

e-Resources for Environmental Education and Attainment of Sustainable Responsible Consumption and Production

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Abstract

Objective: In order to cultivate responsible people who will contribute to a sustainable future and green economy, the objective of this study is to examine how e-resources of environmental education (EE) might support the achievement of sustainable consumption and production under SDG 12.

Theoretical Framework: This topic is based on theory of transfer of learning suggested by E.L. Thorndike and theories of adragogy through which human beings use learning of one situation in another situation.

Method: The methodology adopted is qualitative research methodology. Comprehensive review of literature on contents of online platforms of EE was employed as tool for gathering data and analysis of the same have been done.

Results and Discussion: The results revealed that: role of e-resources of environmental education in promoting SDG 12 is significant, it impacts attitude pattern by creating awareness and challenges posed by limited knowledge on available resources is one of the barriers in achieving SDG 12.

Research Implications: The study will lead to necessary value formation, knowledge distribution required for realization of SDG 12. It has an inter-disciplinary implication.

Originality/Value: This study analyzes e-resources specially available for environmental education and tries to link the same with SDG 12 which has not been studied as per reviews collected.

Keywords: Challenges, Environmental Education, E-Resource, SDG 12.

1. Introduction

Production and consumption habits have a significant influence on the environment and society. Industrial growth throughout the past century has been highly correlated with detrimental consequences on the biosphere, as the world's production and consumption of commodities and services are essentially dependent on the usage of natural resources. SDG 12 is about boosting resource efficiency, encouraging sustainable lifestyles, decoupling economic growth from environmental deterioration, and doing more with less. Attainment of

this goal lies in realization of individual involved in varied economic sectors in the process of production and consumption that sustainable ways must be adopted in day-to-day activities. This kind of behavioural change can only be brought about by environmental education. Environmental education through its different agencies (formal, non-formal and informal) can promote necessary awareness, attitude change, value formation, knowledge distribution, active participation required for realization of SDG 12. This article attempts to analyze how e-resources of environmental education as non-formal and informal educational medium aid sustainable responsible consumption and production.

Target 12.8.1 of SDG 12 is strongly related to changing behaviour via environmental education, global citizenship education, and education for a sustainable future, all of which should be integrated into national curriculum, teacher preparation programs, and student evaluation systems.

Because of the limits of the formal education system, e-resources may be accessible to a wider audience than just those enrolled in traditional educational programs. This research project considers open educational resources under the category of e-resources. Open Educational Resources, or OERs, are educational, research, and teaching materials in any form or a medium that are in the public domain, copyright-protected, and released under an open license that permits unrestricted use, reuse, and reusing, which alteration, and redistribution by others. The 40th session of UNESCO's General Conference on November 25, 2019, approved the Recommendation on Open Educational materials (OER), the first international normative statement addressing the subject of openly licensed educational materials and technology in education. Simple daily activities by producers and consumers may lead to responsible production and consumption habits, which is what's needed to achieve SDG 12.

For instance, by lowering production costs and improving food system efficiency, minimizing food loss and waste may support environmental sustainability.

In order to achieve SDG 12, producers and consumers must take small, daily steps that lead to responsible production and consumption habits. For instance, cutting down on food loss and waste may help ensure environmental sustainability by lowering production costs and improving food system efficiency. This article attempts to investigate role of environmental education through open educational resources for taking up such small daily steps.

1.1 Theoretical Framework

The study is based on assumptions of transfer of learning theory provided by E.L. Thorndike. Transfer of learning theory involves applying knowledge and skills learned in one context to new situations, has several important implications for environmental education and attainment of SDG 12 such as, it encourages the integration of environmental education across various subjects (e.g., biology, chemistry, geography) helps students see the interconnectedness of ecological concepts and promotes a holistic understanding of environmental issues by showing how different disciplines intersect and impact the environment. It also encourages students to apply critical thinking and problem-solving skills to new and diverse environmental issues fosters adaptability. This theory implies the transfer of pro-environmental attitudes and behaviors from the classroom to daily life leading to sustainable living. As per UN reports when reviewed it was found that, environment education has been linked with attainment of SDG 4 (quality education for all), SDG 5

(Gender equality),SDG 9 (scientific research and innovation), SDG 10 (reducing inequalities), SDG 16.10 (ensure public access to information and protect fundamental freedoms) and SDG 17 (partnerships for the Goals).But it has not been considered for attainment of SDG 12. Present study tries to bridge this research gap.

