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Environmental Values and their Role in Pro-Environmental Behaviour among Secondary School Students

Prof. Jessy Abraham

Dept. of Teacher Training
Non-Formal Education (IASE)
Jamia Milia Islamia
New Delhi

Ms. Gulzar

Dept. of Teacher Training
Non-Formal Education (IASE)
Jamia Milia Islamia
New Delhi

Dr. Noor Alam

Dept. of Teacher Training
Non-Formal Education (IASE)
Jamia Milia Islamia
New Delhi

ABSTRACT

This study aimed to identify environmental values posed by senior secondary school students in Delhi and also identify pro-environmental behaviour expected from them. This study also examines the relationship between environmental values and pro-environmental behaviour in three dimensions: ecocentrism, anthropocentrism, and environmental apathy. The sample of the study consists of 100 secondary school students enrolled in Delhi. Two questionnaires have been used to gather data for the study. The first is Environmental Value Scale, used to assess environmental values along these dimensions: anthropocentrism, ecocentrism, and environmental apathy; the second is Environmental Behaviour Scale, intended to check for expecting pro-environmental conduct in their daily lives. Result shows the mixup environmental values in three dimension but more inclined towards ecocentrism and anthropocentrism. There is positive correlation in two dimension ecocentrism and anthropocentrism. Environmental apathy has negative correlation.

Keyword: Environmental Values, Anthropocentrism, Egocentrism, Pro-Environmental.

INTRODUCTION

Environmental problems are the most urgent problems currently facing human beings as well as animals on the Earth. The causes of environmental problems are generally described

as industrialisation, overpopulation, advancement of technologies, increasing needs, and globalisation (Davis, 1998); society is regarded as the most effective factor in these issues in terms of their thinking and behaviour (Watson & Halse, 2005; Negev et al., 2010).

One of the most essential inputs that governs human behaviour and attitude is values. They also play a crucial role in influencing individual behaviour and providing the basis for his or her habits, decisions, and preferences, both on an individual and societal level. They are used to foster social cohesion and collaboration. Parents, the home environment, teachers, friends, religious preachers, and the media all have a strong influence on an individual's values.

Schwartz presented a system for defining human values that is universal and cross-culturally applicable (Schultz & Zelezny, 1999). He also identified ten distinct types of general human values, which he classified into two broad categories: Self-improvement (such as power and achievement) versus self-transcendence; and openness to change (such as stimulation and self-direction) versus conservation (such as compliance, traditions, and security). (such as welfare for others, universalism, and benevolence) (Bjerke & Kaltenborn, 1999). Environmental value refers to values that encourage or support acts that promote environmental stewardship and responsibility (Kaltenborn and Bjerke, 2002). They are defined as "values that propose or support action – oriented toward the environment and take responsibility." McMillan (2002).

There are multiple theories and methods that looked the relationship between values and behaviour and try to explain differences in attitude and behaviour between individuals. Schwartz' norm activation model of altruism is one of these models. According to this model, behaviour toward others is determined by personal and social standards, understanding of consequences, and personal responsibility of individuals. (Snelgaer, 2006). This is because the individual has personal moral standards or norms that he or she follows whenever there is a risk of a negative outcome that may impact others (This means that the individual is aware of the potential implications.) This allows a person to choose what actions to take in order to avoid these repercussions (i.e. self responsibility) (Stern & Dietz, 1994).

The Schwartz model was developed by Stern and his colleagues to explain environmental behaviour and brought up the Value Belief Norms (VBN) theory of environmental concern and behaviour. The existence of indirect relationships between values and environmental decisions is discussed in this theory. Values shape our overall attitude toward the environment, as well as our perceptions of how environmental change will affect the things we value.

There are three different classifications of environmental values or moral responsibility that make up the belief in environmental justice and impact environmental behaviour, according to the literature in the field of environmental values. Anthropocentrism, biocentrism, and ecocentrism are the three classifications (Karch, 2002). According to Human-centred values or anthropocentrism, humans are the centre of the universe, and they must

conserve the environment because it is important to their quality of life. Because human health and well-being are dependent on natural resource sustainability, the environment must be maintained because it provides advantages to future generations (Casey & Scott, 2006). Biocentrism, or ideals centred on living beings, implies that all living things have the right to exist as components of the bio-system. Some proponents of this theory say that animals, not plants, have a higher right to protection, and that endangered animals and colourful birds should be prioritized above mosquitoes or mice (Karch, 2002). Ecocentrism (nature-entered value) puts the environment and its elements ahead of human concerns. Supporters of this position admire nature for what it is, believing that it needs to be protected for its fundamental value, regardless of whether or not it benefits humans (Casey & Scott, 2006).

