi-stakeholder dialogue among all partners representing economic, social and cultural aspects of SD should be encouraged.

However, SD has classically evolved in its meaning and purpose. Beyond the definitions, the parameters by which ESD must be understood have now extended to the identification of specific skills and knowledge. It is no more limited to becoming aware of the environmental conditions, but integrating, in its highest form, the Learning to Learn Skills into the process of improving the quality of life without compromising the ability of future generations to meet their own needs. In effect, climate change education, as an example, need not be only an awareness drive but structured technical and academic body of knowledge and skills to be taught in formal or modularized subject domain areas.

#### **3.2 CHALLENGE 2: Defining Sustainable Development Skills in terms of KSA**

All the three dimensions of sustainable development may require a generic knowledge/concept, skills and attitudes on Education for Sustainable Development (ESD) which need to be embedded and to cut across all discipline or subjects. However, discipline-wise, there are specific SD requirements for the varying nature of business, technology and application.

Broadly, there are generic skills that have been identified to create sustainable communities, according to Rigg (2008), which are the (1) ability to create vision, (2) leadership to achieve buy-in, and (3) understanding sustainable development, economics of development and democratic processes.

Some of the relevant Generic Concepts, which underpin the integration of sustainable development into TVET includes Sustainable Development, Carrying Capacity, Eco-space, Ecological footprint, Natural Capitalism, Eco-efficiency, Lifecycles Analysis, Triple Bottom Line, Environmental Management System, Economic Literacy, Sustainable Production, Sustainable Consumption, Managing Small Enterprise and Application of 6Rs: Reduce, Reuse, Renew, Recycle Repair and Rethink perspectives.

Moreover, the relevant Generic Skills needed to underpin the integration of SD into TVET must lead to the application of concepts related to SD in the workplace, evaluation of the sustainability to the work environment, identification of the environmental strengths, and envisioning of alternative ways to work.

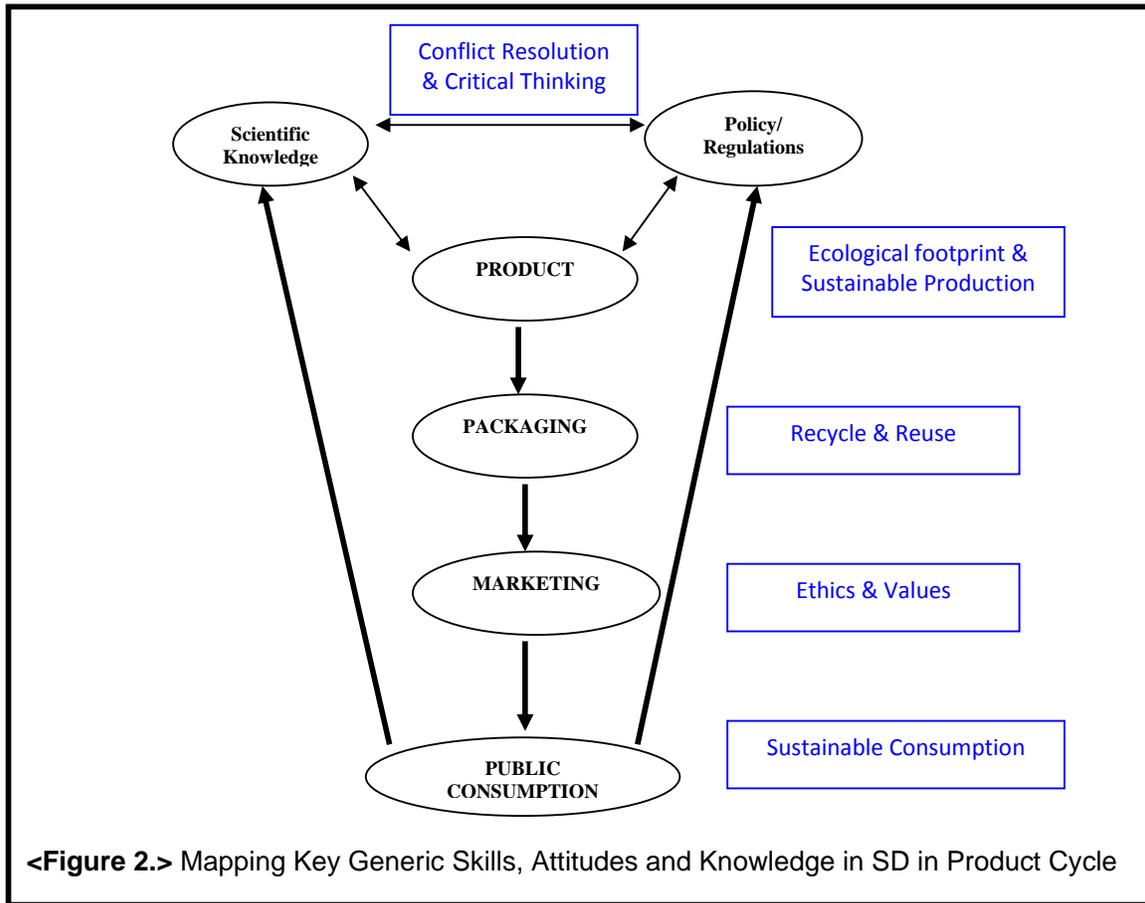
The relevant Generic Attitudes which underpin the integration of SD into TVET include adapting to varied situation, thinking critically and creatively, resolving conflict peacefully, and working honestly and responsively.