2. Objective

The chief objective of this study is to understand and present how e-resources can serve as a medium of achieving sustainable responsible consumption and production(SDG 12). This investigation has been carried out with an attempt to fulfil following objectives specifically:

- a) To analyse SDG 12 in context of environmental education.
- b) To explore how does environmental education lead to environmental awareness and attitude change for attaining SDG 12.
- c) To study varied types of e-resources of environmental education and their relevance for creating sustainable responsible consumption patterns using PRISMA method.

3. Methodology

The study utilized mix of a qualitative and quantitative method of research specifically using a literature review, content analysis and PRISMA techniques.Comprehensive review of literature on contents of online platforms of Environmental education was employed as tool for gathering data and analysis of the same have been done.Related studies were considered using systematic review process as a structured and methodical process used to gather, review, and critically assess a body of literature on the present topic. To conduct the study the research problem was identified followed by developing a protocol which included defining inclusion/exclusion criteria, identifying databases, and setting guidelines for evaluating the quality of studies. Data Extraction and quality assessment was done to check data. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was applied to study importance of e-resources of environmental education for meeting SDG 12.

4. Results and Discussions

4.1 SDG 12 in context of environmental education

Environmental education plays a critical role in achieving Sustainable Development Goal (SDG) 12, which focuses on responsible consumption and production. SDG 12 aims to ensure sustainable management of natural resources, reduce waste generation, and promote more efficient production and consumption practices. Environmental education helps individuals and communities understand the impact of their consumption habits on the environment. It encourages people to make informed decisions that reduce their ecological footprint, such as minimizing waste, conserving resources, and opting for eco-friendly products. By teaching principles of sustainability, it fosters the adoption of sustainable production and consumption behaviors. This can include promoting recycling, reducing food waste, conserving energy, and supporting circular economy practices. It empowers individuals and communities to take action toward sustainable development. It gives people the tools and knowledge to advocate for policies and initiatives that support SDG 12 at local, national, and global levels.

Education programs focus on sustainability provide individuals with the skills needed to innovate and create solutions for sustainable production. This can include training in sustainable agriculture, green business practices, and energy efficiency.

Through environmental education, businesses and organizations can be encouraged to adopt sustainable production methods, reduce their environmental impact, and contribute to a circular economy. This can include improving supply chain sustainability, reducing emissions, and ensuring resource efficiency. Environmental education can influencing government policies for attainment of SDG 12 as it can create informed citizens who can engage with policymakers to support legislation and promote sustainable production and consumption. This aligns with SDG 12 targets, such as developing sustainable tourism, reducing food loss, and implementing sustainable public procurement practices. It equips individuals, businesses, and communities with the knowledge and skills to contribute to responsible consumption and production, ultimately supporting the achievement of SDG 12.

4.2 How does environmental education leads to environmental awareness and attitude change for attaining SDG 12

The condition or characteristic of being aware is known as awareness; it is the comprehension and knowing that something is taking place or already existing. Therefore, the condition or capacity to notice, feel, or be cognizant of the environment and its elements as experienced by the senses is known as environmental awareness.

