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A green touch for the future of distance education

M.Banu Gündoğan[a], Gülsün Eby[b*]

[a]*Instructor, Computer Education and Instructional Technology Department, Middle East Technical University, Ankara, Turkey*
[b]*Associate Professor, College of Open Education, Anadolu University, Eskişehir, Turkey*

Abstract

This paper aims to draw attention to the sustainability of distance learning in terms of the design process based on learner characteristics and technology usage. Distance learning has become a cyberized system owing its presence to developments in digital technologies. Technological developments solve some immediate problems but also have the risk of leading to even greater ones. To 'sustain' is not only about keeping up, supporting or maintaining continuity but also is about nourishing, cultivation and acknowledgement. 21st century incentives in all fields of human endeavour have replaced sustainability measures in their plans and actions as a necessity for meeting the needs of the present and future generations. Green engineering and design perspectives state the importance of carrying out an inventory of all the materials and energy used in the design process and assessing all the environmental discharges resulting from the product's manufacture, use, and disposal. Being cyberized or virtual does not leave distance education apart; still it is a product designed to serve actual human beings and alike every design, the process has inputs, outputs and unfortunately, produces waste. Unless managed properly, waste is harmful; to avoid possible harms and to be able to respond both to current and future demands and expectations, distance education has to include ecological and sustainable perspectives to its vision. This study outlines the historical background of sustainability, lists the green engineering and green design perspectives from literature and expresses a *green touch* for sustainable distance education within these perspectives.

Keywords: *sustainable distance education; future of distance education*

* Corresponding author. Tel.: +90 312 210 3680; fax: +90 312 210 7986.
E-mail address: banug@metu.edu.tr

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1. Introduction

The future is undefined, yet inevitable. Thoughts and actions towards future tend to be hopeful and every organism, including us humans, struggle for permanence and progress rather than to corrupt. There have been numerous incentives in our history which represent this hopeful struggle. The Universal Declaration of Human Rights, adopted in 1948, specifies both individual rights and governmental determinations on promoting social progress and better standards of life for current and future generations. The Bill of Rights for the Planet, declared in 2000, is concerned with the health of the environment where human life takes place and advocated the rights of the planet we live in, the Earth. 21st century initiatives envisioning the future are still based on permanence and progress and the necessity for the wholeness of individual, social, governmental and environmental actions and understandings are underpinned. Education has been one of the common needs of humans. As stated in Article 26 of The Universal Declaration of Human Rights, "Everyone has the right to education… Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit". 21st century education incentives, alike all fields of human endeavour, have to care for meeting the needs of the present and future generations. The new digital age has introduced such technological marvels that were never thought possible before and as John Sener states, "Education is entering the age of cybersymbosis - irretrievably dependent on digital technologies. This is not a fad, a niche, or even a trend; it is education's future" (Sener, 2011).

In terms of education, distance education can be defined as a result of the struggle for permanence and progress. Initially relying on postal services, it was a provision for accessing learning where the source of information and the learners were separated by time and distance. It has now become a cyberized system owing its presence to developments in digital technologies. The contribution of developing technologies together with the increasing demand due to changing living and working styles have enforced distance learning from being a supplementary solution to a unique system. It is a system; a group of independent but interrelated elements comprise a unified whole to accomplish a predefined goal. The goal is to deliver education to students who are not physically "on site" in a traditional classroom or campus by allowing self-determined, independent and interest-guided learning. It is unique; the learner is real and has real needs, the learning environment is virtual. This system could be successful if it becomes being continuous in space or time, hindering interruptions or disconnections, namely it has to be sustained. To 'sustain' is not only about keeping up, supporting or maintaining continuity but also is about nourishing, cultivation and acknowledgement. Kim (1998) explains the term as "the search for providing the best of all possible worlds for people and the environment both now and into the indefinite future". To provide the best solutions for meeting the needs of the present and future generations, the sustainability provisions have to be an integral part in the design and delivery policies regarding distance education. The following sections present the milestones of sustainability, summarize the green engineering and green design perspectives from literature and express a *green touch* for sustainability, aiming an optimistic contribution to the future of distance education.

