Chapter 2

Technology-Mediated Pedagogies for Skill Acquisition toward Sustainability Education

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Abstract

The era of digital technologies has heralded increasing opportunities for technology-mediated pedagogies (TMPs). TMPs as effective means for enhancing acquisition of skills have been widely reported. Sustainable living may be attained by focusing on accessibility, availability, affordability, accountability, and last but not the least, acquisition of knowledge and skills. This study explores the means and ways of realizing the objective of sustainability education by deploying TMPs. Technology and skill acquisition are important means for realizing the concept of sustainable education. Sustainable development goals have targeted 14 goals. The theme of ensuring quality education is included as digital technologies and global inclusiveness. Regional disparities in education continue to be a problem that hinders economic development. Achieving the targets of "Education for All" will contribute to meeting Goal 4.7 that envisages to ensure that all learners acquire the knowledge and skills needed to promote sustainable development by 2030 and Goal 4.c that envisages to increase the supply of qualified teachers.

Keywords: technology-mediated pedagogies, skill acquisition, sustainability education, sustainability skills, TECHSUS skills

1. Introduction

Acquisition of skills for sustainability education has emerged as an important learning outcome of education. Sustainability has been adjudged as a reckoning force contributing to enhancing quality and life span in planet Earth. Education as a means for attaining sustainable living was realized ever since the concept of sustainability gathered momentum in the year of its inception in 1972 in *The Ecologist's A Blueprint for Survival*. It acquired further significance

when the UN's Stockholm Conference called for making modern civilization sustainable. "Sustainability" as implied in Brundtland Commission in 1987 strives for increasing the life span of the planet—material and immaterial—by responsible living. The Earth Summit in 1992 established "sustainable development" as the most important policy of the twenty-first century.

It has been realized that effectiveness of sustainability education is determined not only by mere attainment of concepts, but also by level of applied knowledge and acquisition of skills. Sustainability education focused on acquisition of skills ensures relevant and responsible learning. Studies have revealed that the level of competency attained by learners after completion of course is not adequate. In this context, it is necessary to employ and deploy alternative instructional strategies intended toward skill acquisition.

Since, sustainability strives to develop a community of global citizens, the skills that define global citizenship may be considered for sustainability also. Thereby, it can be deduced that sound and effective sustainability education is obtained by developing skills of critical thinking, ability to argue effectively, ability to challenge injustice, inequitable distribution, respect for people, cooperation, and conflict resolution.

Technology-mediated instruction strategies have been found to be effective in skill acquisition of reading, writing, communication, collaboration, and negotiation. Technological devices such as wireless laptops, electronic decision boards, handheld computing, video devices, computer assisted problem-solving systems, electronic video games, and web-based-mediated instructional systems too have been found to augment learning.

Needless to add, technology offers opportunities for enhancing capacity building in sustainability. However, the role of technology-mediated pedagogies for realizing sustainability education needs to be explored further. For imparting the right sustainability education, focus needs to be on the acquisition of skills.

The chapter will highlight the skills for sustainability education and explore the technology-mediated instructional strategies for skill acquisition for sustainability education.

2. Technology-mediated pedagogies

Instructional strategies that make use of educational potential of technology may be referred to as technology-mediated pedagogies (TMPs). TMPs imply use of technology for teaching and learning. In the last decade, there have been alternate instructional strategies attempted in the learning place. Innovations and inventions have always found a way to the classrooms; first, these have been tried out as experiments and eventually finding permanence as an essential attribute for teaching and learning. The same could be described about digital technologies. Digital technologies starting with the PCs have now transformed classrooms from computer labs to handheld devices [1].

TMPs have contributed to innovations in offering digital-based teaching and learning opportunities. This, in turn, has had an impact on educational needs, both in terms of the content and the delivery of educational services, and has also put pressure on decision makers to acquire

new technologies [2]. At the same time, different forms of TMPs are emerging with various digital learning solutions for practitioners and beneficiaries. The wealth of studies of effective teaching conducted over the last few decades has now clarified the basic nature of the many process variables involved in teaching ranging from discrete observable behaviors to more global and more subjectively assessed qualities [2]. Classroom practices play an important role in the transaction of curriculum. All educational policies and curricular objectives are being realized within the four walls of the classroom. Classroom practices involve and incorporate classroom dynamics, classroom communication, classroom dialogue, and teaching-learning process.

