INTEGRATING SUSTAINABLE DEVELOPMENT IN TVET CURRICULUM

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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 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 our places of work. Successfully making these changes is critically dependent on education and training. Therefore, Technical Vocational Education & Training (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 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. The 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 of the concept and challenges of SD for applying in the work place urgently.

The growing concern about sustainable development has led present day policy makers, administrators and educators to call for a more holistic and integrated sustainable development which demands for linkages among environment, social, technological and economic priorities. These priority concerns and issues indicate that TVET needs to focus on the three dimensions of sustainability-economic, social
and environmental. 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.

The curriculum in TVET has to reflect these changes and needs to provide knowledge, skills and values that will help technician students cope with and adapt to these changes. The focus of this course revolves 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.

It is therefore the task of the TVET professionals to invent new ways in which the concepts of SUSTAINABLE DEVELOPMENT can be infused into the curriculum.

2. GENERIC SKILLS OF SD

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

The relevant generic concepts, which could 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. The relevant generic skills which could underpin the integration of SD into TVET includes Applying concepts related to SD into workplace, Evaluating the sustainability to the work environment, Identifying the environmental strengths, Envisioning Alternative ways of working. The relevant generic attitudes which could underpin the integration of SD into TVET includes adapting to varied situation, thinking critically and creatively, resolving conflict peacefully, working honestly and responsively. But the question is how to integrate the generic skills of sustainable development into the TVET curriculum?
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 21st century. One of the important outcomes of the conference for educators is the recommendation that environment and development education should be incorporated as an essential part of learning within both formal and informal education. A proposal is made that governments should 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. As the coordinator of Technical and Vocational Education and Training (TVET) and sustainable development for the UN Decade of Education for Sustainable Development, UNESCO-UNEVOC has catalyzed key initiatives in many parts of the world. In October 2004, UNESCO hosted an international Experts Meeting on “Learning for Work, Citizen and Sustainability” in Bonn Germany. Recognizing the need for a new paradigm of both development and learning for the world of work, this meeting declared education and training for and through the workplace to be the “master key that can alleviate poverty, promote peace, conserve with the environment, improve the quality of life for all and help achieve sustainable development”.

3. MODELS FOR INTEGRATING SD INTO 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.
3.1 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 1).

![Diagram](image)

**Figure 1. Diffusion Model**

Hence, 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 necessitates 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.
3.2 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 2). This may be done as discussed below.

![Figure 2. Infusion Model](image)

4. DEVELOPMENT OF A CORE FOR SUSTAINABLE DEVELOPMENT

Education for Sustainable Development should encompass certain basic concepts and ideas irrespective of which between the two models is selected. FEDA published a guide to environmental action drawing attention to the moral principle of sustainability, which includes a duty of care for other people and forms of life and acknowledgement of the need to limit and share the use of the earth’s resources.

The following procedure may be 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.

4.1 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

4.2 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.

5. UNIT OF GENERIC EE FOR SUSTAINABILITY

5.1 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.

5.2 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.
5.3 **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.

5.4 **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.

5.5 **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.

**Table 3. Environmental Education for Sustainability (Environmental Protection): General and Specific Learning Outcomes**

<table>
<thead>
<tr>
<th>General Learning Outcomes</th>
<th>Specific Learning Outcomes</th>
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</thead>
<tbody>
<tr>
<td><strong>The student should be able to:</strong></td>
<td>Explain the importance of the cycles of matter and energy supply. Explain the need for management of finite resources. Relate the above to global consumption, population dynamics and industrial and social processes. Be aware of the interdependence of actions by individuals and communities and the environmental consequences and opportunities of these relationships.</td>
</tr>
<tr>
<td>1. Understand the importance of natural processes, relationships and resources that exist in the environment</td>
<td></td>
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<tbody>
<tr>
<td>2. Evaluate the environmental impact of an activity</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>3. Analyse how past decisions and activities affect a local environment</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>4. Interpret the legislative framework which exists to protect the environment</td>
<td>Apply the principles of the relevant environmental legislation. Work (or identify good practice) within the principles of the relevant legislation.</td>
<td></td>
</tr>
<tr>
<td>5. Evaluate the economic and social benefits of good environmental practice</td>
<td>Relate the concept of sustainability to local, national and global environmental issues. Evaluate conservation, re-use and recycling in an economic and social context.</td>
<td></td>
</tr>
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6. IMPLEMENTATION

The unit can be implemented by any of the two models discussed earlier – i.e. either as a stand alone, self-contained curriculum or by integrating the individual outcomes into relevant subjects of the conventional technical and vocational programme.