According to Thompson & Barton, there are two types of values under anthropocentrism: first, which is important to the person, called individualistic; and second, which is significant to others, called social. He kept natural values under the category of ecocentrism. They've also uncovered a third group of people who are uninterested about environmental issues and are even antagonistic to them (Casey & Scott, 2006). These three environmental value categories given by Thompson & Barton have been selected for the current study. Thompson & Barton consider that environmental values and environmental behaviour have a positive relationship. People who have environmental values give effort to protect and care for the environment without being concerned about consequences like reducing or leaving comfort or luxury, or paying extra for environmentally friendly products. People who focus on individuals or communities are less likely to protect or work for the environment. Thomson & Barton believe that environmental values centred on nature are significantly linked to behaviours aimed at safeguarding the environment, whereas values centred on the individual and society are less linked to the same type of activity (environmental protection) (Stern & Dietz, 1994).

LITERATURE REVIEW

Juhl & Grunert, 1995 conducted a research to see the relationship between human values, environmental attitude and organic food purchases. The study objective was to look how effective Schwartz's Value Theory, which has been used to explain some elements of consumer behaviour in numerous nations, was. The study sample included 174 teachers of both genders who were requested to complete a multi-part survey in order to obtain the necessary data. The findings of the study revealed that applying Value Theory to a group of Danish teachers yielded results that were quite comparable to those of other countries, and that there is a link between 30 human sub-values and environmental attitudes. Another Study titled "Environmental Concern and Behavior in an Australian Sample Within an Ecocentrism-Anthropocentrism Framework" Scott & Casey, (2006) wanted to see what is the relationship between social, demographic and concern for the environment is in Australians and as well

as test the hypothesis of Thompson & Barton that ecocentrism is positively correlated with environmental behaviour while ecocentrism and environmental apathy are negatively correlated. The sample of the study was 292 people from Australia. The researcher used three tools. The first was the environmental behaviour scale, the second was the environmental values scale of Thompson & Barton, and the third was used to measure the environmental attitude of Dunlap et al. Findings reveals tha females, the elderly, and those with a higher education showed greater degrees of ecocentrism and reported more pro-environmental activity. **Hansla, et al. 2008**, studied “the relationship between awareness of the effects, environmental interests, and values” in another study. The survey included a total of 1965 Swedish residents. The findings revealed that participants’ environmental attitudes toward the individual, people, and nature are linked to how they view the effects of those attitudes toward the individual, others, and nature. The findings also revealed a link between how participants see the effects of their actions on themselves, others, and nature, as well as the values of power, kindness, and universalism.

OBJECTIVES OF THE STUDY

1. Identifying the Environmental Values in three dimension Ecocentrism, Anthropocentrism and environmental apathy among secondary schools students of Delhi.
2. Identifying the Environmental behaviour of the secondary school students of Delhi.
3. To study the relationship between environmental values and behaviour of the secondary school students of Delhi.

IMPORTANCE OF THE STUDY

As we all know that environment is an important part of our life and this environment is need to live this life but now-a-days, we human being do not value this environment and use it to the fullest for our selfish motives. These motives destroy the whole environment and now we need to talk about the environment value. Values can be take an important role in to tackle environmental crisis facing by develop and developing societies especially local and global level. Additionally this study also highlights overall environmental value orientation of secondary school students of Delhi and their relationship with environmental behaviour. This also help to environmental educationist to develop effective environmental programs especially focus on environmental values (Ecocentrism) and modifying behaviours to protect environment.

METHODOLOGY

Population

The study population was secondary school students enrol in government schools in Delhi, India.

Sample of the study

The study sample consisted 100 students from 9th and 10th class from three different schools of Delhi. School-wise distribution of the sample is shown in table 1.