Teachers should model use of information and communications technology (ICT) to demonstrate usefulness and appropriateness for collaboration, acquisition of resources, analysis and synthesis, presentation and publication, and development of basic skills in students [3]. Only teachers competent in digital literacy and TMPs can transfer these skills to the students they teach. Teachers need to acquire higher levels of functional literacy and lifelong learning skills and be able to demonstrate well-developed socioemotional intelligence, useful for negotiating and collaborating within the global village and be fluent in use of ICT for a variety of purposes [4]. Learning skills enable learners to acquire new knowledge and skills, connect new information and existing knowledge, analyze, develop habits of learning, and work with others to use new information among other skills [5]. This will contribute to enhancing the employability of learners and minimize the gap between skill availability and skill requirement.

TMPs provide new opportunities for people to learn at their own convenience and pace. This shift in education from an instructor-centered to a learner-centered focus requires learners to be motivated and self-directed. New technologies offer less time to gather information and more time on reflection on its meaning [5].

The various theories of learning point out the educational potential of technology and confirm that Techno pedagogies comply with various theories of cognitive learning. Some of the most prominent theories include: sociocultural theory (based on Vygotsky's intersubjectiveness and zone of proximal development), constructivism theory, self-regulated learning, situated cognition, cognitive apprenticeship, problem-based learning (Cognition and Technology Group at Vanderbilt), cognitive flexibility theory, and distributed cognition [6–11]. Each of these theories is based on the same underlying assumptions that learners are active agents, purposefully seeking and constructing knowledge within a meaningful context.

The learner engagement in authentic tasks in authentic contexts using authentic tools and assessed through authentic performance becomes a reality in the context of TMPs. Opportunities for peer, mentor coaching, and scaffolding enhance the scope of learning. It provides a rich collaborative environment enabling the learner to consider diverse and multiple perspectives to address issues and solve problems. It also provides opportunities for the student to reflect on his or her learning. TMS provides powerful tools to help learners access vast knowledge resources, collaborate with others, consult with experts, share knowledge, and solve complex problems using cognitive tools. The constructivist learning environment also emphasizes authentic assessment of learning rather than the traditional paper/pencil test [4, 12] (**Table 1**).

TMPs broaden the information base and widen the range of learning experiences enabling learners to be active agents in their own knowledge construction by integrating new information

Skills	Phases of instruction
Data gathering	Awareness building Introduction and preliminary instructional tasks
Data retrieval	
Communicating for data collection	
Information processing	Acquire understanding
Information organizing	
Information compilation	
Communicating for data sharing and discussions	
Analytic, interpretative, problem solving framing conclusions, and formulating judgments Decision making and professionally engaging	Analyze, solve problems, and capability to address the problem

Table 1. TECHSKILLS developed while deploying TMPs.

into their schema or mental structures. The learning process is seen as a process of "meaning-making" in socially, culturally, historically, and politically situated contexts. TMPs also comply with creating a constructivist environment and involve developing learning communities comprised of students, teachers, and experts who are engaged in authentic tasks in authentic contexts closely related to work done in the real world. A constructivist learning environment also provides opportunities for learners to experience multiple perspectives. Through discussion or debate, learners are able to see issues and problems from different points of view, to negotiate meaning, and develop shared understandings with others. TMPs, thus if used effectively, can contribute to skill acquisition and skill enhancement and paving the way for twenty-first century digital skills [13].

2.1. Skill acquisition through TMPs

Technology can and does help students develop all kinds of skill from the basic to the higher order critical thinking ones. With this point in view, educationists have insisted on technology-enabled learning environment. Skill acquisition by teachers while deploying activity-based instructional strategies in turn enables transfer of skills to learners while using these activities. It has been found that such TMPs are effective vehicles for promulgating a host of skills [14]. Use of TMPs offers opportunities for learners to acquire skills of data collection, information processing, organizing information problem solving, collaboration, networking to negotiate through the cyber world, and to participate in online and community networking [13, 14]. The degree to which ICT has been integrated in an educational system can be evaluated by applying "Morel's Matrix"—a model that proposes an educational system that moves between four distinct phases: (a) emerging, (b) applying, (c) integrating, and (d) transforming [15].

