Biodiversity and Sustainability: A Project of Activity-based Teaching Learning Process

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Abstract:

This is an activity-based teaching learning method of school students where the scheduled curriculum of each class from V to XII regarding the environmental science bears the chapters related to biodiversity, its conservation and sustainability under the appropriate title of the topic. Through the field survey, the students can have the opportunity to come in close and direct contact with the environment which helps them to correlate their syllabus-oriented class room study with their practical live experience. They learnt that biodiversity is essential for our healthy living. It starts from our kitchen and extends too everywhere. The living organisms and ecosystems are all inter dependent on each other. If one connection is broken down, then the whole web of life will be destroyed. After thorough investigation, it was noted that there had a big change in food consumed and sourced. That would affect the health and nutrition and also caused major shifts in livelihood option. The cultivation of wild edible plants (WEP) having rich nutritional value is as easy as it does not need any fertilizer or human care. Artificial pond in school campus helped to gather the idea about the freshwater aquatic environment to learn about the sustainability of aquatic biodiversity which was equally important for maintaining a well – balanced environment.

***Key words**: Curriculum, Conservation, Biodiversity, Sustainability, Ecosystem, Web of life, Artificial Pond*

***Abbreviation**: WEP = Wild Edible Plant*

1. Introduction:

The whole world is full of diversity where from smallest microbes to largest species, every variety of living things unite with each other which is called biodiversity. Environment is a shared space where every four spheres, viz. lithosphere, hydrosphere, biosphere, atmosphere, of earth interact with each other. No sphere works on its own. A change in one sphere results in a change in two or more spheres. Living things collaborate and compete with one another to stay alive and reproduce in a wide range of environmental condition. This creates incredible diversity of life on earth. Biodiversity is a good indicator of our interdependence with other nonliving things. It also signifies each species contribution and function to maintain a healthy ecosystem. Through

this field study about fifty students observed the environment of our schoolyard, school backyard (Microhabitat-1 in moist shady place and other in Microhabitat- 2 in barren land[1]) and their home. We tried to make students understand about the healthy ecosystem in our school and our home to learn that biodiversity is essential for our healthy living. By thorough identification and investigation, they learnt about edible plants, medicinal plants, road side weeds, wild edible plants (WEP), and plants we use in domestic purposes, how plants provide services to us in various ways and why biodiversity with its varied life forms are needed to be conserved to keep our own planet healthy. Our education policy has been giving importance on research at school level where students must need activity-based learning and project-based skill development training for livelihood and learning for sustainability. Keeping in mind this concept, we did this teaching process through field survey on sustainability and biodiversity.

2. Literature Review of Related Studies:

Various studies have been conducted on conservation of biodiversity viz., Review of Biodiversity Conservation Performance Measures by Dr. G. Tucker in 2005[2] where they found that corporate performance measurement systems developed so far are of limited direct relevance to corporate needs. This is primarily because of the difficulties associated with measuring biodiversity. A. Campbell.; *et. al.* (2009)[3]reviewed the literature on the impacts of climate change on biodiversity in the first part. The second section aims to provide a better understanding of the role of biodiversity in societal and in biodiversity conservation adaptation as well as the impacts of adaptation strategies on biodiversity. Finally, the third section aims to highlight the developments in our understanding of the role of biodiversity in climate change mitigation, and the impacts of mitigation policies on biodiversity. The authors, L. Fucsko & B. Sax (2021)[4] draw on relevant evidence from policy documents published by UNESCO & other international agencies.

This entry provides an overview of environmental education for sustainable development (ESD) and briefly examines ESD progress focusing on primary and secondary education from a global perspective. The authors draw on relevant evidence from policy documents published by UNESCO and other international agencies Public Perception of Biodiversity: A Literature Review

[1] School backyard abandoned land, dumping ground with plenty sunlight, bounded by brick wall around three sides

[2] Tucker, G. (2005). Review of Biodiversity Conservation Performance Measures. Retrieved from https://www.cbd.int

[3]Campbell, A. et al (2009). Review of the literature on the Links between Biodiversity & Climate. Retrieved from https://www.cbd.int>doc>c