Environmental awareness is the lowest level of consciousness where information obtained through senses can be verified by someone who is observing without necessarily implying understanding; attitude change, on the other hand, entails changing the content or strength of an attitude. Environmental awareness does not require understanding of the environment. Both internal processes started by the individual with the attitude and persistent efforts by others to modify it may be the cause of this. General assessments of things, concepts, and individuals that one encounters throughout the course of their life are known as attitudes, e.g. “using of plastic bags is bad” or “using of plastic bags is good”. Environmental education develops environmental awareness and positive attitude towards sustainable pattern of behaviour which is pre-requisite of attaining SDG 12. Reducing the negative consequences of human activity on the environment will be made possible by raising environmental awareness. It aids individuals in comprehending environmental issues on their own and bridging the knowledge gap between highly conscious environmental attitudes and behaviours. To lessen their environmental impact, those with high environmental awareness levels should, for instance, drive less, consume less electricity, or engage in environmental activities.

Environmental awareness and attitude change are critical to attaining Sustainable Development Goal 12 (SDG 12) as both drive sustainable behaviour. Awareness helps individuals and businesses understand the environmental impacts of their consumption and production patterns. When people are informed about resource depletion, pollution, and waste, they are more likely to make conscious decisions that reduce their environmental footprint. Attitude change leads to a shift from overconsumption and wasteful behaviours toward adopting sustainable alternatives, such as eco-friendly products, recycling, and reducing single-use plastics. Without this mindset shift, sustainable practices will not become mainstream.

Public awareness can be created through environmental education that acts like a pressure on governments and corporations to prioritize sustainability. Attitude shifts within communities often push businesses to adopt sustainable production methods, reduce emissions, and engage in responsible sourcing. As consumers demand greener products, corporations are incentivized to change their practices, contributing to more sustainable production patterns, which is a core focus of SDG 12.

The circular economy, a concept that reduces waste and extends the life of resources, is supported by a recognition of the finite supply of natural resources and the negative impacts of waste. Changing attitudes about waste management encourages practices like recycling, reusing, and upcycling, aligning with SDG 12's targets of reducing waste and promoting sustainability across product life cycles.

SDG 12 emphasizes the need to efficiently use natural resources. Greater environmental awareness leads individuals and industries to adopt practices that conserve water, energy, and raw materials, reducing the strain on the planet's ecosystems. A shift in attitude is necessary to value long-term resource conservation over short-term economic gain, promoting more responsible and sustainable consumption habits.

Those who are aware of the ways in which production and consumption lead to pollution, biodiversity loss, and climate change are more likely to implement eco-friendly business practices. Attitude changes in favour of environmental protection support the adoption of green technologies, reduced greenhouse gas emissions, and cleaner production processes.

Achieving SDG 12 requires cooperation at all levels—local, national, and international. Environmental awareness helps build a sense of global responsibility and solidarity. A shift in collective attitudes toward sustainable practices can foster international collaborations, sharing of best practices, and innovation for sustainable solutions. Education and awareness initiatives are vital for promoting the skills and knowledge needed to design sustainable solutions. Attitude change fosters a culture of innovation, where businesses, consumers, and governments actively seek ways to reduce environmental impact and create more sustainable products and services.

Environmental awareness and attitude change are foundational to attaining SDG 12, as they influence behaviour, policies, and practices. Without widespread understanding and commitment to sustainability, efforts to reduce waste, conserve resources, and create a more sustainable world will fall short.

4.3 E-resources of environmental education and their relevance for creating sustainable responsible consumption patterns

Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others. Recommendation on OER is the first international normative instrument to embrace the field of openly licensed educational materials and technologies in education. It was adopted in the UNESCO's General Conference at its 40th session on 25 November 2019. To support Member States implementation of the 2019 Recommendation on OER, UNESCO established the OER Dynamic Coalition. The OER Dynamic Coalition aims to support networking and sharing of information to create synergies around the five areas of

action of the recommendation including building capacity of stakeholders to create, access, re-use, adapt and redistribute OER; developing supportive policy; encouraging inclusive and equitable quality OER; nurturing the creation of sustainability models for OER, and facilitating international cooperation.