Skill acquisition is a specific form of learning. Quality of education is determined from the acquisition of skills by learners. Skills have been reported as the global currency of the twenty-first century [5]. The need for acquisition of the right skills has long been considered as instrumental to meeting the goals of education. TMPs have explored various mechanisms by

which learning skills may be augmented and developed. TMPs have inbuilt capability to enhance the technology skills of learners by equipping learners with skills of data gathering, data retrieval, information processing information organizing, information compiling, analytical, and decision making [4, 13, 14]. However, these inbuilt capabilities can be exploited only if appropriate learning tasks are assigned to students. TMPs, which assign projects and require problem solving, are excellent methods by which skills of independent learning, self regulation, analytics, and decision making are utilized and enhanced.

Skill acquisition also transcends through various stages in tune with the level of integration of technology innovations in the classroom (**Table 2**).

The matrix represents graphically the evolutionary pathways for any educational experiment in the classroom. The details as compiled in the matrix assigns TMPs to development of critical thinking, stimulating one's preferred learning style, and opportunities for collaboration and experimentations.

The twenty-first century learning skills envisage four Cs viz., creativity, critical thinking, communication, and collaboration as most important skills for the future work environments.

The instructional strategies and teaching approaches that are suited for sustainable education reveal the deployment of information gathering skills, information processing skills, and analytical skills. The web 2.0 technologies hve opened up scope of communication and collaboration paving the way for community engaged learning, which is most relevant for disciplines that have a global connotation. A critical and thorough understanding of issues related to sustainability necessarily involves contributions from a wide variety of disciplines throughout the natural sciences, social sciences, and humanities. It requires thinking outside one's intellectual expertise and mobilizing multiresources for learning. In short, resourcefulness of the teachers is required to incorporate and adapt sustainability concepts to the curriculum [15].

The effective use of the skill depends on executive control of the teacher, which implies understanding of the purpose and rationale of the skill and adapting it appropriately during instruction. Appropriate adaptability involves modifying or creating instructional materials,

Transforming	Integrating	Applying	Emerging	Criteria/phase
Entire learning community involved	Driven by subject specialists	Driven by ICTs specialists	Limited, pragmatic, dominated by interested individuals	Vision*
Critical thinking, preferred learning styles, collaborative, and experimental	Learner centered; collaborative	Teacher centered	Teacher centered	Learning Pedagogy*
Technology-mediated pedagogical skills	Technology-mediated learning skills	Technology-mediated teaching skills	TECHSKILLS	Skill acquisition

*Adapted from Centre for Research on Lifelong Learning, 2009.

Table 2. Examples of stages in Morel's Matrix.

organizing learning experiences and learning activities, and blending it with other instructional approaches [4].

TMPs created learning pathways that contribute to higher learning skills like structuring models and judgment formulation [14]. The various technology mediated instructional strategies (TMIS) that teachers can use may be categorized into three based on the objectives that govern intended learning outcomes, for awareness building, collection of information, and collaborative e-learning activities [4]. The technology-mediated problem-based learning activities enable developing higher order thinking skills by providing students with authentic and complex problems. This approach to learning provides a more authentic context for learning and engages students in authentic tasks. It is used frequently in fields such as engineering, medicine, and architecture, through the process of working together, articulating theories, creating hypotheses, and critically discussing the ideas of others [16].

The development of such skills is most required for transaction of interdisciplinary and multidisciplinary curriculum, which are related to contemporary global subject and issues [15]. The listed strategy thus becomes very relevant for realizing goals of sustainability education. Sustainability, being an integrative multidisciplinary discipline has statistical, scientific, and humanistic dimensions. With its focus on specific problems and particular solutions, sustainability education emphasizes the significance of utilizing place-based and project-based approaches for attainment and application of concepts [16].

