Smart Green Classroom and Machine Learning to Promote Green Awareness for Sustainable Livings

Subhasree Pal [1], Souren Bhattacharya [2], Subhranil Mustafi [3*], Shankar Prasad Mitra [4]

[1] Research scholar of the School of Education,
Netaji Subhas Open University,
West Bengal, India
subhoriddhipal2010@gmail.com

[2] Research scholar of the School of Humanities and Social Science,
Department of History, University of Technology,
Jaipur, Rajasthan, India.
sbhattacharya1977@gmail.com

[3] Junior Research Fellow, Kalyani
Government Engineering College,
Kalyani, Nadia, India
subhranilmustafi2011@gmail.com

[4] Assistant Teacher, Panchkhela High School (H.S.),
Plassey, Nadia, West Bengal, India
shankarmitra35@gmail.com

Corresponding Author :- Subhranil Mustafi

Abstract

The gyration of development has been started through an unwise input that natural resources are abundant and surplus to use. To boost up a sustainable ambience for the present generation as well as for the future generation, metamorphosis is initiated to adopt green transformation in the society, in every sphere of life including Education. If education is getting assembled with techno-savvy approaches putting a bird's eye on green conversion, the world again rejuvenates with all its blooms. Machine learning and deep learning can be utilised for mining acquainted knowledge from natural unpolished circumstances to provide necessary inputs in the teaching-learning process to bring out the most desirable outcomes to transfer society into green and habitable one. The main aim of this paper is to anatomies to understand the interconnection between machine learning and green education to effectuate sustainability. For this, different machine learning processes are discussed, probable changes in infrastructure and curriculum are prescribed to generate future green soldiers who value green and sustainability. This paper analyses the applicability and different dimensions of introducing green classrooms along with various machine learning techniques are mentioned to amalgamate two different halves into making one.
.

Keywords: *Machine Learning, Green Classroom, Sustainability, Green Education.*

Introduction

Where the quality of life goes down for the environment, the quality of life goes down for humans" ………. *George Holland.*

A classroom is more in respect to mere bricks-cements edifice, a place where minds and living targets are set to protect humanity and its existence. The very coinage took its origin in the early 1990's when the Rio Earth Summit (1992) laid hold of apprehension on the priority to held initiatives in "every area in which human impacts on the environment". The World Summit on 'Sustainable Development' held in Johannesburg in 2002 stimulated the efforts to bring about a shift in 'education about the environment to 'education for sustainability. This

transition in thinking and implementation perspectives posturized the necessity to provoke thought about sustainable development which indicates to satisfy the prerequisite of the present generation without jeopardizing the necessity of the future generation. It is an hour necessity to realise for every habitant of the Earth that if in the pursuit of development, we carry on the tradition to abuse the natural resources without minimum consideration, it is we who stimulates our destructions making the future humanity endangered and dilapidated. Therefore, to survive, to revive, to re-establish the tenure of our survival, there is an urgency to create a deep root of consciousness among the present and among future citizens to combat skilfully the challenges that are they going to face in the question of survival and existence. Realizing the importance of education as the pivotal means to attain sustainability, the 'United Nations' has introduced the 'Decade of Education for Sustainable Development' in 2005. Furthermore, 'the United Nations Sustainable Development Goals' delineates the preferences according to global climatic scenario up to 2030 (UN Department of Economic and Social Affairs, 2015) which assembles the difficulties fronted by the community throughout the world. Again, European Union initiates the goal to touch the zenith of climatic neutrality up to 2050 (European Commission, 2018). Therefore, emphasis has been put on renovating the ecosystem, economy and society through green modification to attain sustainable goals. (Altenburg & Pegels, 2012). But the only transformation in industrial policy, as well as consumer policy, are not enough to meet the goal, the mentality and behaviour modification along with creating awareness among youths and future generation is also the sole right way of the society to lit the candles (Polzin, 2017) and hence the role of education is initiated to get this concern into real shape. Total quality management in education refers to that issue that not only the transaction of lessons and enhancement of employability skills but to the creation of a sustainable environment that celebrated the legacy of commons (Pal & Bhattacharya, 2020). The steams of education are originated from the concepts of sustainability issues, the concerns for mitigation regarding climatic change along with fatalities that the environment facing and to respond 'Sustainable Development Goals'(Fleacă et al., 2018). The green transformation to achieve this goal, education delivers its lesson through Tran's disciplinary approach rather than disciplinary or interdisciplinary method. Green Smart curriculum has appeared on the field in this regard (National Research Council, 2012) in collaboration with soft skills and civic values (Holbrook & Rannikmäe, 2014).

 The present paper is going to highlight what is Green Education, what is the form of prescribed curriculum and how it assimilated with smart education with the help of machine learning enlightens present as well as coming future generations to achieve the aim of green sustainability and transform them into the green citizen.

Methodology

The present study is purely qualitative, analytical and descriptive in nature based on secondary data. The data for concept of smart education ,machine learning and green job is collected from various related articles. Further data is collected from different government organisations and other international organizations like UNO, EPA, UNSDR etc. All data are interfaced with each other to reach the conclusion. Green education, smart education and machine learning are three major components which are bridged up to show the path towards sustainable living.

Dynamics of Aim and Objectives of Education:

Education had started its journey with aim of moral and spiritual upliftment of the individuals and to promote his moral contributions to society. Along with the age of Vedic society, If we make a journey throughout the world's ancient education system, the root of education originated from religion which was modified with the geographical and social structure of that very region. Where India flagged off the education-based antiquity, there China lied its foundation on making civil servants, as the country was too big with different landforms. In the domain of Christianity, the Church was responsible to carry on education along with spreading the doctrines of Christianity. Whereas in Israel, the superstructure of education lied in Jewish tradition, there Buddhists carried on their education system emphasizing 'all-round development' attained by hymns and meditations. Again, in that time, in Athens, a faded picture of systematic formal education was visualised based on reading and writing along with emphasizing physical training accorded with the learning of lyre playing: a full package of education system satisfying brain, muscles and heart.