2. Milestones of Sustainability

Sustainability definitions have held the Earth - our planet and the Human - our lives as focal points for a long period of time. The concept itself has been a human concern from the earliest civilizations to the present, but has become popular at the post-World War II period when technology had become the determinant of economic growth and innovations like plastics, synthetic chemicals and nuclear energy were changing production and life styles. Popular books such as Silent Spring by Rachel Carson (1962)

and The Population Bomb by Paul R. Ehrlich (1968) raised public awareness on the fact that there were environmental costs to be paid for obtaining material benefits and the quality of the environment was linked closely to economic development. Consumption of natural resources and the harm made by technology were major concerns. In 1972, The Limits to Growth Report and the Stockholm Conference on the Human Environment started a wave of governmental regulations for concerns about environmental issues and with the publication of the Brundtland Report in 1987, the society was recommended to act as a whole with the awareness of the fact that current patterns of resource consumption and environmental degradation could not continue as they were. Brundtland Report was the first report to use the term "sustainable development" and defined it as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The report agreed that technological developments may solve some immediate problems but also stated that these developments had the risk of leading to even greater ones. As to reach a coherent path, the report underlined the fact that sustainable development had to be understood as a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change all collate in harmony and enhance both current and future potential to meet human needs and aspirations. Taking these steps further, The Bill of Rights for the Planet, developed and presented by William McDonough Architects for EXPO 2000, aimed to outline priorities which would be taken into consideration by designers, planners, government officials and all involved in the built environment. The aim of setting these principles were declared as follows: “For the development and improvement of humankind, it is imperative to renew a commitment to living as part of the earth by understanding development and growth as processes which can be sustained, not exploited to impractical limits” (McDonough, 2000).

Following these milestones, there has been increasing attention focused on the challenges of sustainability. Hargroves and Smith (2005) have sorted the common sustainability principles from the work and publications by different authorities as follows:

- dealing cautiously with risk, uncertainty and irreversibility,
- ensuring appropriate valuation, appreciation and restoration of nature,
- integration of environmental, social and economic goals in policies and activities,
- equal opportunity and community participation,
- conservation of biodiversity and ecological integrity,
- ensuring inter-generational equity,
- recognizing the global dimension,
- a commitment to best practice,
- no net loss of human or natural capital,
- the principle of continuous improvement and
- need for good governance

Anastas and Zimmerman (2006) state that changes can be made through innovations in science and technology to mutually benefit the environment, the economy, and the global society. They further state that “Most popular constructs of sustainability are in agreement that there are three major aspects-environmental, economic and societal. Inherently, if an action is not advancing each of the three *pillars* of sustainability it could not be viewed as advancing sustainability overall. Therefore, the difficult questions are involved with the short-term versus long-term consequences of actions, regional versus global, and known consequences versus unforeseeable consequences”. Green engineering and green design are terms which offer paths to realize the goals of sustainability in practice.

2.1. Green Engineering and Green Design

Green Engineering is the design, discovery, and implementation of engineering solutions for sustainability (Anastas and Zimmerman, 2006) and *Green Design* is intended to develop more environmentally benign products and processes (Hendrickson et.al.,1999). The Principles of Green Engineering presented by Anastas and Zimmerman (2006) represent a reflection of those engineering techniques that are being used to become more sustainable. The authors describe their intention in forming these principles as follows: "While there are significant, creative, and important examples of engineering solutions that are being developed, they are neither comprehensive nor systematic. The 12 Principles should be thought of not as rules, laws or inviolable standards. Instead they are a set of guidelines for thinking in terms of sustainable design criteria that, if followed, can lead to useful advances for a wide range of engineering problems" (Anastas and Zimmerman, 2006). The principles of Green Engineering are as follows:

- Principle 1 - Designers need to strive to ensure that all material and energy inputs and outputs are as inherently non-hazardous as possible.
- Principle 2 - It is better to prevent waste than to treat or clean up waste after it is formed.
- Principle 3 - Separation and purification operations should be a component of the design framework.
- Principle 4 - System components should be designed to maximize mass, energy and temporal efficiency.
- Principle 5 - System components should be output pulled rather than input pushed through the use of energy and materials.
- Principle 6 - Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse or beneficial disposition.
- Principle 7 - Targeted durability, not immortality, should be a design goal.
- Principle 8 - Design for unnecessary capacity or capability should be considered a design flaw. This includes engineering "one size fits all" solutions.
- Principle 9 - Multi-component products should strive for material unification to promote disassembly and value retention - (minimize material diversity).
- Principle 10 - Design of processes and systems must include integration of interconnectivity with available energy and materials flows.
- Principle 11 - Performance metrics include designing for performance in commercial "afterlife".
- Principle 12 - Design should be based on renewable and readily available inputs throughout the life-cycle.