But the question is how to integrate the generic concepts, skills and attitudes of sustainable development into the TVET curriculum? To start with, classifying skills to be taught, according to the perceived specific outcome, espoused by Turok & Taylor, may be a helpful exercise. These are enumerated in the following table.

**<Table 1> Skills Classifications & Learning Outcomes**

| Skills                          | Learning Outcome                    |
|---------------------------------|-------------------------------------|
| Strategic and leadership skills | For initiating and promoting change |
| Process skills                  | For enabling change                 |
| Practical skills                | For delivering change               |

Below is a simple illustration (Figure 2) of how generic skills, concepts and knowledge are mapped within dynamic processes in the workplace. TVET as a discipline is expected to anticipate their applications in the world of work to appreciate the extent by which curricular foundations need to be strengthened.



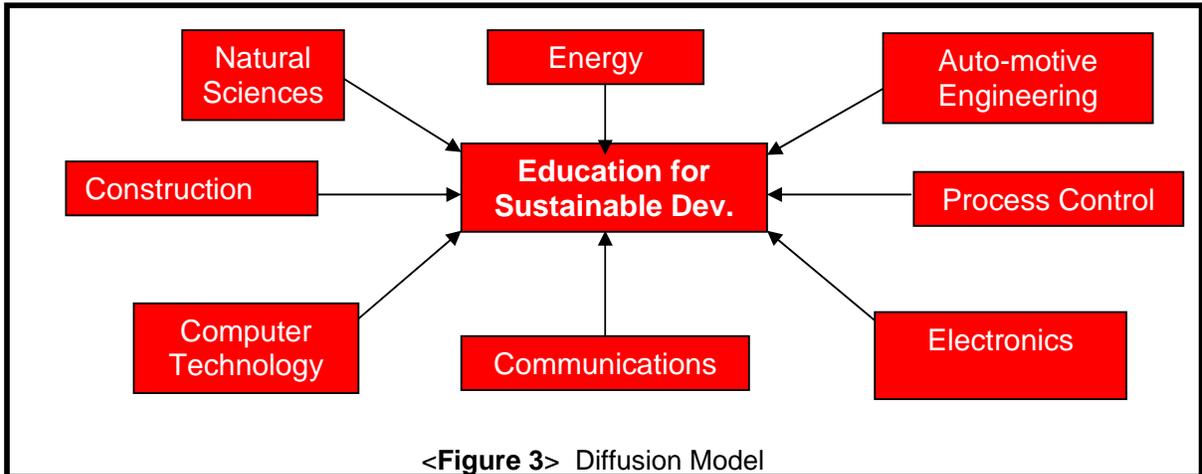
Greater learning outcome of integrating ESD in TVET is elaborated by this author in subsequent section.