With the invention of the steam engine and starting the era of the industrial revolution, the priority to have skilled labour forces had emerged and this priority began to reshape the education system to satisfy the need and priorities of the Industrial Revolution putting the foundation of Formal education system. Emphasis was put on refining and tuning the skill to turn the wheel of Industry. To make more human labour, open education system appeared in the field to make education reachable to more and more aspirants (Pal & Sarkar, 2021). The invention of the steam engine also made the world communicable and accessible to each other which deeply had affected the education system. Later the education system has stepped into an era where everything has been deeply influenced by different usages of technology and innovations. The motto of education has now shifted to make life more comfortable and enjoyable. The economy has begun to leave its mark on every part of the educational periphery and begins to mould its aims and curriculum as per Liberalisation, globalization and different attributes of World trade. With the emergence of the era of the knowledge society, humans is begun to consider as resources and the making process is done at the institution level. Now the aim has been shifted to making humans more skill efficient and potential with the employability skills which the society. To quench the need, smart education emerges in the field transferring the conventional into a smart one (T. Kim et al., 2013) by opening a new platform of 'MOOC'. The education

system which had started its journey from limited access and opportunity now reach into the learner's bedroom to provide its accessibility such as the Indian Government has launched 'Swayam' platform (Bhattacharya & Pal, 2020b). The skill-based and the need-based prioritised with value-based education, to satisfy society's need, to raise the standard as per global priority and standard (Bhattacharya & Pal, 2020a) along with injecting the dose of morality and aesthetic value are the prime aims of the education system.

Changing Environmental scenario

Human beings appear on this blue planet around million years ago, starting their journey with fire and extraction of mineral resources by causing harm to Mother Nature. The unprecedented blue-print of development escalated resource depletion. With the advent of the industrial revolution, human beings started indiscriminate exploiting of biotic and abiotic resources unwisely, throwing self-understanding and self-reliance as an obsolete philosophy. Ecological imbalance is now a global concern for the last few decades. It's a multi-facet problem that includes climate change, loss of biodiversity, the decline in food production and decline in quality of soil, air, and water (Verma, 2018). We have lost 100 million hectares of land within two decades (2000-2020) and 37,400 plants and animal species are on the verge of extinction according to IUCN Red Data Book (United Nations, 2021). When more than 3 billion people are directly dependent on oceans, the dead zones are increased from 400 to 700. The emission of millions of tons of greenhouse gases leads to global warming threatening the existence of human civilization on this blue planet in a multi-faceted way. The UNO warns that in the next 30 years the world is going to witness severe scarcity in food production if no action is taken to reduce the GHGs. The global demand for wheat will reach 700 million for which we have to increase the wheat production by 60 per cent of the present production to feed approximately 9.6 billion people. A study has shown that global food production must be increased by 100 to meet the global demand (Tilman et al., 2011). Further, this will accelerate poverty. When tons and tons of edible oil and foods are lost or wasted every then the contrasting scenario is poverty is slowly increasing since 2014 (Cervantes-Godoy et al., 2014). It is estimated that around 17 per cent of global food production is wasted. According to a UN report, 7 million people die at premature age due to environmental pollution (Air Pollution – Deadly Effects on Life, 2019). Deadly diseases like asthma, bronchiolitis, Chronic Oppressive Pulmonary Disorder (COPD), the neurological disorder is increasing at an alarming rate along with several deadly viruses stimulating mortality and morbidity rates (Desai et al., 2004) and badly hampering the health of the future citizens. The students are the worst victim of environmental degradation (Po et al., 2011). The problem is grave in developing countries due to lack of development, overpopulation and hunger. Household air pollution (HAP) has crossed the threshold limit in developing countries as a silent killer. It was reported that around 1.5 million died alone in South East Asia due to HAP (Ahmed et al., 2019). Three out of ten have access to safe drinking water and six in ten people lack safe sanitation (UN News, 2019).

Impact on the learners:

The environmental degradation proves to be a catastrophe for the children, the asset of every nation hampering health and education with increasing the ratio of diseases like asthma due to exposure to polluted air (Hulin et al., 2010), pneumonia (Jary et al., 2015). the cases of eye-related diseases like cataract, glaucoma, (Díaz et al., 2007), irritation and swelling of eyes (Person et al., 2012). According to the estimation of WHO, 785 billion people lack safe drinking water access and 2 billion people are using contaminated surface water with faeces (Bachelet, 2019). Due to unsafe water, sanitation, hygiene and lack of awareness, every year around 87500 children below 15 years dies of diarrhoea (UN News, 2019). With the onset of global climate change, natural disasters are also increasing at an increasing rate which diarrhoea such as the recent earthquake of Haiti exposes around 540000 children to life-threatening water-borne diseases (UN News, 2021). Moreover, the school poor environmental infrastructure has a deep impact on the learners' health (Joshi et al., 2005)and also learning process along with lack of nutrition (Paulson & Barnett, 2016). The onset of heat waves, overcrowding, increase vector borne diseases have impacted the learners' health (Landrigan et al., 1998). It suffices to say that the neurocognitive development of the learners and their learning comprehension, respiratory and ophthalmic health (World Health Organization, 2017) and overall progress are influenced by the institutional environment, (USEPA, 2019).

The emergence of a green-smart education system:

There is indeed no perfect and unified demarcation of "smart education", it only implies that technology can play an important role in the bridge between teachers and learners. Different from conventional education, Smart learning comprises technology-aided advancement of digest knowledge and skills more conveniently, effectively and efficiently.

- According to Gwak though technology has an important role to support smart learning, focusing more on learners and content rather than using devices so that learners can become a proactive leader under the mentorship of teachers.
- From Dr. Mansoor Al Awar's perspective, Smart learning is the outcome of the Three T's –"Total Transformational Thinking".
- Authors (T. Kim et al., 2013) proposed that smart learning association the advantages of social learning and global learning concentrating on learner-centric and service-oriented education.
- Authors in "Smart learning: Teaching and learning with smartphones and tablets in post-compulsory education"(García-Peñalvo et al., 2020) also mentioned learner-centric structures of smart learning using smart education technologies.
- As per the viewpoint of authors in (Lee et al., 2014), smart learning includes formal and informal types of learning along with social and collaborative learning.