Hendrickson et.al. (1999) outline three general goals for green design in pursuit of a sustainable future: (1) Reducing or minimizing the use of non-renewable resources, (2) Managing renewable resources to insure sustainability and (3) Reducing, with the ultimate goal of eliminating, toxic and otherwise harmful emissions to the environment, including emissions contributing to global warming, and identify the objective of green design as to pursue these goals in the most cost-effective fashion. The authors give special importance to the fact that the application of green design involves a particular framework for considering environmental issues, the application of relevant analysis and synthesis methods, and a challenge to traditional procedures for design and manufacturing. Some Green Design Methods and Tools listed by the authors are as follows:

- Conducting mass balance analysis based on measurements of inflows, inventories, and outflows (including products, wastes and emissions).
- Paying attention to green indices and ranking systems which attempt to summarize various environmental impacts into a simple scale by providing rudimentary guidance in choosing materials, components, or process alternatives that have reduced environmental impacts.
- Designing for disassembly and recycling; making products that can be taken apart easily for subsequent recycling and parts reuse.

- Including risk analysis in design as a means for tracing through the chances of different effects occurring.
- Using material selection and label advisors through which designers can select the most environmentally preferred material among alternatives.
- Integrating full cost accounting methodologies; management information systems that reveal the cost of decisions about materials, products, and manufacturing processes to the company.

The application of green design principles rely heavily on managerial and institutional support since designers are specialists who cannot be expected to be environmental experts capable of estimating the environmental and sustainability implications of their decisions. Especially mass balance analysis and full cost accounting methodologies need to be defined and provided by the management which also means that the institution itself has to plan and act towards sustainability and moreover green design (Hendrickson et.al. 1999). In terms of materials selection, Graedel and Allenby (2002) recommend designers to choose abundant, non-toxic, nature familiar rather than man-made materials which have an existing recycling infrastructure. They also advise to minimize the number of materials used in a product or process and use recycled materials where possible.

Green design principles stress the need to consider the systems effects of design decisions. In designing a new product or service, reducing waste with the ultimate goal of eliminating it, is found important. Life Cycle Assessment, a systematic analysis of the environmental effects of a new product or process, is common to both green design and engineering perspectives. This necessitates defining a system boundary, carrying out an inventory of all the materials and energy used and assessing all the environmental discharges resulting from the product's manufacture, use, and disposal within the defined boundary. Regarding the disposal process, the design choices on recycle, reuse or beneficial disposition becomes important. Within this framework, after completing its intended usage the product or process could be an input in; a closed-loop, which refers to the re-use of the product or service for the same function and an open loop, which refers to the re-use of the product or service in a different function, typically with lower quality requirements (Hendrickson et.al. 1999).

3. The Need for Sustainability in Distance Education

21st Century is the age of digital literacy. Information is located, organized, received, evaluated, and analyzed mostly using digital technology. Technological forces affect culture and human behavior. When introduced in 2001 by Marc Prensky, the term *digital native* defined the ones born into the digital age, and *digital immigrant* referred to ones who adopted technology later in life. These terms aid in understanding the issues of teaching digital literacy; technology has changed the way today's students read, perceive, and process information and today's educators need to find effective teaching methods for the digital natives.

The 21st Century Fluency Project, uses the term *fluency* particularly to emphasize an alteration regarding digital literacy; literacy defines to have knowledge or competence whereas to fluency describes the demonstration of mastery- doing unconsciously and smoothly. The fluencies of a digital citizen are given in Fig. 1 and the project states that these fluencies *are not about technical prowess, they are critical thinking skills, and they are essential to living in this multimedia world*.

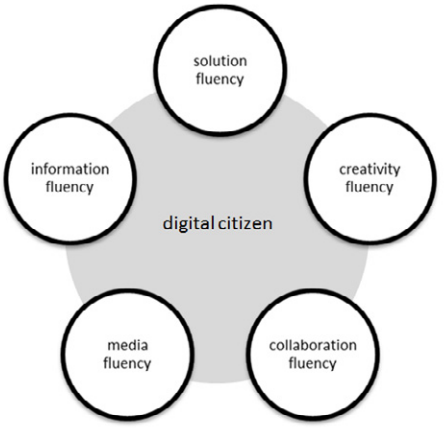

Fig.1. Fluencies of a 21st Century digital citizen

- Solution fluency is the ability to think creatively to solve problems in real time by clearly defining the problem, designing an appropriate solution, applying the solution then evaluating the process and the outcome.
- Creative Fluency is the process by which artistic proficiency adds meaning through design, art and storytelling. It regards form in addition to function, and the principles of innovative design combined with a quality functioning product.
- Collaboration fluency is team working proficiency that has reached the unconscious ability to work cooperatively with virtual and real partners in an online environment to create original digital products.
- Media Fluency is firstly, the ability to look analytically at any communication media to interpret the real message, how the chosen media is being used to shape thinking, and evaluate the efficacy of the message and secondly, to create and publish original digital products, matching the media to the intended message by determining the most appropriate and effective media for that message.
- Information fluency is the ability to unconsciously and intuitively interpret information in all forms and formats in order to extract the essential knowledge, authenticate it, and perceive its meaning and significance.