### 3.3 CHALLENGE 3: Applying functional models for integrating SD in TVET Curriculum

There could be many approaches for incorporating “Sustainable Development” components into the curriculum, but two specific models of Hungerford have been very much talked about in this field. The first model of Hungerford is known as “Inter-disciplinary or Diffusion Model;” whereas the second model is known as “Multi-disciplinary or Infusion Model”. The essential features of these two models are discussed below.

#### 3.5a Hungerford’s Diffusion Model

In this model the sustainable development issues arising from different disciplines of education are diffused i.e., taken out from their respective areas and pooled into a common discipline or subject known as ‘Education for Sustainable Development’ (see Figure 3).



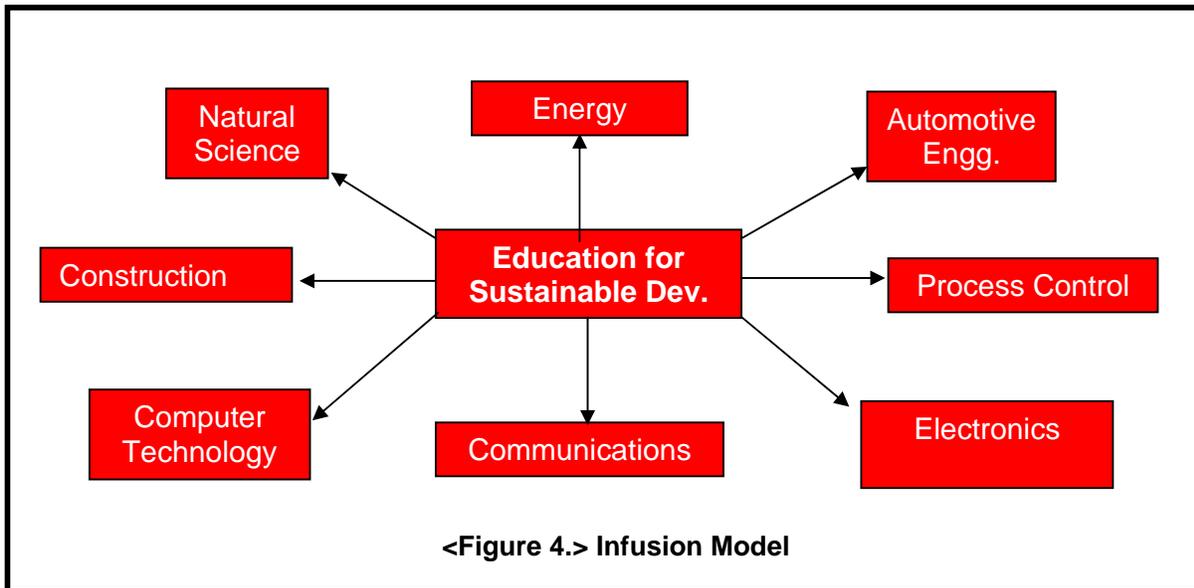
The implementation of this model in TVET may lead to a subject or course on Education for Sustainable Development where generic concepts, skills and attitudes of SD will be covered with specialization in specific fields.

The macro-level courses will be at par with the conventional technical courses. These courses, being interdisciplinary, necessitate the interactions between a wide range of people trained in different fields of knowledge (discipline) each with its own concepts, methods, body of knowledge and language attacking a common problem from various viewpoints. The interaction may range from simple communication of ideas to mutual integration or organization of the concepts, methodology, procedures, epistemology, terminology, data, etc. This requires continuous interaction and communication between the exponents of different discipline.

This model is also known as Hungerford's "stand alone" model.