2.2. Significance of skill acquisition for sustainability education

The learning possibilities of technology may be deployed for a multidisciplinary and interdisciplinary subject like sustainability education. Studies have reported change in the technology skills required by learners due to changing learner's expectations and needs [17]. New technologies are interactive, making it now easier to create environments in which students can learn by doing, receive feedback, continually renew their understanding, and build new knowledge. Students in technology-integrated environments have reported that students immerse in the learning activity, which in turn individualizes the educational process to accommodate the needs, interest, current knowledge, and learning styles of students [7, 11, 12]. The curriculum is no longer focused exclusively on the traditional core subjects of language, mathematics, and history. Informed by the new vision of what the community felt, tomorrow's students would need to know and be able to do, these disciplines underwent major revision. Mathematics, for example, now includes the skill of comprehending extremely large and extremely small numbers, which are essential to environmental literacy and understanding relative risk factors, both in personal life and at work. Health now includes environmental issues such as cancer, allergies, and food additives as well as "consumerism" [18].

The term "sustainability" has an important history in development literature. In 1983, the United Nations convened the World Commission on Environment and Development (WCED), known informally by the name of its chair, Gro Harlem Brundtland. The Brundtland Commission's report, Our Common Future (1987), contains one of the most often cited definitions of sustainability:

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> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainability education (SE) describes the practice of teaching for sustainability (**Figure 1**). Agenda 21 was the first international document that identified education as an essential tool for achieving sustainability development and highlighted areas of action for education [15]. Sustainable education attempts to change attitudes and lifestyles through imbibing and adopting the right approach to sustainability. It has been widely emphasized that sustainable development cannot be achieved by technological solutions, political regulation, or financial instruments alone. The need to change the way one thinks and acts becomes an important course of action for sustainability education. This requires quality education and learning for sustainable development at all levels and in all social contexts. Education has been included as a significant aspect of attaining sustainable livelihoods by focusing on accessibility, availability, affordability, accountability, and last but not the least, acquisition of knowledge and skills [18].

Ever since being a free nation, the concept of universal education was enshrined in the Indian constitution. Free and compulsory education were important terms, which found their places ranging from constitutional guarantees, election mandates, vision documents, and earmarking of planned funds.