[4]Fucsko,L& Sax, B. (2021). Learning activities for Environmental Education for Sustainable Development. Retrieved from https://www.researchgate.net

of its role in Urban Green spaces by A. Belle & U. Chakradeo (2021)[5] where they suggested that the triangular relationship between biodiversity, urban green spaces and public perception is still unexplored; Social innovation for Biodiversity: A literature review and research challenges by R. Ziegler (2022)[6]where the proposal was three cross cutting issues that can be a focus for future research, practice and supportive policy: social innovation for nature based solutions, for participatory governance, and for technology that tackles biodiversity loss. According to Idabou *et. al. (2023)*[7] it is essential to understand teachers' representations of biodiversity to effectively guide educational efforts because of the significant role of education in raising awareness and promoting sustainable behavior. The National Environment Policy, 2006, seeks to achieve balance and harmony between processes and also forms the basic framework for the National Biodiversity Action Plan, Biological diversity or biodiversity, encompasses the variety of all life on earth.

The NEP 2020 underlines the importance of making environmental education an integral part of curricula and encouraging environmental awareness and sensitivity towards its conservation and sustainable development. The future of biodiversity will depend on the global collective action of an educated society, including efforts to promote local and indigenous knowledge of biodiversity - Education and awareness stated by UNESCO. L. Wolff & T. Skarstein in 2020 concluded that implementing species knowledge in early childhood (EC) teacher education promotes an interest in the natural world and may form a significant contribution to nature and sustainability education for EC teachers[8]. People's plant awareness develops where they have frequent interaction with plants that have direct relevance to their lives. According to the belief of B. Stagg & J. Dillon (2022)[9], it is important to ensure plant topics are included in frameworks and strategies for sustainability education at both the school curriculum and educational policy levels. The study of Zaitegi, Etxaberria &Moneva (2022)[10] discusses the main insights from the analysis, proposes future research directions and provides practical implications for biodiversity protection and environmental sustainability. In the paper of Peters *et. al.* (2023)[11] describes

[5] Belle, A. &Chakradeo, U. (2021). A literature Review of its role in Urban Green spaces. Retrieved from https://www.researchgate.net

[6] Ziegler, R. et al (2022). A literature review and research challenges. Retrieved from https://www.sciencedirect.com

[7] Idabou, Selmaoui, Alami&Benjelloun, (2023). Towards a Sustainable & Engaged Education for Sustainable Development. Retrieved from https://www.researchgate.net

[8] Wolff, L. &Skarstein, T (2020). Species learning and Biodiversity in Early Childhood Teacher Education. Retrieved from https://www.mdpi.com

[9] Stagg, B. & Dillon, J (2022). Plants, Education & Sustainability: rethinking the teaching of Botany in school science. Journal of Biological Education Vol. 57, 2023. Issue 5. Retrieved from https:// www.tandfonline.com

[10] Zaitegi, Etxaberria&Moneva (2022). Biodiversity accounting and reporting : A systematic literature review and biometric analysis. Retrieved from https://www.sciencedirect.com

[11] Peters, A. et al (2023) Sustainability in Computing Education: A systematic Literature Review. Retrieved from https://dl.acm.org>dol

approaches taken in computing education to address the issue of sustainability. It presents results of a systematic review of literature on sustainability in computing education. According to K. Nolan (2020) [12] Biodiversity education had a positive influence on the participants' sustainability consciousness, making them more aware of sustainability issues and action-oriented to address these issues. However, they lacked one dimension of sustainability; therefore, their sustainability consciousness was not fully developed. Further research is needed to analysis and interprets the rationale as to why the economic dimension was less developed in these participants who attended a school that promotes biodiversity education.

3. Objectives:

i) To understand the meaning of environment and diversity of life in our surroundings, how plants and animals change the environment around them.
ii) To compare among the organisms living in different habitats, impacts of current climate change, to investigate species diversity in the areas of investigation.
iii) To learn sample techniques[13] to study biodiversity of an area, about services that humans derive from nature.
iv) To explore the connection between biodiversity, people and culture, the attitude of people towards biodiversity and conservation, how change in the environment have influenced the community and their relationship to the local biodiversity.
v) To identify and document WEP resources and traditional knowledge associated with these plants.
vi) To capture the chronology[14]of ecological events and historical landmarks as were recalled by local people; to investigate local knowledge of change of environment occurring in these regions.
vii) We tried to produce the shared vision of the working area.