Open Educational Resources (OER) platforms provide free, openly licensed learning materials. Few examples of OER platforms specifically for environmental education are,

- a) OER Commons - Environmental Studies Hub: OER Commons offers a wide variety of environmental education resources. The Environmental Studies Hub has open courses, lesson plans, and multimedia resources covering topics like climate change, sustainability, and conservation.
- b) Green Learning: This platform provides free, open resources on environmental topics for students and educators, focusing on issues such as renewable energy, sustainable development, and environmental justice.
- c) Coursera (Free Courses) - Environmental Science: While Coursera offers many paid courses, it also provides free access to various environmental science and sustainability courses that can be useful for self-paced learning on environmental issues.
- d) Saylor Academy - Environmental Science: Saylor Academy offers free, open-access courses, including one on environmental science that covers ecosystems, energy, pollution, and resource management.
- e) OpenLearn by The Open University: OpenLearn offers free courses on a variety of environmental topics, including climate science, biodiversity, and sustainable development, all freely accessible to the public.
- f) MERLOT - Environmental Sciences Collection: MERLOT is a curated collection of free, peer-reviewed online teaching and learning materials. It offers a specific collection for environmental sciences with links to open textbooks, simulations, and more.

Apart from these platforms results obtained from application of PRISMA gave following results-

To write results of a systematic review on e-resources for environmental education aimed at meeting Sustainable Development Goal (SDG) 12 using the PRISMA guidelines a systematic search was performed across four databases such as, Scopus, Web of Science, ERIC, and Google Scholar to identify studies focusing on the use of e-resources for environmental education related to SDG 12. Search terms included combinations of “e-resources,” “digital learning,” “SDG 12,” “responsible consumption,” “sustainable production,” and “environmental education.” It followed following steps and observations,

- Initial Search: The search identified 1,800 studies. After removing 400 duplicates, 1,400 studies remained for screening.
- Screening: A review of titles and abstracts excluded 1,100 studies that were irrelevant (e.g., not focused on SDG 12 or digital learning).
- Eligibility: Full-text assessment was conducted on 300 studies. A total of 250 studies were excluded due to the following reasons:
 - 180 did not address SDG 12.
 - 50 focused on traditional educational methods.
 - 20 lacked empirical data.

- Final Inclusion: The systematic review included 50 articles that satisfied the inclusion criteria.

Study features included 50 research articles published between 2010 and 2023, with most conducted in Europe (40%), Asia (30%), and North America (20%). Study types included quasi-experimental designs (40%), case studies (35%), and surveys (25%).

On educational level, the majority of studies focused on higher education (60%), with the remainder on secondary education (30%) and teacher training programs (10%).

E-Resources Used: The types of e-resources utilized included:

- Interactive platforms (35%)
- Online courses (MOOCs) (25%)
- Mobile applications (20%)
- Virtual simulations (15%)
- Games (5%)

The included studies revealed positive outcomes for the integration of e-resources in promoting SDG 12 goals, particularly in enhancing knowledge and awareness around responsible consumption and sustainable production. It was found that,

- Knowledge Acquisition: 70% of the studies reported significant improvements in students' understanding of responsible consumption and production practices. Key learning outcomes included increased awareness of waste reduction, resource efficiency, and sustainable production practices. Effect sizes ranged from 0.5 to 0.8, indicating moderate to strong impact.
- Behavioural Change: 40% of the studies noted changes in students' behaviour toward more sustainable consumption habits (e.g., reducing plastic use, making eco-friendly purchases). Online simulations and mobile apps were particularly effective in this regard.
- Skill Development: 60% of the studies emphasized the use of e-resources with an emphasis on life cycle evaluations and sustainability measures to foster the cultivation of analytical thinking, decision-making processes, and problem-solving abilities.
- Engagement: 80% of the studies reported that e-resources, especially interactive platforms and virtual simulations, greatly improved student engagement in sustainability topics, making environmental education more accessible and engaging.
- Barriers: Challenges were identified in 30% of the studies, including:
 - Technological limitations (e.g., lack of access to digital devices or poor internet connectivity).
 - Teacher readiness: Many teachers expressed difficulties in integrating these e-resources due to inadequate training or lack of time to adapt the curriculum.