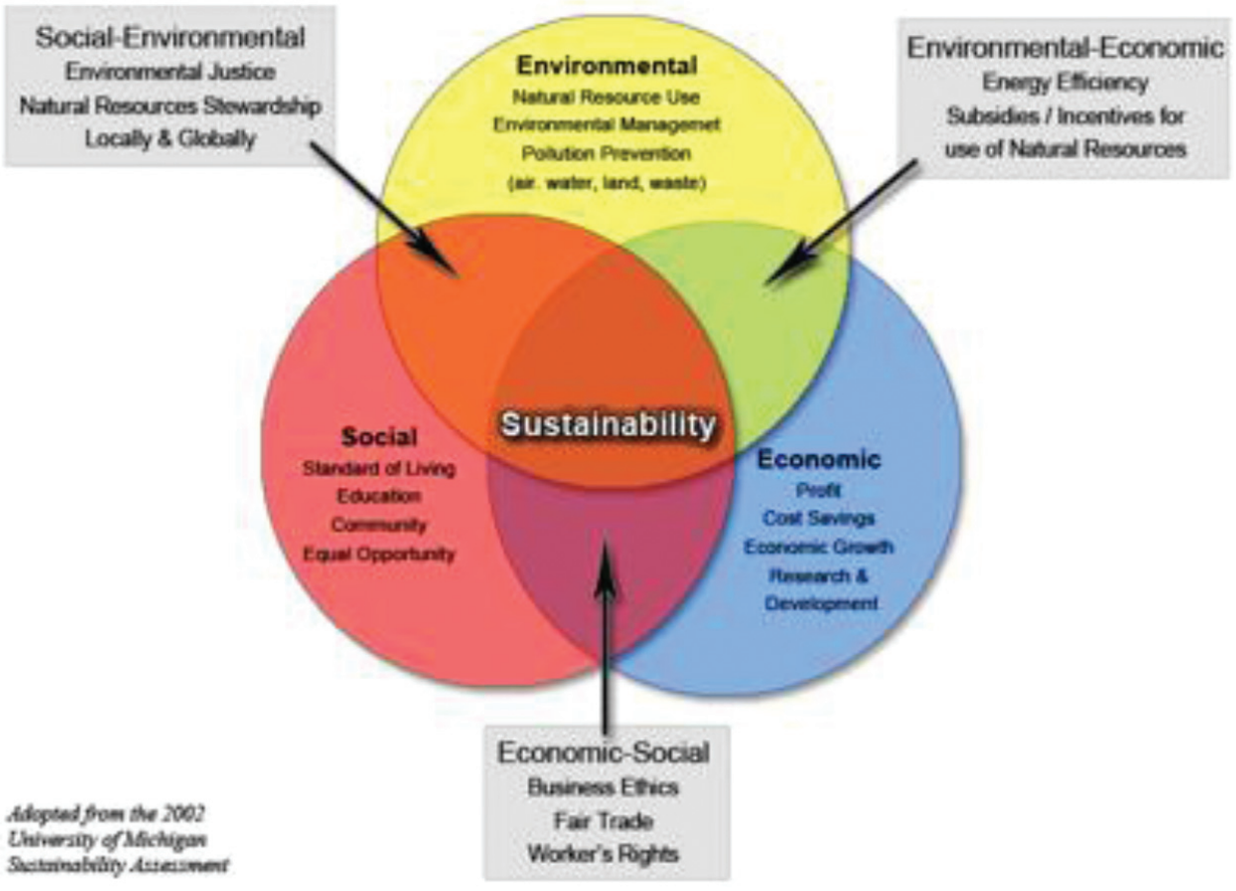

Figure 1. The three spheres of sustainability [19].

Concepts related to sustainability are growing in significance, in the context of the world, harboring a population of 7 billion, with resources becoming limited. This makes it imminent the need for individuals and societies to take responsibility for their actions. Actions, here and today, can have implications for the lives and livelihoods of people in other parts of the world, as well as for future generations [20].

This emphasizes the need to empower learners through responsible educational practices by which competencies like critical thinking, imagining future scenarios, and making decisions in a collaborative way are cultivated and enhanced.

SUSSKILLS	TECH SKILLS	TECHSUS SKILLS
SUSSKILLS TECH SKILLS TECHSUS SKILLS **Acquire skills of sustainability** Experimenting and experiencing sustainability—age 11–14 years Ecology footprinting—calculating natural resource use, measure levels of resource consumption relative to resource availability, the consumption of individuals, campus communities, cities, or entire nations. Carbon calculators—measures of carbon resource consumption necessary to curb such problems as climate change **Equipping others to practice sustainability** Practice, preach, and perform-conserving resources, ecological Ecological literacy. Provide occasions to discuss natural resource and waste management, particularly resource depletion, renewal, and toxification. Enhancing social skills by community engagement for learning such things as population demographics, consumption trends, and economic development models, and policy priorities, lifestyle choices. Community living and digital citizenship provide a unique feedback. Communication and collaboration activities for initiating dialogs and forums for discussions, deliberations and formulating judgments, Ecological footprinting, encouraging investigation and discussing processes to minimize and eliminate problems related to achieving targets	Digital resource identification, retrieval, and utilization Digital resource organization, data mining, and data analytics Peer tutoring, online tutoring, social media networking and developing online community problems	Use of digital resources, Wikis, blogs, online platforms, social media, MOOCS for collecting information for attaining concepts with regard to sustainability through activities like: use of online databases and use of statistical applications like R, SPSS, and MATLAB for analysis leading to knowledge generation and problem with regard to sustainability through activities like: trace the environmental history. Sustainability models offer opportunity to attempt chronological analysis, time series analysis, and projections of the future Footprint calculations compared over individuals, groups, or entire nations can provide a basis for wide-ranging discussions of inequality in resource use and waste, as well as the cultural, political, and economic systems that structure them. Policy analysis. More precise ecological accounting inevitably leads to discussions of different regimes of resource management and thus offers opportunities to debate environmental policy at the local, national, or global level. Furthermore, because ecological footprints can suggest multiple and highly different models of achieving sustainability, they may foster discussion about a wide range of environmental policies. Project future directions.