4. Methodology:

4.1. Planning:

An outline of biodiversity map of our school was prepared on a fullsize chart paper. **(Fig. 1)**. Firstly, the main building, other human made structures and the school boundary, details of various land types were drawn and coloured each land type to classify them and label them for thorough investigation of biodiversity systematically. Students were divided into small groups of

[12] Nolan, K. (2020). Biodiversity Education and Sustainability Consciousness. Retrieved from https://liu.dive-portal.org
[13] Sampling is a technique of selecting individual members or a subset of the population to make statistical inferences from them and estimate the characteristics of the whole population.
[14] The arrangement of events or dates in the order of their occurrence

two. In school ground an area with sides of about one square-feet to make the boundaries with pushing sticks into the soil at four corners of the area and tied the string around it to make a box of equal sides. These are the representation of microhabitats (Fig. 2) by quadrat method. In school backyard we observed two microhabitats (Fig.3), one was moist shady place and other was a barren land (Table 2). A game between biodiversity and us was played by drawing the grid on floor with chalk, to prepare team, placing the cards in respective squares. Interview was taken in local area with community members who were directly dependent on local biodiversity and livelihood. One case study about biodiversity threats and conservation on restoring the mangroves in Sundarban was done. Artificial pond ecosystem in our school was created which helped the students to learn more about the artificial ecosystem, to gather the idea about the freshwater aquatic environment, about rain water harvesting system, to know the importance of aquatic ecosystem.

4.2 Tools used:

Hand gloves, notebook, pen, pencil, cardboard, 4-5 small sticks, measuring tape, string, magnifying glass, compass, mobile phone, ruler, chalk, piece of stone, the containers of aquatic plants, soil and other natural materials.

4.3. Area of the Study:

Students observed plants, animals, their microhabitats in school ground, class rooms, and roof, in their home and its surroundings, in artificial pond in our school.

4.4 Survey:

They surveyed about 89 plants & 58 animals in the school premises, in school backyard and home environment (Table-1 & 3). Under teachers' guidance they classified the plants according to their height i.e. herbs, shrubs and trees, edible plants, medicinal plants, plants used in domestic purposes, parts of plant, parts of leaf, different shapes of leaves, venation pattern, types of leaves, phyllotaxy, some defensive organs of plants, understanding biodiversity among observed animals according to their location, food habit, role in ecosystem (Table-1).

They observed genetic diversity of plants, grassland ecosystem, ecosystem in moist shady place and one barren land and diversity of nests of animals during home survey. Our artificial little pond was situated in the west side of the school inside the campus where we collected the rain water from our roof area through rain water pipe into this pond. It also added a beauty to the school. They practically learnt about aquatic ecosystem that was necessary for supporting life in a pond and they understood that environment is dynamic in nature.

5. Data Collection and Analysis of collected Data:

5.1. Data Collection:

Table No. 1: Survey of Plants in Study Area

Features of surveyed plants noted in each habitat according to	No of plants studied			Total no of plants studied
Height	Herbs –11	Shrubs - 6	Trees - 6	23
uses	Edible - 17	Medicinal - 8	Domestically used- 18	43
	Herbs	**Shrubs**	**Trees**	
Shapes of leaves	4	3	3	10
Venation pattern	3	1	3	7
Types of leaves	2	6	3	9
Phyllotaxy	2	3	2	7
Defensive organs	1	3	2	6