In the learner-centric framework of smart education, faculty plays the role of mentor and coach rather than just being a teacher with the advancement of self-direction, motivation,

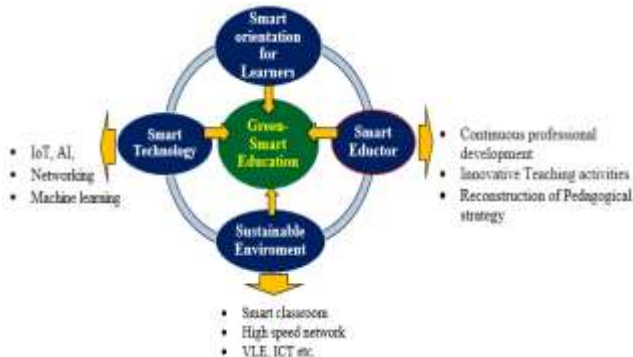adaptive, resource-enriched and technology-embedded features **(Fig. 1).**

Fig 1: Layout of Green Smart Education

The major components of smart education:
The word 'smart' is now consistently used in the modern education system and nowadays we are quite familiar with the new terminologies like "Smart Education", "Smart Learning", "Smart Classroom", "Smart Learning Environment", etc.(Shoikova et al., 2017). This new educational model steams from smart devices and artificial intelligence-enabled technologies. (Lee et al., 2014), (Uskov et al., 2017), (S. Kim et al., 2011). In the digital era, it is found that technology can be used to learn more effectively, efficiently, flexibly, and happily; in a single word "smartly" as Modern electronic educational technology. Modern electronic educational technology incorporates e-learning, instructional technology, computer-based instruction (CBI), information and communication technology (ICT) in education, learning technology, multimedia learning, technology-enhanced learning (TEL), computer-managed instruction, computer-based training (CBT), computer-aided instruction (CAI), internet-based training (IBT), web-based training (WBT), flexible learning, online education, digital educational collaboration, computer-mediated communication, cyber-learning, and multi-modal instruction, personal learning environments, networked learning, virtual learning environments (VLE), m-learning, global learning and digital education (Day & Payne, 1987), (Dodorp, 2013). In the modern-day smart education system, intelligent technologies like the Internet of things (IoT), cloud computing, learning analytics, big data, artificial intelligence (AI) etc. encourage the development of smart education. Using such technologies learning data of any individual can be captured, analysed properly and directed which indicates the improvement of the one-to-one TEL model by promoting smart personalized teaching-learning (Elias, 2011), (Naimi & Westreich, 2014) (Picciano, 2012). In addition to that integrating the location information of the learners, social media communication of the learners and visual-reality tools via wearable technology and artificial intelligence teaching-learning process can further be improved by connecting these advanced technologies. In comparison to the traditional static educational systems todays dynamic educational systems emphasises on "Mobile learning" which focuses on the mobility of learners throughout globe. (Hwang et al., 2008). Through this learning

process learners can learn and exchange their views in global platform through formal and informal both (Chan et al., 2007).

Overview of Green Smart Education:
We are in the era of industry 4.0 and from the educational point of view; we are at the optimum level of this era. The learning outcome balance is tilted towards industry orientation but the major aim of education this millennium is to create sustainable wisdom in our future citizens. For this, we need to develop a Green Education system that includes zero energy infrastructure, zero water discharge, the wise use of energy (Sridhara Acharya, 2015) and eco-friendly resources, a green curriculum and green management (S. & Jeevan, 2016). The infrastructures like the building, energy, material resources should be taken in the light of the concept of green. A major breakthrough has been done when UNO declared 2005 -2014 as the decade of green education. It was aimed to create awareness in society and among the students about greenness and sustainability. At the same time, we have to make every endeavour so that our future generation can create a green and sustainable environment. Green education is not a mere introduction and inculcation of environmental ethics, norms and values in the curriculum but at the same, it will use smart ways to make the learning outcomes more healthy, precise and sustainable manner with fulfilling Industrial needs through addressing the socio-environmental issues. So, the concept of green and sustainability are two major pillars of green smart education (**Fig. 2**).
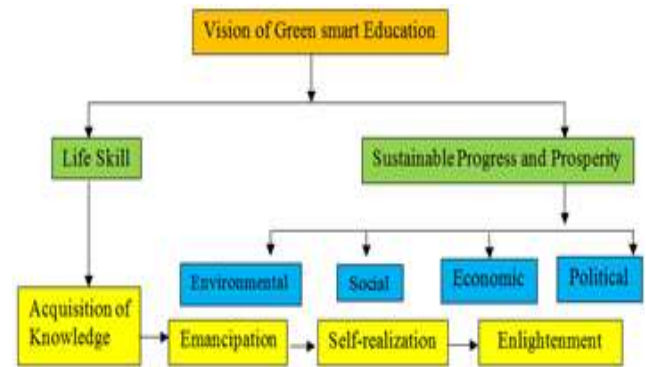

Fig 2: Vision of Green Smart Education

The construction material used for building the educational institutes should use environmentally friendly materials like usages of less water, energy efficiency and generate less waste by creating less impact on the environment (Manna & Banerjee, 2019) The educational institutes should transform themselves into zero energy buildings through producing renewable energies for themselves as for examples solar energy and wind energy can be used to meet the requirements. Moreover, energy consumption is minimized with smart technologies. Lighting is the most important physical factor which affects learners' performance. The lighting should be controlled specially in the classroom because lighting has a direct impact on learners' performance and achievements (Koper, 2014), (Spector, 2014). The lighting can be induced into a smart classroom equipped

with smart teaching devices making learning more adaptive and hyper-personalized stimulating psychological and cognitive domains such as attention, attitude, motivation and visual pleasure. LED lights in classrooms have better engagement and activities of the students and especially for the students with developmental difficulties. Buildings are built keeping the philosophy of optimal utilization of sunlight and solar energies. The physical design of the classroom should retain naturalness because it directly affects students, progress (Barrett et al., 2017). The green infrastructure ensures supply of safe drinking water. World is going face acute scarcity of water within next 50 years. The educational institutes use significant amount of water for drinking, laboratory use and for sanitation. The supply of safe water is prime concern to ensure healthy living of all associates of institutions. Water budgeting, water auditing, water harvesting and zero water discharge mechanism should be incorporated in education institutions by incorporating smart sensors to reduce wastage of water. The teaching equipment should be eco-friendly.