The general and specific learning outcomes remain the same regardless of the given technical and vocational area but the assessment criteria which qualify the outcomes are likely to vary according to the application to reflect the context adequately.

For example, ‘Evaluation of the Environmental Impact of an Activity’ may involve the impact of either the manufacture of a fabric or garment in a Fashion and Textile course or waste disposal of paper manufacturing unit as a part of Chemical Engineering course or a meal or recipe as a part of a Hotel and Catering course.
Similarly, the specific learning outcome: ‘Explain the ways in which past activities and decisions have shaped the environment of the present day’ may, in an assignment on Road Building Policy in a Business and Finance course have an accompanying assessment criteria, ‘state existing traffic flow problems and analyze their effect on the environment and the community.’

7. TEACHING METHODOLOGY OF SUSTAINABLE DEVELOPMENT

The most important part in Education for Sustainable Development as in any other education system is the teaching methodology. In this regard, it should be kept in mind that Environmental Education focuses more on learning than on teaching, therefore it emphasizes active, participatory techniques rather than passive one-way instruction from the teacher.

Figure 4 and Tables 5 and 6 exhibit the role of Teacher with various teaching/learning methods, their objectives and explain and how they may be matched to obtain the required objective.

![Figure 4. Role of Teacher in various Teaching / Learning Methods](image-url)
Table 5. EE Teaching-Learning Methods and Guidelines for their Use

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Where Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lecture (exposition)</td>
<td>Direct and continuous communication from teacher through speech, demo and visual media</td>
<td>For introduction to a topic</td>
</tr>
<tr>
<td>2. Group Discussion</td>
<td>Student centered: exchange of opinion mainly between students</td>
<td>For changing attitudes, exploring values and sharing viewpoints</td>
</tr>
<tr>
<td>3. Lab work</td>
<td>Student interacts with equipment and/or people and/or material; can be structured or open-ended</td>
<td>Teaching or verifying principles, hypotheses, investigate data collection, etc.</td>
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<tr>
<td>4. Workshop</td>
<td>Use of machines, tools to produce specific articles</td>
<td>To improve and perfect psychomotor skills, scientific thinking</td>
</tr>
<tr>
<td>5. Simulation and Gaming</td>
<td>Student interaction with people takes part in events, uses 'Model' materials</td>
<td>Practical skills for dangerous and large-scale situations</td>
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<tr>
<td>6. Seminars</td>
<td>Student presents viewpoint or problem-solution, followed by discussion/evaluation</td>
<td>In-depth study of specific problem changing attitudes</td>
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</table>

Table 6. Matching Teaching-Learning Methods to Objectives

<table>
<thead>
<tr>
<th>Method</th>
<th>Domain(s) of objectives likely to be achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Low and high cognitive domain, low in affective domain.</td>
</tr>
<tr>
<td>Demonstration</td>
<td>Low in cognitive domain, low in affective domain.</td>
</tr>
<tr>
<td>Group Discussion</td>
<td>High in cognitive domain, low and high in affective domain.</td>
</tr>
<tr>
<td>Tutorial</td>
<td>High in cognitive domain, low and high in both affective and psychomotor domain.</td>
</tr>
<tr>
<td>Gaming and Simulation</td>
<td>High in cognitive domain (games), high in psychomotor domain (simulation).</td>
</tr>
<tr>
<td>Method</td>
<td>Cognitive Domain</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Role Playing</td>
<td>Low and high in both the affective and psychomotor domains and high in cognitive domain.</td>
</tr>
<tr>
<td>Case Study</td>
<td>High in cognitive domain, low and high in affective domain.</td>
</tr>
<tr>
<td>Seminar</td>
<td>High in cognitive domain, low and high in affective domain.</td>
</tr>
<tr>
<td>Self-Study</td>
<td>High in cognitive domain, low and high in both the affective and psychomotor domains.</td>
</tr>
<tr>
<td>Programmed Learning</td>
<td>Low and high in cognitive domain, low in affective domains.</td>
</tr>
<tr>
<td>Project Work</td>
<td>High in cognitive, affective and psychomotor domains.</td>
</tr>
<tr>
<td>Laboratory Teaching</td>
<td>Some in cognitive domain, mostly affective and psychomotor.</td>
</tr>
<tr>
<td>Workshop Practice</td>
<td>Psychomotor and affective objectives at all levels.</td>
</tr>
</tbody>
</table>

8. BASIC PRINCIPLES OF TEACHING ESD

The following are some basic principles of ESD pedagogy:

(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 inter-disciplinary way.

(8) Learners should have access to elective subjects suited to their own personal and professional needs, interests and job opportunities.

9. CONCLUSION

Hungerford’s diffusion 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 Infusion Model of Hungerford 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.
References