Table No. 2. Comparison between Biodiversity of Moist shady area and Barren land

Microhabitat	Plants Observed				Animals Observed	
Moist shady Area (6/6 ft)	Types of plants	Number of each type	Species found	Total number of each species	Species found	Total number of each species
	Tree	14	Neem	3	Butterfly	3
			Fig	5	Dragonfly	2
			Ficus	6	Centipedes	5
	Herbs	26	Coccinia	2	Ladybug	5
			Cyperus	18	Ant	Huge
			Tetrastigma	6	Snail	4
	Fern	10	Dryopteris	10	Earthworm	11
	Funji(Non green)	09	Agaricus	9	Frog	3
Barren Land (6/6 ft)	Tree	Nil			Insect larvae Dragonfly Ant Rat Cat Jewel Bug	4 5 Huge 2 1 3
	Herbs	67	Cyperus	7		
			Lindenbergia Acalypha	20 19		
			Coccinia	1		
			Phyllanthus	20		

Table 3: Understanding Biodiversity among Animals (correlated with table 2)

Name of the animal	Location	Activities of each animal	Method of activity involved	Service towards environment
Earthworm	Soil	Searching food	Crawling	Increased nutrient availability in soil,, better drainage, more stable soil structure
Ant	Soil, on leaves	Searching food	Walking	Turn and aerate the soil , allowing water & oxygen to reach plant roots
Butterfly, Bee	Leaves	Searching food	Flying	Pollinate plants,
Spider	Leaves	Searching food	Alternating Tetrapods Walking Movement	Keep insect populations in check, act as both predator & prey
Termite	Brick wall of class room, in broken furniture, dried tree trunk	Searching food	Levy Walking	Help recycle dead wood from trees, act as both detrivores & decomposers
Snail	soil	Searching food	Gliding	Help to recycle nutrients
Fish (Koi, Magur, Shol, Telapia, Gappi)	Pond	Searching food	Swimming	Transport nutrients from one location to another
Frog	On leaf	Searching food	Hooping	Integral part of the food web, serve as food for aquatic insects,, fish, mammals & birds
Lizard	On door	Searching food	Crawling	Eat the pests that annoy us
Crow, Pigeon	On sunshade	Searching food	Sitting	Play role in waste management, important food source for many birds of prey
Rat	In building	Searching food	Wandering Here & There	As a food source for many predators
Cat	In building	Searching food	Walking	Regulating prey populations
Dog	In building	Searching food	Walking	To remove the sick or diseased and dead creatures from the environment
Man	In building	Loking around	Walking	Contribute to create & maintain ecological balance

5.2 Analysis of collected Data:

i) In the microhabitat 1 the species led a comparatively peaceful life due to less human interference. Though human made garbage were also dumped here but most of these were

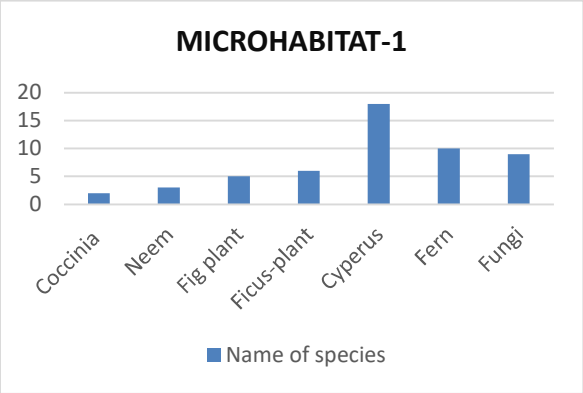

Fig 1: Bar graph on survey of plants in Microhabitat-1

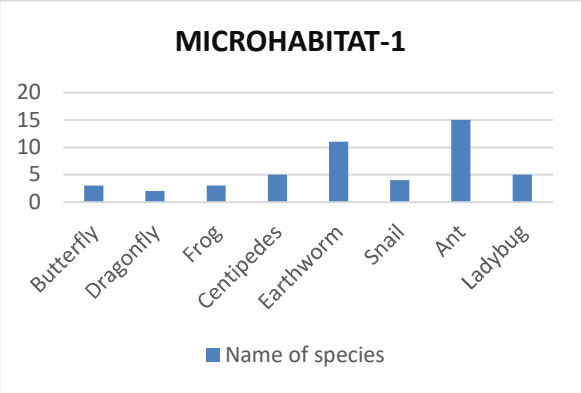

Fig 2: Bar graph on survey of animals in Microhabitat- 1

domestic which was wet in nature and which ultimately directly or indirectly helped different species of both plants and animals resided themselves with the help of nature (Table 2). It had some canopy type of plants that caused 'shady environment' naturally causing great dwelling places for animals stated above. Here some animals preferred a particular specific habitat to survive. Plants like fern, *Cyperus* sp., and certain patches of fungi preferred moist soil with moist environment and naturally shaded areas to reproduce (Fig.1). And animals like earthworms, centipedes, beetles, snails preferred naturally shady areas to survive (Fig.2).