Evidently, current learners of distance education are mostly digital immigrants and in the near future they all will be digital citizens. This is where the importance on envisioning sustainability regarding distance education becomes important. Current distance education planning and solutions need to support present needs but while doing so, have to create a care taking vision for its future generations- the digital citizens. Distance learning has already become a cyberized system but technological developments have the risk of leading to greater problems while solving immediate ones. Thus, there is a need for a supplementary vision; a vision which not only integrates technology but also an overall systems view of the planning process. Distance education is a designed product and service and alike every design, the process has inputs, outputs and unfortunately, produces waste. Unless managed properly, waste is harmful; to avoid possible harms and to be able to respond both to current and future demands and expectations, distance education has to include Green Engineering and Green Design perspectives to its vision.

4. A Green Touch to Distance Education

Sustainable development has been the search for protection and preservation of the environment not only for current generations but for the future ones as well. Sustainable development strategies lead shareholders to be more attentive to the concerns of all stakeholders and thus to convey the expectations of society as well as the environment of the company (Amann et al., 2009). Weybrecht (2010) states that these strategies have created huge competition not only between organizations and firms, but also between countries and societies; the importance of inclusion of sustainability is a publically acknowledged necessity. Green engineering and green design visions offer paths to realize the goals of sustainability in practice. They have resulted from the recognition of the consumption of natural resources and the harm made by technology. The main focus is on cleaning up past pollution and ongoing waste streams (Hendrickson et.al.,1999). Considering the right factors, and building in the right parameters as design criteria, green engineering and green design visions stress the importance of:

- assessing the life cycle of products and processes, including their afterlife period
- using renewable and readily available inputs throughout the life-cycle
- selecting all material and energy inputs and outputs to be as inherently non-hazardous as possible
- choosing materials, components, or process alternatives that have reduced environmental impacts
- designing for disassembly and recycling and
- preventing waste

The contribution of developing communication technologies together with the increasing demand due to changing living and working styles have enforced distance learning from being a supplementary solution to a unique system. It is unique; the learner is real and has real needs, the learning environment is mostly virtual. We have to recognize the fact that in the near future all distance learners will be digital citizens of a world we can't yet even imagine. The distance education system to serve the digital citizens must take into account their fluencies and this is where sustainability becomes significant. Following sections propose definitions and a *green touch* for sustainable distance education by linking distance education principles, fluencies of digital citizens and green engineering and design perspectives.

4.1. Inputs and Outputs

With reference to distance education principles, context, learner needs, goals, characteristics and the local learning environment can be defined as inputs whereas active and effective learning can be defined as outputs in terms of sustainability. The team working and creativity fluencies of digital citizens add interaction and collaboration as an input and generating innovative products as an output. From the instruction part, managing interaction and collaboration necessitates the provision of feedback which also is an input unit. Fig.2 presents the inputs and outputs of a sustainable distance education system as described above.

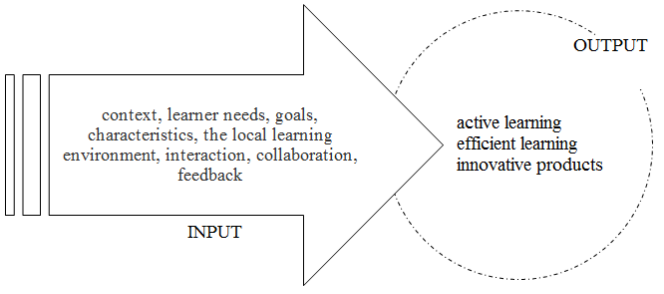

Fig.2. Inputs and Outputs of Distance Education

4.2. The Energy

The energy with which inputs would be transformed to outputs are the institutional strategies. It is important for any institution to possess both a technology plan and a human infrastructure to ensure that appropriate technical requirements are established and learners and learning facilitators are supported in their use of these technologies. The natural resources of distance education, namely the learners, facilitators and content have to be used without depleting them. The main focus needs to be on preventing waste. Fig.3 presents the energy component of a sustainable distance education system.