Table 3. Technology-mediated pedagogies for enhancing skills of sustainability (TECHSUS).

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2.3. Skill acquisition—technology-mediated sustainability (TECHSUS models)

The sustainability integrated curricular model (SICM) [14] attempts to integrate sustainability concepts within curriculum and inculcate the values of sustainable living and livelihood among future and prospective citizens of the world. Sustainability concepts are inculcated at four levels. The skill set embodied in the twenty-first century skills implies preparing learners toward living sustainably. Sustainable development as is commonly defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (**Table 3**).

Technology intervention for attaining concepts of sustainability and acquiring skills of sustainable living may be introduced from the age of 11 years, when students are in the high school. For effective skill acquisition, it is necessary that the foundation of sustainability education has been laid. In the early years of schooling, sustainability concepts may be attained through direct experiences and activity-based learning strategies like nature study, field study, and gardening. These are incorporated in the broad discipline of environmental studies. The skills for sustainability that need to be emphasized for attainment of concepts pertaining to sustainability may be referred to as SUSSKILLS, which comprise of identifying the concepts involved, differentiating between healthy and nonhealthy sustainability practices, developing, inculcating sustainability skills, and fostering values related to sustainability viz., care and caution, prudence, and simplicity [21].

These need to be differentiated from the TECHSUS SKILLS, which encompasses TMPs for development of sustainability skills viz., identify resources on sustainability, use of digital resources, organizing information on sustainability literature, analyze the information using digital techniques like data mining, development of software applications, and digital web tools for sustainability practice. As envisaged by the sustainability integrated curricular model (SICM), sustainability skills at the higher secondary level (age 11–14) comprise of equipping skills of responsible livelihood, identifying the real-time problems concerning sustainability, associating concepts of "sustainability" to global events—past and present, building capabilities in identifying measures of problem solving, developing, and inculcating sustainability skills. Studies have found that skill building offers cent percent assurance of effective realization of objectives of sustainability education with regard to capacity building and ensures proficiency in concept delivery [15–18].

3. Conclusion

To conclude, ensuring inclusive and equitable quality technology and engineering education and promoting lifelong learning opportunities for all has been envisaged under goal 4 of the sustainable development goals. How well students learn in the learning place equips learners with skills of global citizenship. These get transferred to the work environment. The current global scenario requires engineers to be global citizens, as well as aspirational, ethical leaders" [20]. Hence, it is necessary that timely curricular intervention is required to address the needs of skilled manpower for sustainability education.

Sustainability education can be imparted through the use of digital resources, Wikis, blogs, online platforms, social media, MOOCS for collecting information, and for attaining concepts with regard to sustainability through activities like, use of online databases and use of statistical applications like R, SPSS, and MATLABS for analysis, leading to knowledge generation and problem solving with regard to sustainability through activities like tracing the environmental history. Sustainability models offer opportunity to attempt chronological analysis, time series analysis, and projections of the future.

Footprint calculations whereby individuals, groups, or entire nations are compared can provide a basis for wide-ranging discussions and highlight instances of inequality in resource use. More precise ecological accounting inevitably leads to discussions of different regimes of resource management and thus offers opportunities to debate environmental policy at the local, national, or global level. Furthermore, because ecological footprints can suggest multiple and highly different models of achieving sustainability, they may foster discussion about a wide range of environmental policies and project future directions.

Governments have a role in building capabilities through formulating the right policies based on research and global trends. Implementing these in various educational settings will help to drive innovation and infusion toward developing a sustainability-empowered community for the future. It can, therefore, be concluded that digital technologies may be effectively utilized for deploying TMPs, which would contribute toward skill acquisition for sustainable living.