S. No.	School Name	Number of the students
1	School 1	50
2	School 2	20
3	School 3	20
4	School 4	10
	Total	100

DATA COLLECTION AND TOOLS

There were two scales used for data collection first is standard tool of environmental values develop by Thompson & Barton in 1994 to measure environmental value. It consist 25 items on 5 point Likert Scale and measures environmental values in three dimension (Ecocentrism, Anthropocentrism and Environmental Apathy). Questionnaire translated in hindi language and given to expert evaluation and feedback to ensure this questionnaire use for local use.

Second scale is Environmental Behaviour develop by researcher to measure desirable behaviour exercise on the daily basis among secondary school students. This scale consists of 20 items related to environmental behaviour to protect environment. This scale was design to touches areas of environment such as consumption, energy use and natural resources. This scale is also 5 point Likert scale from strongly disagree to Strongly agree. Questionnaire was validated by several expert from the field of environmental education ensure the clarity and validity. First this questionnaire was piloted on small sample for feedback and clarity then it finalised for study.

Reliability of the tools

Reliability coefficient (Cronbach's alfa) were calculated separately of both the tools. The reliability coefficient of Environmental Value Scale was 6.52 and 0.775 of Environmental Behaviour.

Result and discussion

To answer the first objective that is to identify environmental value among students in three dimension (Ecocentrism, Anthropocentrism and Apathy), means and standard deviation calculated for each themes separately ecocentrism 10 items, anthropocentrism 10 item and environmental apathy 5 items. Table 3 shows the result.

Table 5. Pearson coefficient correlation between environmental value dimensions and environmental behaviour

Environmental Value Dimension	r	Sig.
Ecocentrism	0.198	0.049
Anthropocentrism	0.122	0.228
Environmental Apathy	-0.158	0.116

Table 5 show positive correlation in two dimensions ecocentrism and anthropocentrism but only ecocentrism is statistically significant at 0.05 but negative correlation between environmental behaviour and environmental apathy. This outcome is consistent with the findings of earlier research in this field (Schultz, 2001, Casey & Scott, 2006). The majority of studies have demonstrated a positive link between environmental value orientations in terms of ecocentrism and environmental behaviour expectations. This study confirms the findings of Schultz (Schultz, 2001) about the relationship between the ecocentrism dimension and environmental behaviour. This positive correlation shows the greater scope to inculcate more environmental values and hence more upgraded environmental behaviour among school students. Ultimately pro environmental behaviour will lead to more protected and preserved environment. Schools and different social organisation should work towards deepening these environmental values among these future-generation of ours so that, we are better prepared to fight that upcoming issues of environment and its related concerned. It is important to ensure that this future generation protect environment for the sake of nature (Ecocentrism) not according to their comfort and convenience as an anthropocentric do.

CONCLUSION

The present paper studied the values in three dimensions and their relation with pro environmental behaviour among secondary school students. Environmental Values and behaviour were measured using Environmental Values Scales and it was found that only average level of values among secondary school students and environmental behaviour scores were also not very much impressive. Also in this paper try to find correlation between environmental values and pro environmental behaviour, there is positive correlation in ecocentrism and anthropocentrism but not much impressive. These scores provide the scope to work upon these issues which are important for the sake of environment and human being. Average scores indicates that there is still need to develop these values among youngsters, deepening these values in them will help to preserve the environment, environmental education should given preference. Teachers, policy makers, NGOs must work upon creating more opportunities and programmes to educate these students about their environment and related issues. Filled them only with knowledge would not work, developing values preferably ecocentrism values, in them will motivate them to take actions as well.

Table 3. Means and standard deviation of environmental value scale in three dimension

Environmental value dimension	Means	Std. Deviation
Ecocentrism	37.5	4.88
Anthropocentrism	32.4	4.71
Environmental Apathy	15.6	2.86

We can conclude from the the result of table 3, the secondary school students have combination of environmental values but their value more inclined to ecocentrism (37.5) followed by anthropocentrism (32.4), environmental apathy (15.6) in the last. These results indicates that students has more environmental values related to ecocentrism and anthropocentrism which could be a result of environmental courses introduced at secondary level by the government and equip them with the knowledge related to environmental issues and the present situations of Delhi's environmental situations. Results for this objective are also consistent with previous studies (Stern & Dietz, 1994, Snelgaer, 2006) showing values varying in different categories for different individuals.