### 3.5b Hungerford's Infusion Model

In this model, the generic concepts/skills/attitudes of sustainable development are injected or embedded into the various conventional disciplines and subjects without introducing new subjects or courses such as Education for Sustainable Development or so (see Figure 4). This may be done as discussed below.



A combination of both models called Hybrid model is further seen suitable in the effort of integrating ESD in TVET curriculum. This allows opportunity to create a new multi-dimensional discipline for vocational and skills training based on emerging trades and at the same time, provide ready offerings on having SD relevantly embedded where it may be useful and necessary for preparing the workforce for the world of work.

**3.4 CHALLENGE 4: Relating Generic to Specific Learning Outcomes in SD**

While developing the curriculum, there is a need to correlate between Generic learning outcome to specific learning outcome in Education for sustainable development. To illustrate the concept, a learning outcome in the terms of General and Specific in the area of Environment Education for sustainability has been described.

**<Table 2.> Environmental Education for Sustainability (Environmental Protection):  
 General and Specific Learning Outcomes**

| General Learning Outcomes                                                                                                                                        | Specific Learning Outcomes                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>The student should be able to:</i></p> <p>1. Understand the importance of natural processes, relationships and resources that exist in the environment</p> | <p>Explain the importance of the cycles of matter and energy supply.</p>                                                                                      |
|                                                                                                                                                                  | <p>Explain the need for management of finite resources.</p>                                                                                                   |
|                                                                                                                                                                  | <p>Relate the above to global consumption, population dynamics and industrial and social processes.</p>                                                       |
|                                                                                                                                                                  | <p>Be aware of the interdependence of actions by individuals and communities and the environmental consequences and opportunities of these relationships.</p> |

| General Learning Outcomes                                                      | Specific Learning Outcomes                                                                               |
|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 2. Evaluate the environmental impact of an activity                            | Evaluate the impact of action in terms of environmental, economic, social and aesthetic dimensions.      |
|                                                                                | Select options and justify good environmental practice.                                                  |
|                                                                                | Evaluate potential changes in technical, vocational, personal and national behaviour                     |
| 3. Analyse how past decisions and activities affect a local environment        | Explain the ways in which past activities and decisions have shaped the environment of the present day.  |
|                                                                                | Evaluate relevant historical perspectives and events.                                                    |
|                                                                                | Identify the conflicts that arise from environmental issues and consider ways to resolve such conflicts. |
| 4. Interpret the legislative framework which exists to protect the environment | Apply the principles of the relevant environmental legislation.                                          |
|                                                                                | Work (or identify good practice) within the principles of the relevant legislation.                      |
| 5. Evaluate the economic and social benefits of good environmental practice    | Relate the concept of sustainability to local, national and global environmental issues.                 |
|                                                                                | Evaluate conservation, re-use and recycling in an economic and social context.                           |

The following procedure may be generally adopted in developing the core of sustainable education which is widely applicable and which can be built into the technical and vocational education programme curriculum.

#### 3.4a. Choosing the Content

The chosen content should take into account:

- Discussion of the aims of SD as identified nationally and internationally
- The essential learning for SD
- The need to build on a student's previous learning and awareness from their school curriculum or elsewhere
- The views of practicing teachers of technical and vocational education who have already included environmental issues in their programmes
- The key dimensions such as management of resources and use of energy, pollution, legislation, health, safety of people and other species, etc.
- Global perspectives, justice and equity, cultural awareness, information and communication skills, group working, planning, executing and evaluation

#### 3.4b. Presenting the Contents

Units of learning outcomes may be designed for presenting the content. Learning outcomes define the intended achievements of knowledge, understanding, skills and attitude change. General learning outcomes may be subdivided into more specific terms. It has been found useful to write learning outcomes in three categories: general

learning outcomes, more specific learning outcomes and assessment criteria which enable students' achievement to be measured.

An example of a Unit of Environment Education (EE) for Sustainability designed for students is given below.