Leveraging Green Smart Education through Machine Learning:

In layman's terms, Artificial Intelligence is the ability to predict or classify the possible outcomes based on past inputs upon a mathematical model. However, there are certain parameters that define the possible outcomes and the ability in revolutionizing the education system efficiently becomes one of the most challenging tasks in this modern era (Siau et al., 2018). Smartness in the education system applies to the usage of devices that are interactive in nature and pertains to effective learning through the omnipotent ways of teaching. Traditionally, the use of artificial intelligence lies in aiming at the simulation of filtered information, constraint handling, pattern recognition and inferring significant outcomes necessary in dealing with the real life problems in a self-efficient automated manner (Drigas et al., 2015). The basic schematic diagram for such machine learning algorithms can be seen in **Fig. 3**.
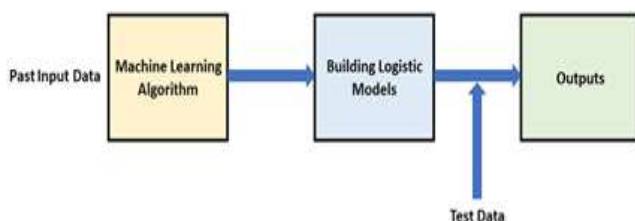

Fig 3: Schematic Diagram for Machine Learning

Wherein the concept of Green smart education lies in applying the concept of smart education efficiently, the use and scope of machine learning approach a bigger domain in predicting a few possible outcomes. Proposed to be specific in its novelty for this paper, it may be used in:

1. Predicting the absence of students and thereby turning on/off the electricity: This proposal leads to a havoc impact in saving the energy when not in practical use.

Often vacant classes are kept with lights and fans on, where the unnecessary usage of electricity leads to widespread misuse of the resources leading to the depletion of the same. The prediction of the presence of students through the use of sensors and drawing a possible inference based on the day, time on the past instances shall be highly efficient and useful in saving the unnecessary depletion of resources required for the generation of electricity.

2. Creation of self-assessed domain selection in the choice lift of the curriculum for the students: It is often heard that the schools and colleges have been an "education-reaping-factory" where all the students study the same subjects, give the same tests, listen to the same lectures, turns the pages at the same instant upon getting instructions from the teachers, although having the different ability of interpretation, levels of understanding and most importantly, different subjects of interest. It would be of significant help for the students if they were able to choose their choice of interest in an articular domain, following a standard curriculum as prescribed by the authorities. The excellence of pursuing this kind of work would definitely avert in making machines out of factories and help in developing self-understanding and implementation skills for each student. Machine Learning would help in altering a few values of standard defined parameters and hence infer to a generalized result regarding this.

3. Generation of self-assessed tests for the students by the teachers: Teachers on the other hand shall have the credibility in identifying the quality of understanding and response of each student by conducting personalized tests and based on the results or values may modify the teaching the self-prescribed way. The parameters upon receiving values for each student shall have the capability in predicting the outrageous outcomes of their learning abilities.

4. Prediction of Reason behind Dropouts: Often a large number of students each year drops themselves out of the course due to the inability in pursuing the same. The reason is mainly being unable to complete the syllabus and answer the questions in the qualifying examinations. The actual motive behind such problems shall have an impact in assessing the records of liking or disliking the subject for which they desire to present the answer convincingly gets omitted during the final answering in the examinations. The actual reasons shall be predicted precisely only by defining a model with the parameters pertaining to such changes.

5. Study based on the localized climatic conditions of the student: It often becomes necessary to teach the students the localized climatic conditions so that harnessing the natural resources becomes easier and there lies something that the student may return to the society after receiving values from their schools and colleges. However, the proper understanding of one's

localized climatic conditions may help each student in developing a clear knowledge of how to improve the vegetation and other ecological factors necessary for the survival of upcoming generations.

As assessment is an important tool in predicting future predictions, the parameters (including activation weights and biases) need to be justified with proper values. The classification of machine learning algorithms into supervised learning, unsupervised learning and reinforcement learning fulfills the requirement for usage of such algorithms as per the usage. As supervised machine learning plays a key role in performing the self-assessment strategies, it can further be classified into classification and regression algorithms. Regression might not be more suitable than classification as it pertains mostly to continuous values, the latter shall be used in classifying the answers and predicting the most favourable solution for the particular student (**Fig 4**).
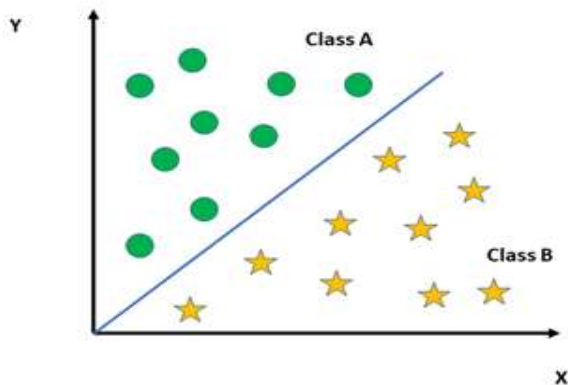

Fig 4: Inter-Class Classification

The neural networks, being a subset of machine learning are hence designed based on the modifications at each layer to predict the output, whether it is to classify the presence of students or assessment of students or learning local geographical conditions based on the location. These layers need to be trained recurrently following the supervised machine learning approach in inferring to a specific class as result (Asthana & Hazela, 2020).

In a nutshell, machine learning can be treated as a subset of e-learning wherein it helps in improving e-learning based on return-on-investment (ROI), delivering increased personalized contents of e-learning, employing the use of chatbots for instructing the content usage, providing numerous assessments and automating administrative e-tasks based on the respective time quanta.