Scale	Mean	Std. dev.
Environmental Behaviour	59.23	3.49

To answer the second objective which is identifying the environmental behaviour among secondary school students, means and standard deviation calculated. Mean value of environmental behaviour for secondary school students is 59.23 with SD is 3.49 (Table 4) which indicated that students' behaviour towards environment is not that much friendly as they has values towards environment which is shown through table 2. Maybe this practice behaviour towards environment are the only result of this questionnaire's measurement, actual behaviour could be different.

To answer the third objective of this this study which concerned with correlation between environmental value and environmental behaviour among secondary school students, Pearson coefficient correlation were calculated. Result depicted in table 5.

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Education for Sustainable Development (ESD)

Dr. Seema Yadav
Assistant Professor
SCERT
Delhi

ABSTRACT

Education for Sustainable Development (ESD) is a type of education that aims to help people develop the knowledge, skills, values and attitude to create a sustainable society and to contribute to a sustainable future. It emphasizes in ensuring inclusive and equitable quality education. It is not confined to schools but applies to all levels of formal, non-formal and informal education and promotes lifelong learning opportunities for all. The goal of ESD is to integrate principles of sustainability into all aspects of education and learning, enabling individuals to make informed decisions and take responsible actions that address not only global challenges like climate change, loss of biodiversity, and inequality, but also the specific challenges faced by their country at the local and national levels.

The successful implementation of ESD will elevate the quality of life for both present and future generations, fostering a harmonious balance between human progress, cultural diversity, and the well-being of our planet.

ESD is now recognized as a vital component in achieving the Sustainable Development Goals (SDGs) set by the United Nations (UN). The National Education Policy (NEP) 2020 of India aligns closely with the ESD objectives and the SDG 2030 agenda. NEP 2020 acknowledges that realizing this vision requires a comprehensive overhaul of the education system to support and promote learning that meets the SDGs. The policy incorporates nearly all SDG 2030 objectives, reflecting a commitment to integrating ESD principles throughout the education continuum-from early childhood care to secondary education.

This paper explores the fundamental aspects of ESD and its critical role in advancing all 17 SDGs. It also highlights NEP 2020's vision for ESD and present the pivotal role of State Councils of Educational Research and Training (SCERTs) in implementing ESD in practice at school level.

Keywords: Education for Sustainable Development (ESD), United Nations (UN), Sustainable Development Goals (SDGs), State Council of Educational Research and Training (SCERT), New Education Policy (NEP) 2020, sustainable society, principles of sustainability.

INTRODUCTION

The concept of Education for Sustainable Development (ESD) was born from the need for education to address the growing environmental challenges facing the planet. As a lifelong learning process, ESD is essential to quality education. It aims to create a better world for current and future generations by fostering innovative solutions to environmental, economic, and social issues.

ESD equips individual with the knowledge, skills, values and attitude to create a sustainable and just society and enable them to address global challenges like climate change, biodiversity loss, and inequality.

ESD contribute to a sustainable future. It enables individuals to make informed decisions and take actions that foster sustainability. A sustainable society is one that meets the needs of the present without compromising the ability of future generations to meet their own needs. It balances economic growth, social inclusion, and environmental protection, ensuring a high quality of life while preserving natural resources and ecosystems for the future.

ESD seeks to develop learning outcomes that foster key competencies, such as critical and systemic thinking, collaborative decision-making, and responsibility for both present and future generations.

ESD uses innovative pedagogy and teaching methods that prioritize interactive, learner-centered approaches. These methods promote exploratory, action-oriented, and transformative learning, empowering learners to think critically and cultivate the values and attitudes needed for a sustainable future.

ESD can help people develop the skills to:

- Think globally and act locally
- Take responsibility for problems in their immediate environment and tackle them with a global perspective
- Participate in decisions
- Make decisions that improve quality of life without damaging the planet, both locally and globally
- Lead healthy lifestyles
- Live in harmony with nature and consider social values, gender equity, and cultural diversity

HISTORY OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Education for Sustainable Development (ESD) gained prominence following the UN's endorsement of sustainable development in 1987, and its role was recognized in three major UN summits on sustainable development i.e. 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil; 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa and the 2012 UN Conference on Sustainable Development (UNCSD) in Rio de Janeiro. The Earth Summit in 1992 further defined ESD, incorporating it into Agenda 21's Chapter 36, which focused on promoting education and public awareness. The UN Decade of Education for Sustainable Development (2005-2014) advanced ESD globally, emphasizing its integration into all educational levels. UNESCO has since led ESD initiatives, continuing through the Global Action Programme (2015-2019) and the ESD for 2030 framework.