### 3.4c. Unit of Generic EE for Sustainability

*3.4c.1. Understanding the importance of natural processes, relationships and resources that exist in the environment.* – This general learning outcome requires an understanding of the natural process that takes place in the environment and an awareness of the interdependence of all species and development of the attitude that individual species must learn to enjoy the benefits of nature without encroaching upon the rights of others. A true understanding of these issues will lead one to manage resources and materials effectively, reduce waste and recycle materials.

*3.4c.2. Evaluation of the environmental impact of an activity.* – Processes in the natural world are interconnected. It is the activities of human societies that threaten these relationships and balances. Awareness on the dynamic nature of the environment is important in understanding problems of pollution and personal responsibilities as a consumer of resources. Many of the environmental problems that face us today are due to lack of knowledge and concern for the production and consumption process. Environmental audit and review is a central process in taking environmental responsibility. To achieve environmental protection and sustainability acknowledgement of our individual roles as employees and consumers is required.

*3.4c.3. Analysis of past decisions and activities affecting local and/or the global environment.* – Analysis of past activities and decisions which are responsible for the present environmental degradation is required. Perspectives may include social, cultural, and industrial components. Awareness of the long-term consequences of decisions is necessary for future planning and sustainable development.

*3.4c.4. Interpretation of the existing legislative framework for environmental protection.* – Awareness about the relevant environmental legislations and development of attitudes to work within that framework. Students should understand the underlying principles of environmental law developed to meet national and international requirements.

*3.4c.5. Identification of economic and social benefits of good practice.* – Students should be able to identify good environmental practice and develop an understanding of sustainable development. Often this may require understanding of different cultures and viewpoints.

Each general outcome is accompanied by a number of more specific outcomes. In the full specification the range of knowledge and understanding required is added to each general outcome as shown below.

### 3.5 CHALLENGE 5: Integrating Sustainable Development in Subject Domain

All the three dimensions of TVET and sustainability may be integrated or infused with the disciplines specific course like Civil engineering, Electronics Engineering, Chemical Engineering etc. This is the most difficult and challenging part of integrating S.D. into existing occupations. There is a need to study each and every discipline with the generic concepts of 5R and see how it is applicable or modified in the subject content. Example like carefully disposing of chemicals, recycling of materials, renewable energy generation, low energy equipment, organic agriculture, eco-design, water supply and quality, eco-efficiency, ecological footprint need to be carefully studied in each and every discipline. Most importantly, alternative ways of thinking is the call of the day.

### 3.6 CHALLENGE 6: Imparting ESD with innovative pedagogy

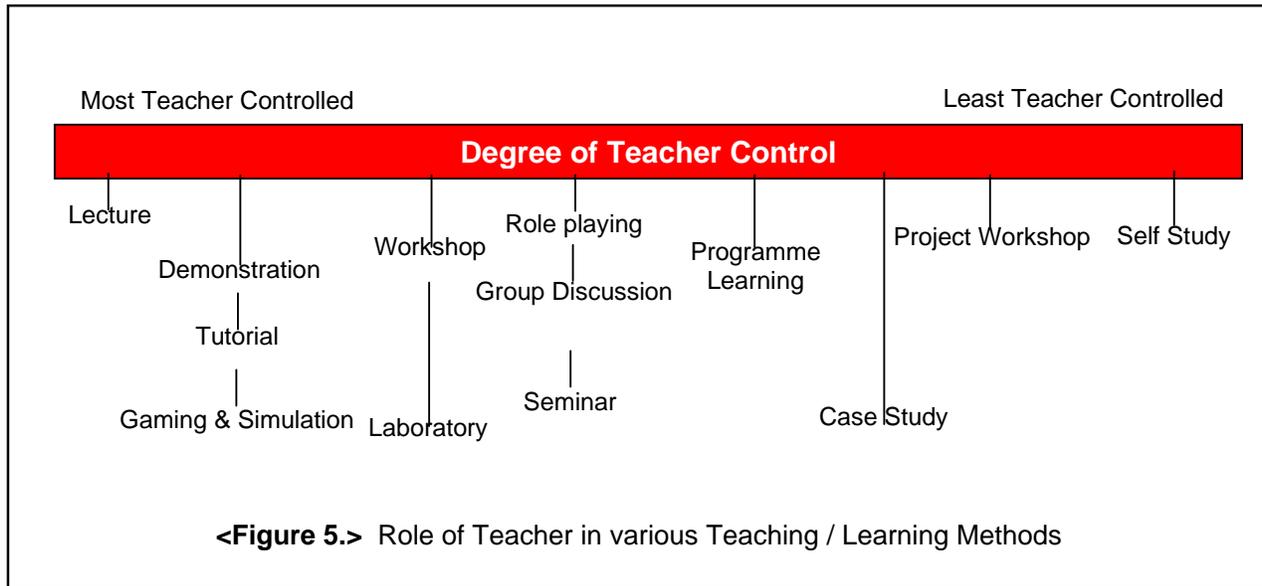
There are some basic principles in imparting ESD or keeping ESD aligned with pedagogy. These are:

- (1) Methods for ESD in TVET should promote problem solving skills, creativity and innovative skills.
- (2) All techniques should be designed to suit learner characteristics, meet their needs and develop their interest and enthusiasm.
- (3) Methods should focus on real-life problem-solving, *i.e., application of principles of science, social science and technology to solve environmental problems.*
- (4) Problem or project-centered approach is usually more appropriate than subject or discipline approach for ESD.
- (5) Scientific and technological aspects of environmental issues should be supplemented with values and ethical aspects.
- (6) Teaching approaches should shift away from lecturing towards group-work, self-study and methods which use active involvement in projects and community life.
- (7) Team-teaching can effectively pool talents of specialist teachers to work in an interdisciplinary way.
- (8) Learners should have access to elective subjects suited to their own personal and professional needs, interests and job opportunities.

Unlike other conventional courses, ESD can not be delivered in the same way. However, there are specific ways to impart ESD for creating greater learning outcome. To do this, it is to be understood that the most important part in Education for Sustainable Development is the teaching methodology. Thus, Environmental Education, as an example, must focus more on learning than on teaching, so that it will have the ability to emphasize active, participatory techniques rather than passive one-way instruction from the teacher.

#### 3.6a Teaching and Learning Methodology

Figure 5 exhibits the role of Teacher with various teaching/learning methods, their objectives and explain and how they may be matched to obtain the required objective.



Similarly, there should be a clear understanding on how different methods of delivery helps in achieving domains of learning objectives.

#### 4. CONCLUSION

The Hybrid model is widely used over most of the developing countries at present in integrating Sustainable Development into TET curriculum. To develop a better understanding of the environment and sustainable development, policy makers, administrators and teachers must now endeavour to adopt the Hybrid Model towards integrating SD into technical and vocational education. The integrated approach has to be injected into the curriculum in a gradual manner so that the required change can be effected over a period of time.

Moreover, the use of primarily interactive, participatory and collaborative teaching-learning techniques are recommended for SD with a focus on hands-on experience including field and factory visits, field work, lab work, etc. Field and factory placement programs for TVET students may be reoriented to include environmental and sustainable development elements. Facilities to work with business and government organisations, NGOs and local communities should be arranged as much as possible for providing access to environmental expertise and exposing the students to real-life problems. However the process of reorienting TVET towards sustainable development is broader and a more pervasive task than that of revising syllabi and devising new teaching and learning materials that incorporate principles and examples of sustainability. Thus, re-orienting the curriculum towards sustainability requires significant educational reforms or what Cuban calls “second-order change”. Where first-order change seeks to improve the effectiveness or efficiency of educational processes through new courses or materials without disturbing the basic organizational structure, “second order change” reforms the fundamental ways in which educational systems and institutions function and includes new goals, structure and roles of schools, teachers and students.

All these if implemented successfully would lead to environmentally responsive engineers and technicians for green society.

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