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References

[1] Srikirupa V, Nayar AK. A comparative study of technology enabled learning environments in the context of convergence of technologies in the global scenario-handheld devices. In: CTE, editor. The International Seminar on Education at Crossroads Tilting Social Educations (ISECTCE' 17); February 1–3, 2017. Trivandrum [In press]

[2] UNESCO Web Archive [Internet]. 2001. Available from: http://portal.unesco.org/education/en/ev.php.URL_ID=27040&URL_DO=DO_TOPIC&URL_SECTION=201.html [Accessed: 2017-07-09]

[3] Laurillard D. Teaching as a Design Science: Building Pedagogical Patterns for Learning and Technology. India: Routledge; 2012

[4] Nayar AK. A study of proficiency exhibited by secondary school students in digital learning skills—A case study of a state in India. In: Bastiaens T et al., editors. Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2009. Chesapeake, VA: AACE; 2010. pp. 2982-2987

[5] Partnership for 21st Century Skills. Framework for 21st Century Learning. 2014. Retrieved from: http://www.p21.org/about-us/p21-framework [Accessed: 2015-07-09]

[6] Spiro RJ, Coulson RL, Feltovich PJ, Anderson DK. Cognitive flexibility theory. Advanced knowledge acquisition in ill-structured domains. In: Tenth Annual Conference of the Cognitive Science Society. Hillsdale, NJ: Erlbaum; 1988. pp. 375-383

[7] Salomon G. Distributed cognitions: Psychological and educational considerations. New York: Cambridge University Press; 1993

[8] Vygotsky LS. Mind in society: The development of higher psychological processes. In: Cole M, John-Steiner V, Scribner S, Souberman E, editors. Cambridge, MA: Harvard University Press; 1978.

[9] 31st Annual Meeting of the Jean Piaget Society. Available from: http://www.piaget.org/Symposium/index-2001.html

[10] Bransford JD, Stein BS. The Ideal Problem Solver. Centers for Teaching and Technology—Book Library; 1993. p. 46.

[11] Oshima J, Bereiter C, Scardamalia M. Information-access characteristics for high conceptual progress in a computer networked learning environment. In: Schnase JL, Cunnius EL, editors. Computer Support for Collaborative Learning '95. Bloomington, IN, USA: Lawrence Erlbaum Associates; 1995. pp. 259-267

[12] Nayar AK, Barker MA. Computer labs as techno-pedagogical tools for learning biology—Exploring ICT practices in India. 2014

[13] Donnelly R. Teaching and Learning in the Digital World: Possibilities and Challenges. 2005. http://unesdoc.unesco.org/images/0024/002431/243126e.pdf.

[14] Nayar AN, Lopez C, Srikirupa V. Paper Presented in the international Conference on Emerging Knowledge Society-Curricular and Technological Innovations and Practices-(EKSCTIP-2017) titled Capacity building In Sustainability practices (CISP) through Sustainability Integrated Curricular Models (SICM)Achieving Sustainable Development Goals In Education"; March 1–3 2017; Mar Theophilus Training College, Nalanchira. 2017

[15] Frisk E, Larson KL. Educating for sustainability: Competencies & practices for transformative action. Journal of Sustainability Education. 2011;**2**. ISSN: 2151-7452

[16] Zirbel EL. Teaching to promote deep understanding and instigate conceptual change by using technology to support project and problem based learning. 2005. http://cosmos.phy.tufts.edu/~zirbel/ScienceEd/Teaching-for-Conceptual-Change.pdf

[17] UNESCO. Educating for a sustainable future: A transdisciplinary vision for concerted action. 1997

[18] Marable S. Green schools—The implementation and practices of environmental education in LEED and USED green ribbon public schools in Virginia. The Journal for the International Society for Educational Planning. 2015;**22**(1):49-65

[19] Rodriquez SI, Roman MS, Sturhahn SH, Terry EH. Sustainability assessment and reporting for the University of Michigan's Ann Arbor campus. University Master's Project. Ann Arbor: University of Michigan; 2002. pp. 1-396

[20] Caird S, Lane A, Swithenby E, Roy R, Potter S. Design of higher education teaching models and carbon impacts. International Journal of Sustainability in Higher Education. 2015;**16**(1): 96-111. DOI: 10.1108/IJSHE-06-2013-0065

[21] UNESCO. Teaching and Learning for a Sustainable Future. 2010. Retrieved from: http://www.unesco.org/education/tlsf/ [Accessed: 2017-07-09]