Curriculum Restructuring to Meet Up Green Needs:
Green Education simply indicates the need to assemble the values, attributes, skills and cognitive changes related to environment and environmental sustainability. Again, the green economy reshapes every region that has direct or indirect relation with political, social, philosophical in collaboration with changing the aim of education. Former American President Barak Obama in the summit of United Nations thoughtfully reflected to impose a change in the curriculum to make this globe sustainable for the future generation to live "Our generation's response to will be judged by history, for if we fail to meet it- boldly, swiftly and together- we risk consigning future generations to an irreversible catastrophe" (Louw, 2013). Education is the only gateway to produce human resources, now time has knocked our doors to restructure curriculum from the societal point of view along with stimulating the speed of the economy. To promote a green curriculum, it is become obvious to integrate it with Digital Smart Transformation (**Fig. 5).**
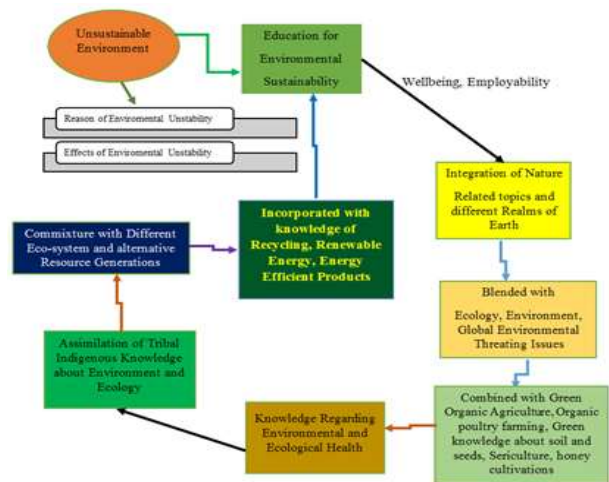

Fig 5: Incorporated with knowledge of Recycling, Renewable Energy, Energy Efficient Products

Green education also assembles with them green machine learning technology to enhance students' knowledge as well as participation. The main of introduction Green curriculum are to:
- Transforming aspirants into green citizens with desired competency to accelerate the process of green transformation
- Increasing the value regarding civic aptitude to an improvised entrepreneurial active competence

Through following this framework of green curriculum, following capabilities have taken the desired shape in the young minds to make a green sustainable world

Change of climate, need to acquire green skills (ILO, 2019) and sustainability capacity have been advanced throughout the last few years. These again comprise equality and sustainability in societal grounds, safeguarding for bio-diversities and campaigning of associated education (Lozano et al., 2017) and elaborating the competencies of students on green sustainability in a larger notion (Scherak & Rieckmann, 2020). Exercising of these capabilities varied from technology development to zero energy production celebrate the green competencies all walk of livelihoods (European Commission, 2021).

Table 1: green curriculum, following capabilities

Desirable Skills	Green Abilities
Understanding	Environmental Concerns and prioritised environmental elements
Knowledge	Ecology, Eco-system, Realms, Global Warming, Green Nano Technology
Creativity	Produce synthesis of knowledge and to develop new eco-friendly technologies
Insight	Presume the unseen needs and necessities of the society
Collaborative Skill	Developing of group activity skills to work of different sections as a whole on addressing environmental vestiges
Resource Management Skill	Ability to reproduce, reuse along with developing the capabilities to apply low-carbon eco-friendly technology, adaptation and environmental mollification.
Ethical Reasoning towards Green Sustainability	Communion and comprises skills for the sake to promote desired transformations to communities and societies
Self-Awareness	Resilience in willing to accept desired changes among within
Transferable quality	Learning by experiences and through interdisciplinary approaches to attain green sustainability.

Therefore, to make a bridge between the needs of a green economy and a green society, educational institutions should implement a green curriculum from lower standards as it is the necessity and priority of the society to excel and thrive by creating a green sustainable environment. Again, technology and science should be amalgamated with the green curriculum to bring out desirable learning outcomes.
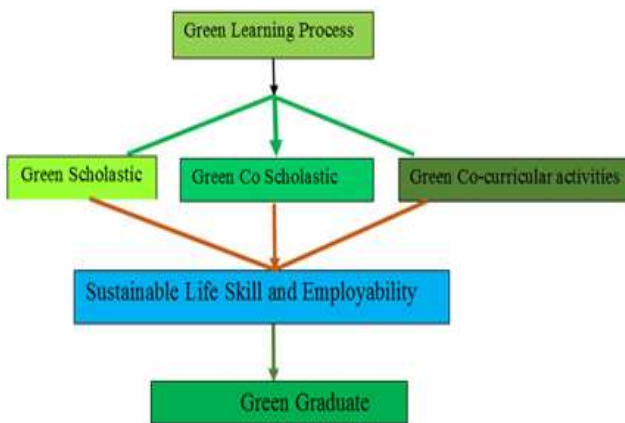

Fig 6 Green Learning Process

Green Smart Education leads towards Sustainable living:
The child spends their maximum time at school when they mould themselves as per the need of society. In the early phase of development, when energy had been considered as an unlimited source that never ended, the attitude of students towards using it reflected that very tendency for what we are now at the juncture of scarcity. Student life is the seed time where we can plant what we need in future. If a child develops

seeing the attitude to preserve and conserve forces every time, they grow up accordingly. They prioritize the use of less electricity; they give importance to not destroying resources of forces and strengthen the practice to preserve all usable forces as much as possible. A leaking tap can waste billion and billion liters of water in a week if it is left as it is. If a student in the school learns to preserve water, he never allows this in his house. Seeing in school, they learn to use rainwater, they never wastage electricity, they force their parents to start the vehicles when the traffic light is red. All these little small steps lead us towards sustainable living. Students are the harbinger of new desirable change not only in a future life but also in the present life. They can guide their parents what they learn from school and in their adult period of payback phase in life, they remould the World as per necessity.

Therefore, classroom is an essential element to generate awareness, create consciousness among the children to meet the needs of sustainable development. Education and classroom practices make desirable cognitive development to address sustainable development, without that sustainable development remains as a daydream. They make the desirable connection to transform the learnt knowledge into desirable action where students are the main protagonist.

Scope for Green Jobs:
Present attributions of the economy to make a more solvent, more climate flexible and efficient green economy that maintains environmental sustainability and create environmental friendly work conditions that modify the present and restores an environmental serene ambience for future generation asking for the necessity to adopt green jobs and 'Green Human Resource Management'(Mehta & Chugan, 2015). The Asia Business Council Report assumes that by the end of 2030, nearly 100 million green jobs opportunities are created worldwide which is supposed to be 2% only regarding work participation in future. The economy already has gone through three metamorphosis stages to reach a green economy: factor-driven economy, efficiency-driven economy and innovation-driven economy with a mid- transitional period. The transformation into green has been now considered another revolution to create an ambience for well beings, equity on the social periphery which remarkably and drastically lessen the hazards and imbalances in the environment as well as in ecology (Bowen et al., 2018). Green jobs are created for two main purposes: transferring existential jobs into green jobs and stimulating the economy whose foundation is on 'green'(Martinez-fernandez & Hinojosa, 2010). To satisfy the need of employees and employers for green job fields, it is also necessary to give the opportunity of 'career changers' and 'career starters' (Bowen et al., 2018). Again, by the end of 2030, energy needs throughout the globe will be supposed to accelerate by 45% (Burleson, 2009). OECD enumerated that "green growth is gaining support as a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use" (Towards Green Growth, 2014). Again, 'International Energy Agency' has foresighted that by 2030, one barrel of oil is likely to enlarge its price by $200 (Ball, 2008). Within a single generation gap, the population who resides in

urban is increased in number by half to two-thirds of the whole (UN Habitat, 2021) which constantly has called up an ambience of competition, the rat race for limited resources, threats for leading a meaningful life along with conflicts. There is again another angle for creating the superstructure of green jobs.