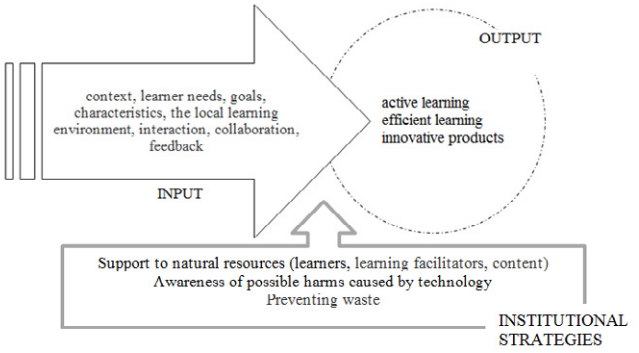

Fig.3. The Energy Component for Sustainable Distance Education

4.3. Designing Learning Materials

Distance education has the ability to provide access to unlimited information via communication technologies, yet has to shape this information so that the learner receives it in coherence with its intended aim. Once designed, the learning materials and environment become real products for which life cycle assessment has to be conducted. These products need to be designed for disassembly and recycling in order to be renewable and readily available inputs. Fig.4 presents the design process as an input for a sustainable distance education system.

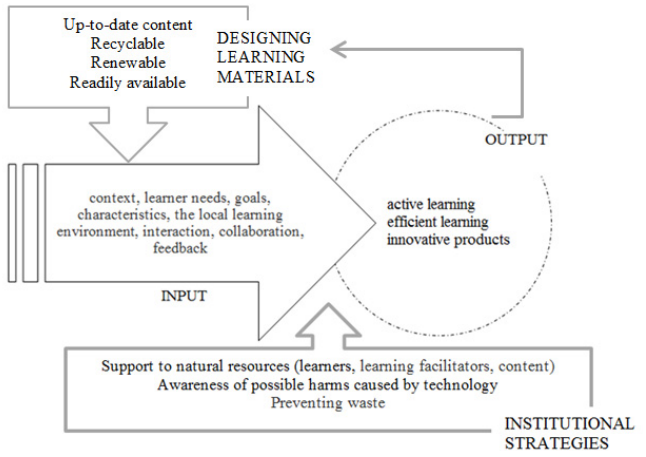

Fig.4. The Design Process for Sustainable Distance Education

4.4. Waste

Waste is anything is unwanted or useless; it is a loss through carelessness, inefficiency, or ignorance. Ignoring environmental effects during the product design and production stages resulted in environmental damage caused by careless consumption of natural resources and the inefficient dumping of hazardous waste. Recognizing this damage, green engineering and design perspectives proposed actions towards cleaning up past pollution and ongoing waste streams. Being mostly cyberized or virtual does not leave distance education apart; still it is a product designed to serve actual human beings and alike every design, the process has inputs, outputs and unfortunately, produces waste. Unless managed properly, waste is harmful; to avoid possible harms and to be able to respond both to current and future demands and expectations, a sustainable distance education design needs to integrate waste prevention.

Every distance education is unique regarding its components and goals, thus the concept of waste has to be redefined in the planning stage of each system. Considering the right factors and building in the right parameters as design criteria, green engineering and green design visions stress the importance of reducing waste with the ultimate goal of eliminating it.

A sustainable distance education at first hand, must be caring, efficient, or aware towards its resources; the learners, facilitators and content information. If not, then dissatisfied learners and/or facilitators, dropouts and out of date information would be wastes. In terms of both hard and software, due to rapid developments, technology itself has the tendency to be waste. Although designers of a distance education system are not expected to be environmental experts capable of estimating the environmental and sustainability implications of their decisions, managerial and institutional support integrating green engineering and design perspectives would provide a reference area at least by forcing product life and after life analysis into the design process. Within this framework, all resources and outputs can be planned as different quality inputs after completing their intended usage.

5. Conclusion

Sustainability is a multi-scale study with many frames of reference and application context ranging from the planet Earth to economic sectors. As all 21st century incentives, current distance education planning and design has to integrate sustainability as a necessity for meeting the needs of the present and future generations. Distance education has become a cyberized system owing its presence to developments in digital technologies but in terms of sustainability, it can no longer rely on advances in technology or the increasing 'consumer' demand; the inputs, outputs, energy and wastes have to be defined and managed so that the system can be sustained for an indefinite period without damaging its own environment, without depleting resources and has to be renewable. This study defines the inputs as learner characteristics, content, learning materials and environment, outputs as active and efficient learning and energy as the institutional strategies. Understanding the characteristics of learners in the near future, namely the digital natives, is important for the design process. Since every distance education is unique regarding its components and goals, the concept of waste has to be redefined for each system. Green engineering and design principles focusing on efficient use of resources and provisions for reducing waste with the ultimate goal of eliminating it would be a reference for designers in creating sustainable distance education systems for future generations.

Our planet has always offered us colorful resources. Now, in turn, we owe a green touch to our descendants.

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