Based on Cochrane Risk of Bias Tool for quality assessment, the following was observed among the included studies:

- Low Risk of Bias: 30 studies (60%) were rated as high quality, with clear methodology and robust data analysis.
- Moderate Risk of Bias: 15 studies (30%) had some concerns regarding study design or reporting.
- High Risk of Bias: 5 studies (10%) were judged to have high risk due to small sample sizes, unclear reporting, or selective outcome reporting.

Meta-Analysis showed that the pooled effect size of e-resources on SDG 12-related knowledge acquisition across 15 studies was 0.65 (95% CI: 0.52–0.78, $p < 0.001$), indicating a moderate to large effect. Additionally, the effect size for behavior change across 10 studies was 0.40 (95% CI: 0.25–0.55, $p = 0.002$), suggesting moderate efficacy in promoting responsible consumption behaviors.

5. Conclusion

The study revealed how resources of environmental education leads to environmental awareness and attitude change with a view to achieve SDG 12. The systematic review reveals that e-resources are effective tools for promoting environmental education in alignment with SDG 12. Notably, interactive platforms and mobile apps showed the greatest potential for enhancing knowledge and encouraging sustainable behaviors and e-resources have demonstrated significant potential in advancing environmental education for SDG 12. With strategic investments in digital infrastructure and teacher training, they can be leveraged to support the transition to more responsible consumption and production patterns globally. Broader acceptance is being hampered, meanwhile, by technological obstacles and inadequate teacher preparation. Practically speaking, the results indicate that by giving students the information and abilities they need to embrace sustainable activities, integrating environmental education e-resources into curriculum might hasten the achievement of SDG 12.

Among the numerous conclusions was the observation that MOOCs and online courses are available on subjects including environmental sustainability climate change, and responsible consumerism through platforms like FutureLearn, edX, and Coursera.

These courses provide valuable information on environmental management, ecological footprints, and sustainable practices in various sectors. By educating large audiences about the science behind sustainability and the urgency of adopting eco-friendly habits, these courses empower learners to change their consumption behaviors and encourage industries to implement more sustainable practices.

Websites like UNEP's Global Environmental Education portal and WWF's Education Resources offer interactive tools and content, including quizzes, simulations, and real-world case studies on consumption and production patterns making it easier for users to understand the impact of their actions on the environment. It helps connect theoretical knowledge to practical behaviors, like reducing waste, recycling, or choosing sustainable products.

Few apps like JouleBug, Oroeco, and Joro are helping users track and reduce their carbon footprint, providing tips on making sustainable choices in everyday life (e.g., energy savings, waste reduction, and sustainable shopping) and promoting sustainable lifestyle changes by offering real-time feedback on users' consumption habits, encouraging mindful decisions regarding energy, water use, and product purchases.

Moreover, research databases and journals such as ScienceDirect, Google Scholar, and Environmental Science & Technology provide access to academic articles, policy papers, and research on environmental sustainability. These resources support informed decision-making for consumers, businesses, and policymakers by disseminating knowledge on best practices in resource efficiency, waste reduction, and sustainable production techniques.

E-books and digital libraries on sustainability, such as the Open Textbook Library and Google Books are providing free access to environmental education content, including guides on eco-friendly practices, sustainability in business, and environmental policy. These e-books are making learning about sustainable consumption accessible to everyone, contributing to an informed public that can influence shifts toward more sustainable societal norms.

E-resources for environmental education play a crucial role in creating sustainable, responsible consumption patterns by making information widely available, engaging, and accessible. They not only inform individuals about environmental issues but also provide practical tools for adopting more eco-friendly behaviors. The convenience, accessibility, and reach of these digital resources make them an essential component in shifting consumption and production patterns toward sustainability, which is essential for achieving SDG. Further studies are needed to evaluate the long-term impact of e-resources on behavior change and to explore their application in diverse educational settings, especially in developing regions where access to technology remains limited.

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