Challenges for Adaptation of Green Smart Education:
- Synchronising, assimilation between different streams, simplifying extant competencies structure into Green Transformation Capability is a difficult task
- Transformation into the green is still a long way to go, a lot of fund allocation is needed to carry on research on it.
- Over dependency on smart technologies may curtail the warmth and feelings of human interactions
- Still, there is no policy and blueprint of implementation of green smart education from the end of the Government
- Teaching and transforming the present workforces into green one badly needs an age-appropriate competencies model
- Awareness and motivation have to be created to enlarge the competencies of citizens to adopt green.
- Learning pedagogies should continuously be at a current pace to cope up with the need of the civilisation.

Conclusions

The world in near future does not 'run out of oil' but due to the tremendous hike in the price of oil, it becomes beyond our capacity to purchase. Investment in green smart education is supposed to sort out those issues at a large scale. Research in green education enlarges the scopes to research low carbon energy options, reduction in greenhouse gas emissions, and search for alternative green resources that enlarges the path of sustainability. The path towards transferring into a green is stimulated by technological advancement in green, enlarging the scopes and work-fields of the green economy which again opens the opportunities and employ abilities for present generations. There is an hour demand to rebuild their curriculum from green perspectives. Diverse topics and data are needed to get assembled into one field and use different components of machine learning to analyse this to reach the exact picture which still now hides behind the curtain. A breakthrough is needed to cut off age-old thinking and components of education which fails to produce critical and cutting edge thinking which are the priorities of the hour. Emphasis should be given on real-life problems and issues that 21st-century civilisation is struggling with through green smart education by disintegrating routine arrangements of non-green conventional education. The development and adaptation of Green Transformation is not a one-day task, it is the result of continuous thinking and approaches to reach that goal. The curriculum should be framed in such a manner

that students are embodied with desired capabilities and competencies to become a delegate and thought provoker in the field of Green Transformation with the ability to use machine learning and soft computing skill as per situation demands. It is only expected from future generations through learning from Green Smart Education, they perform the pivotal in the green transformation process of the World. Acclimation with Green Smart Education is only the key to opening the door of metamorphosis.

Acknowledgement

References

[1] Ahmed, F., Hossain, S., Hossain, S., Fakhruddin, A. N. M., Abdullah, A. T. M., Chowdhury, M. A. Z., & Gan, S. H. (2019). Impact of household air pollution on human health: source identification and systematic management approach. *SN Applied Sciences*, *1*(5). https://doi.org/10.1007/s42452-019-0405-8

[2] *Air Pollution – Deadly Effects on Life*. (2019). United Nations. https://www.un.org/sustainabledevelopment/blog/2019/03/air-pollution-deadly-effects-on-life/

[3] Altenburg, T., & Pegels, A. (2012). Sustainability-oriented innovation systems – managing the green transformation. *Innovation and Development*, *2*(1), 5–22. https://doi.org/10.1080/2157930X.2012.664037

[4] Asthana, P., & Hazela, B. (2020). Applications of machine learning in improving learning environment. *Intelligent Systems Reference Library*, *163*, 417–433. https://doi.org/10.1007/978-981-13-8759-3_16

[5] Bachelet, M. (2019). *Leave No One Behind*. https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=24360&LangID=E

[6] Ball, J. (2008, November 7). Does Green Energy Add 5 Million Jobs? Potent Pitch, but Numbers Are Squishy. *The Wall Street Journal*. https://www.wsj.com/articles/SB122601449992806743

[7] Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2017). The Holistic Impact of Classroom Spaces on Learning in Specific Subjects. *Environment and Behavior*, *49*(4), 425–451. https://doi.org/10.1177/0013916516648735

[8] Bhattacharya, S., & Pal, S. (2020a). Artificial Intelligence, The Future Pacemaker of Indian Higher Education. *Purakala*, *31*(41), 51–59. https://www.academia.edu/49210252/Artificial_Intelligence_The_Future_Pacemaker_of_Indian_Higher_Education

[9] Bhattacharya, S., & Pal, S. (2020b). Leveraging Indian Higher Education to Global Standard through Total Quality Management. *Tathapi*, *48*, 152–164.

[10] Bowen, A., Kuralbayeva, K., & Tipoe, E. L. (2018). Characterising green employment: The impacts of 'greening' on workforce composition. *Energy Economics*, *72*, 263–275. https://doi.org/https://doi.org/10.1016/j.eneco.2018.03.015

[11] Burleson, E. (2009). Energy Security , Green Job Creation , and Youth Innovation. *DigitalCommons@Pace*, *381*, 381–397. https://digitalcommons.pace.edu/cgi/viewcontent.cgi?article=1779&context=lawfaculty

[12] Cervantes-Godoy, D., Dewbre, J., Amegnaglo, C. J., Soglo, Y. Y., Akpa, A. F., Bickel, M., Sanyang, S., Ly, S., Kuiseu, J., Ama, S., Gautier, B. P., Officer, E. S., Officer, E. S., Eberlin, R., Officer, P., Branch, P. A., Oduro-ofori, E., Aboagye Anokye, P., Acquaye, N. E. A., … Swanson, B. E. (2014). The future of food and agriculture: trends and challenges. In *The future of food and agriculture: trends and challenges* (Vol. 4, Issue 4). www.fao.org/publications%0Ahttp://www.fao.org/3/a-i6583e.pdf%0Ahttp://siteresources.worldbank.org/INTARD/825826-1111044795683/20424536/Ag_ed_Africa.pdf%0Awww.fao.org/cfs%0Ahttp://www.jstor.org/stable/4356839%0Ahttps://ediss.uni-goettingen.de/bitstream/han

[13] Chan, T., Roschelle, J., Hsi, S., Kinshuk, K., Brown, T., Patton, C., Cherniavsky, J., Pea, R. D., Chan, T., Roschelle, J., Hsi, S., Kinshuk, K., Sharples, M., & Chan, T. (2007). *One-to-one technology-enhanced learning : an opportunity for global research collaboration To cite this version : HAL Id : hal-00190632*.