ii) In Microhabitat 2 the human interference was much more prominent which ultimately caused littering of manmade garbage and destruction or lack of habitat of species due to human residence construction. But some hardy species of plants like *Phylanthus* sp., *Acalypha*, *Lindenbergia* sp. (Fig.3) and animals like ants, flies spiders adapted themselves and resided along with this environment. Also, insects like jewel bug were predominant in this region because despite of insufficient natural space, that sustained themselves in that region. There were some 'shady spaces' caused by those gigantic buildings, but these created some 'damp' or 'cool' areas which became a 'home' to some domestic species like ants, house lizards, fly, snails, Bettles, etc. (Fig.4). Some plants like banyan tree etc. did sustain in that unfavorable environment. This was due to the dispersal of different foreign particles like soil, micronutrients, etc. and when it rained, it got the supply of water which gradually helped them to grow and reproduced again.

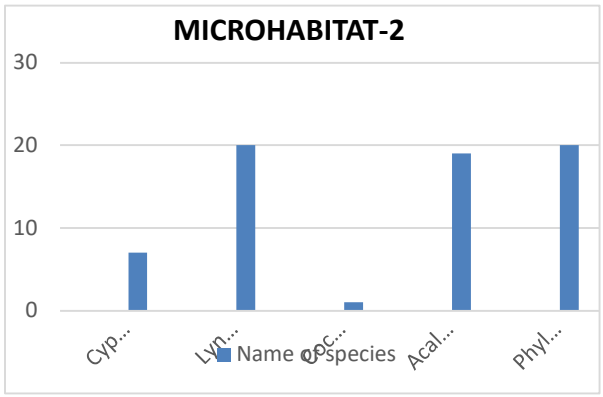

Fig 3: Bar graph of survey of plants in Microhabitat-2

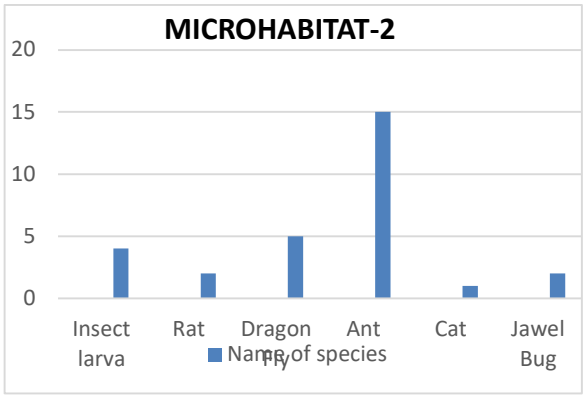

Fig 4: Bar graph of survey of animals in Microhabitat-2

iii) In artificial pond ecosystem, water parameters were one of the most important things to monitor. This study helped to learn that abiotic factors such as sunlight, nutrients, dissolved oxygen, temperature, pH and biotic factors such as plants and animals (fishes) interacted with each other and affected productivity. As rain water from time to time enters the pond, so it increases air contact, resulting in higher and more consistent levels of oxygen in the pond water. Bacteria, protozoa and other microbes were there. Water and dissolved oxygen enabled the fishes to breathe. They are the abiotic factors which enables the fishes to survive in the pond. This small pond helped to moderate the temperature and added moisture. There were also algae and fungi. Small insects like butterfly, dragonfly was also attracted.