[14] Day, R., & Payne, L. (1987). Computer-Managed Instruction: An Alternative Teaching Strategy. *Journal of Nursing Education*, *26*(1), 30–36. https://doi.org/10.3928/0148-4834-19870101-08

[15] Desai, M. A., Mehta, S., & Smith, K. R. (2004). Indoor smoke from solid fuels: Assessing the environmental burden of disease at national and local levels. *Environmental Burden of Disease Series*, *4*, 82.

[16] Díaz, E., Smith-Sivertsen, T., Pope, D., Lie, R. T., Díaz, A., McCracken, J., Arana, B., Smith, K. R., & Bruce, N. (2007). Eye discomfort, headache and back pain among Mayan Guatemalan women taking part in a randomised stove intervention trial. *Journal of Epidemiology and Community Health*, *61*(1), 74–79. https://doi.org/10.1136/jech.2006.043133

[17] Dodorp, R. (2013). Education and Technology: Key Issues and Debates. In *Comparative Education* (Vol. 15, Issue 2).

[18] Drigas, A., Kokkalia, G., & Lytras, M. D. (2015). ICT and collaborative co-learning in preschool children who face memory difficulties. *Computers in Human Behavior*, *51*, 645–651. https://doi.org/10.1016/j.chb.2015.01.019

[19] Elias, T. (2011). *Learning Analytics: The Definitions, the Processes, and the Potential*. 1–22.

[20] European Commission. (2018). A Clean Planet for all. A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy. *Com(2018) 773*, 25. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0773&from=EN

[21] European Commission. (2021). *A European Green Deal Striving to be the first climate-neutral continent*. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[22] Fleacă, E., Fleacă, B., & Maiduc, S. (2018). Aligning strategy with sustainable development goals (SDGs): Process scoping diagram for entrepreneurial higher education institutions (HEIs). *Sustainability (Switzerland)*, *10*(4), 1–17. https://doi.org/10.3390/su10041032

[23] García-Peñalvo, F. J., Casado-Lumbreras, C., Colomo-Palacios, R., & Yadav, A. (2020). Smart learning: Teaching and learning with smartphones and tablets in post compulsory education. In *Applied Sciences (Switzerland)* (Vol. 10, Issue 19). https://doi.org/10.3390/app10196964

[24] Holbrook, J., & Rannikmäe, M. (2014). The philosophy and approach on which the PROFILES project is based. *Center for Educational Policy Studies Journal*, *4*(1), 9–29.

[25] Hulin, M., Caillaud, D., & Annesi-Maesano, I. (2010). Indoor air pollution and childhood asthma: Variations between urban and rural areas. *Indoor Air*, *20*(6), 502–514. https://doi.org/10.1111/j.1600-0668.2010.00673.x

[26] Hwang, G.-J., Tsai, C.-C., & Yang, S. (2008). Criteria, Strategies and Research Issues of Context-Aware Ubiquitous Learning. *Educational Technology and Society*, *11*, 81–91.

[27] ILO. (2019). *Skills For a Greener Future*. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_709121.pdf

[28] Jary, H., Mallewa, J., Nyirenda, M., Faragher, B., Heyderman, R., Peterson, I., Gordon, S., & Mortimer, K. (2015). Study protocol: The effects of air pollution exposure and chronic respiratory disease on pneumonia risk in urban Malawian adults - the Acute Infection of the Respiratory Tract Study (The AIR Study). *BMC Pulmonary Medicine*, *15*(1), 1–8. https://doi.org/10.1186/s12890-015-0090-3

[29] Joshi, S. D., Pandit, N., & Kuma, S. (2005). THE SCHOOL ENVIRONMENT AND ITS IMPACT ON CHILDREN'S HEALTH IN DEVELOPING COUNTRY. *Epidemiology*, *16*(5). https://journals.lww.com/epidem/Fulltext/2005/0900 0/THE_SCHOOL_ENVIRONMENT_AND_ITS_IM PACT_ON.401.aspx

[30] Kim, S., Song, S. M., & Yoon, Y. I. (2011). Smart learning services based on smart cloud computing. *Sensors*, *11*(8), 7835–7850. https://doi.org/10.3390/s110807835

[31] Kim, T., Cho, J. Y., & Lee, B. G. (2013). Evolution to Smart Learning in public education: A case study of Korean public education. *IFIP Advances in Information and Communication Technology*, *395*, 170–178. https://doi.org/10.1007/978-3-642-37285-8_18

[32] Koper, R. (2014). Conditions for effective smart learning environments. *Smart Learning Environments*, *1*(1), 1–17. https://doi.org/10.1186/s40561-014-0005-4

[33] Landrigan, P. J., Carlson, J. E., Bearer, C. F., Cranmer, J. S., Bullard, R. D., Etzel, R. A., Groopman, J., McLachlan, J. A., Perera, F. P., Routt Reigart, J., Robison, L., Schell, L., & Suk, W. A. (1998). Children's health and the environment: A new agenda for prevention research. *Environmental Health Perspectives*, *106*(SUPPL. 3), 787–794. https://doi.org/10.1289/ehp.98106787

[34] Lee, J., Zo, H., & Lee, H. (2014). Smart learning adoption in employees and HRD managers. *British Journal of Educational Technology*, *45*(6), 1082–1096. https://doi.org/10.1111/bjet.12210

[35] Louw, W. (2013). Green curriculum : Sustainable learning at a higher education institution. *International Review of Research in Open and Distance Learning*, *14*(1), 1–15. https://doi.org/10.19173/irrodl.v14i1.1310

[36] Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. In *Sustainability* (Vol. 9, Issue 10). https://doi.org/10.3390/su9101889

[37] Manna, D., & Banerjee, S. (2019). A review on green building movement in india. *International Journal of Scientific and Technology Research*, *8*(10), 1980–1986.

[38] Martinez-fernandez, C., & Hinojosa, C. (2010). Green jobs and skills : the local labour market implications of addressing climate change. *Oecd*, *February*, 1–55. http://www.oecd.org/dataoecd/54/43/44683169.pdf

[39] Mehta, K., & Chugan, P. K. (2015). Green HRM in Pursuit of Environmentally Sustainable Business. *Universal Journal of Industrial and Business Management*, *3*(3), 74–81. https://doi.org/10.13189/ujibm.2015.030302

[40] Naimi, A. I., & Westreich, D. J. (2014). Big Data: A Revolution That Will Transform How We Live, Work, and Think. *American Journal of Epidemiology*, *179*(9), 1143–1144. https://doi.org/10.1093/aje/kwu085

[41] National Research Council. (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. In *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. https://doi.org/10.17226/13165

[42] Pal, S. & Sarkar, P. (2021). *World Bulletin of Social Sciences (WBSS) WEB 4 . 0 AND NEW REFORMATION IN EDUCATION*. *2*(September), 66–72.

[43] Pal, S., & Bhattacharya, S. (2020). *Improving the Standard of Higher Education by Improving its ' Quality*. 55, 58–67.

[44] Paulson, J., & Barnett, C. (2016). Perspectives | Brief Communication Public Health Stops at the School. *Environ Health Perspect*, *124*(10), 171–175.

[45] Person, B., Loo, J. D., Owuor, M., Ogange, L., Jefferds, M. E. D., & Cohen, A. L. (2012). "It is good for my family's health and cooks food in a way that my heart loves": Qualitative findings and implications for scaling up an improved cookstove project in rural Kenya. *International Journal of Environmental Research and Public Health*, *9*(5), 1566–1580. https://doi.org/10.3390/ijerph9051566

[46] Picciano, A. (2012). The Evolution of Big Data and Learning Analytics in American Higher Education. *JALN*, *16*. https://doi.org/10.24059/olj.v16i3.267

[47] Po, J. Y. T., FitzGerald, J. M., & Carlsten, C. (2011). Respiratory disease associated with solid biomass fuel exposure in rural women and children: Systematic review and meta-analysis. *Thorax*, *66*(3), 232–239. https://doi.org/10.1136/thx.2010.147884

[48] Polzin, F. (2017). Mobilizing private finance for low-carbon innovation – A systematic review of barriers and solutions. *Renewable and Sustainable Energy Reviews*, *77*(February), 525–535. https://doi.org/10.1016/j.rser.2017.04.007

[49] S., A. P., & Jeevan, P. (2016). *Strategic Rethinking of Management Education : Green MBA Model*. https://doi.org/10.5281/ZENODO.154278

[50] Scherak, L., & Rieckmann, M. (2020). Developing ESD Competences in Higher Education Institutions—Staff Training at the University of Vechta. In *Sustainability* (Vol. 12, Issue 24). https://doi.org/10.3390/su122410336

[51] Shoikova, E., Nikolov, R., & Kovatcheva, E. (2017). Conceptualising of Smart Education. *SCIENTIFIC JOURNAL "ELECTROTECHNICA & ELECTRONICA" (E+E), 3-4 2017, p. 29-37*, *3–4*.

[52] Siau, C. S., Wee, L. H., Ibrahim, N., Visvalingam, U., Ling Yeap, L. L., Yeoh, S. H., & Wahab, S. (2018). Predicting burnout and psychological distress risks of hospital healthcare workers. *Malaysian Journal of Public Health Medicine*, *2018*(Specialissue1), 125–136.

[53] Spector, J. M. (2014). Conceptualizing the emerging field of smart learning environments. *Smart Learning Environments*, *1*(1), 1–10. https://doi.org/10.1186/s40561-014-0002-7

[54] Sridhara Acharya, P. (2015). Innovations in Effective Management of Energy using Green Technology. *International Journal of Conceptions on Management and Social Sciences*, *3*(2), 18–22. https://doi.org/10.5281/zenodo.268814

[55] Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(50), 20260–20264. https://doi.org/10.1073/pnas.1116437108

[56] *Towards green growth* (Issue May 2011). (2014). https://doi.org/10.1787/9789264213715-7-en

[57] UN Department of Economic and Social Affairs. (2015). Transforming our world: the 2030 Agenda for Sustainable Development. In *UNO*. https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981

[58] UN Habitat. (2021). *World Cities Day 2021*. UN Habitat. https://unhabitat.org/global-observance-of-world-cities-day-2021-in-egypt-calls-for-action-on-climate-change

[59] UN News. (2019, March 21). More children killed by unsafe water, than bullets, says UNICEF chief. *UNO*. https://news.un.org/en/story/2019/03/1035171

[60] UN News. (2021, September 3). Haiti earthquake: Waterborne disease poses new threat to children. *UNO*. https://news.un.org/en/story/2021/09/1099122

[61] United Nations. (2021). *Goal 15:Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*. Department of Economic and Social Affairs Sustainable Development. https://sdgs.un.org/goals/goal15

[62] USEPA. (2019). *America's Children and the Environment*. https://www.epa.gov/americaschildrenenvironment/key-findings-americas-children-and-environment

[63] Uskov, V. L., Bakken, J. P., Heinemann, C., Rachakonda, R., Guduru, V. S., Thomas, A. B., & Bodduluri, D. P. (2017). Building smart learning analytics system for smart university. *Smart Innovation, Systems and Technologies*, *75*(5), 191–204. https://doi.org/10.1007/978-3-319-59451-4_19

[64] Verma, A. K. (2018). Ecological Balance: An Indispensable Need for Human Survival. *J. Exp. Zool. India*, *21*(1), 407–409.

[65] World Health Organization. (2017). Don't Pollute my future! The impact of the environment on children's health. *World Health Organization*, 30. https://www.who.int/ceh/publications/don-t-pollute-my-future/en/%0Ahttp://apps.who.int/iris/bitstream/handle/10665/254678/WHO-FWC-IHE-17.01-eng.pdf?sequence=1%0Ahttp://apps.who.int/iris/bitstream/10665/254678/1/WHO-FWC-IHE-17.01-eng.pdf