6. Interpretation of Results:

The school has a garden with herbs, shrubs and trees also. Herbs & shrubs consist of the largest green area in the school premises. After drawing Biodiversity Map of our school and during survey the students noticed that as in our school most of the areas are cemented, so there is less wild vegetation and more potted plants. Through plantation in the different areas of our school and by making an artificial pond ecosystem in the school, teachers' learners are maintaining a healthy ecosystem, both terrestrial and aquatic. These plants absorb carbon dioxide, produce oxygen and reduce pollution in school campus. This observation is linked with the syllabus of general curriculum. Not only the artificial pond added a beauty to the school but also it helped the students to learn more about how to create an artificial pond ecosystem, to explore the idea about the freshwater aquatic environment, the diversity of life associated with a pond ecosystem, to observe how some wild life come to the pond on its own. So sustainability of aquatic biodiversity was equally important for maintaining a well – balanced environment. They have identified **(Table 1)** edible plants both wild and domestic, medicinal plants, plants we use in

domestic purposes. They realized the present global challenges and have developed a vision for the future.

7. Findings:

Most importantly, the living organisms and ecosystems are all inter dependent on each other. The wild edible plants are not available in the market in sufficient qualities; the nutritional value of these plants is rich. These plants should be cultivated and available in the super market. Their cultivation process was as easy as it does not need any fertilizer or human care. The final interesting fact observed is: In both the microhabitats, the observed population of 'ANTS' was highly predominating. This was probably due to the high adaptation power of the ants by which they survive in possibly every climate irrespective on the environment. So, biodiversity with its varied life forms is needed to be conserved to keep our planet healthy. Unscientific way of using the natural resources deteriorates biodiversity. Knowledge, awareness and action plans can only save our biodiversity and thus we save our humanity.

8. Conclusion:

The scheduled curriculum of each class from V to XII regarding the Biological Science bears the chapters related to biodiversity, its conservation and sustainability under the appropriate title of the topic. We know that only the theoretical knowledge about the environment related topics cannot create an interest in learning among the students, but through the field survey, the students can have the opportunity to come in close and direct contact with the environment. This helps them to correlate their syllabus-oriented class room study with their practical live experience. This also increases their creativity, thinking ability and vision for future.

References:

- Belle, A. & Chakradeo, U. (2021). A literature Review of its role in Urban Green spaces. Retrieved from https://www.researchgate.net
- Campbell, A. et al (2009). Review of the literature on the Links between Biodiversity & Climate. Retrieved from https://www.cbd.int>doc>c
- Fucsko, L& Sax, B. (2021). Learning activities for Environmental Education for Sustainable Development. Retrieved from https://www.researchgate.net
- Idabou, Selmaoui, Alami&Benjelloun, (2023). Towards a Sustainable & Engaged Education for Sustainable Development. Retrieved from https://www.researchgate.net
- NEP 2006. Retrieved from www.indiaenvironmentalportal.org.in
- NEP 2020. Retrieved from www.indiaenvironmentalportal.org.in
- Nolan, K. (2020). Biodiversity Education and Sustainability Consciousness. Retrieved from https://liu. dive-portal. org
- Paribesh O Biggan (Class V to Class VIII), published by West Bengal Board of Secondary Education

- Peters, A. et al (2023) Sustainability in Computing Education: A systematic Literature Review. Retrieved from https://dl. acm. org>dol
- Stagg, B. & Dillon, J (2022). Plants, Education & Sustainability: rethinking the teaching of Botany in school science. Retrieved from https:// www.tandfonline.com
- Taylor & Francis Online. Retrieved from https://www.tandfonline.com
- Tucker, G. (2005). Review of Biodiversity Conservation Performance Measures. Retrieved from https://www.cbd.int
- UNESCO's Commitment to Biodiversity. Retrieved from https://www.unesco.org
- Wipro Foundation and Climate for Environment Education (2023). Sustainability & Biodiversity, An activity based learning program for schools.
- Wolff, L. & Skarstein, T (2020). Species learning and Biodiversity in Early Childhood Teacher Education. Retrieved from https:// www.mdpi.com
- Zaitegi, Etxaberria&Moneva (2022).Biodiversity accounting and reporting: A systematic literature review and biometric analysis. Retrieved from https://www.sciencedirect.com
- Ziegler, R. et al (2022). A literature review and research challenges. Retrieved from https://www.sciencedirect.com