ROLE OF UNESCO

UNESCO, as the United Nations' specialized agency for education, is entrusted to lead and coordinate the Education 2030 Agenda, which is part of a global movement to eradicate poverty through 17 Sustainable Development Goals by 2030. Education is essential to achieve all of these goals.

UNESCO's ESD efforts focus on:

- **Advancing Policy:** Shaping and supporting sustainable education policies.
- **Transforming Learning Environments:** Improving educational settings to promote sustainability.
- **Building Educator Capacity:** Enhancing the skills of educators in sustainability.
- **Empowering Youth:** Mobilizing young people for sustainability action.
- **Accelerating Local Action:** Supporting local initiatives and practices for sustainability.

ESD FOR ACHIEVEMENT OF THE 17 SUSTAINABLE DEVELOPMENT GOALS (SDGS) –

ESD is recognized internationally as a crucial driver of sustainable development, and equips individuals with the knowledge and skills needed for sustainable practices.

The UN Decade of Education for Sustainable Development (2005-2014) triggered a global effort to reorient education to address the challenges of sustainable development. It highlighted that education is fundamental for achieving sustainability.

ESD plays a vital role in advancing all 17 UN SDGs, especially Goal 4, which aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.” The 17 SDGs are interconnected and address economic, social, and environmental dimensions of sustainability. The UN calls on nations to work towards these goals by 2030.

Here's how Education for Sustainable Development contributes to each of the SDGs:

1. No Poverty (Goal 1): Education provides skills for better employment, breaking the poverty cycle.
2. Zero Hunger (Goal 2): Knowledge in sustainable agriculture and food security ensures resilient farming and food sustainability.
3. Good Health and Well-being (Goal 3): Health education promotes healthier lifestyles and preventive healthcare.
4. Quality Education (Goal 4): Inclusive education fosters lifelong learning, crucial for sustainable development.
5. Gender Equality (Goal 5): Education empowers women and girls, promoting gender equality and participation.
6. Clean Water and Sanitation (Goal 6): Awareness of water conservation and sanitation is enhanced through education.
7. Affordable and Clean Energy (Goal 7): Education drives innovation in renewable energy and energy-efficient practices.
8. Decent Work and Economic Growth (Goal 8): Skills development through education promotes decent jobs and sustainable economic growth. Goal eight of sustainable development goals emphasizes promotion of sustain inclusive and sustainable economic growth along with full and productive employment and decent work for all.
9. Industry, Innovation, and Infrastructure (Goal 9): Education in technology fosters sustainable industrialization and infrastructure development.
10. Reduced Inequality (Goal 10): Equitable access to education reduces social and economic inequalities.
11. Sustainable Cities and Communities (Goal 11): Education supports responsible urban planning and environmental protection.
12. Responsible Consumption and Production (Goal 12): Education promotes sustainable consumption, resource conservation, and waste reduction.
13. Climate Action (Goal 13): Environmental education raises awareness about climate change and sustainable practices.
14. Life Below Water (Goal 14): Education supports marine conservation and sustainable fishing practices.
15. Life on Land (Goal 15): Education fosters awareness of biodiversity conservation and sustainable land use.
16. Peace, Justice, and Strong Institutions (Goal 16): Civic education promotes justice, human rights, and accountable institutions.

17. Partnerships for the Goals (Goal 17): Education encourages global collaboration and knowledge-sharing for SDG achievement.

In essence, education supports progress in every SDG, driving sustainable and equitable development globally.

CORE PRINCIPLES OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

1. Interdisciplinary Approach:

ESD transcends traditional subject boundaries by integrating knowledge from fields such as environmental science, economics, social sciences, and ethics. It promotes an interdisciplinary learning model where sustainability concepts are woven into various subjects rather than treated as standalone topics. For instance:

- o Science Education: Teaching about climate change, biodiversity, and renewable energy sources.
- o Social Studies: Exploring the social and economic dimensions of sustainability, including poverty reduction, gender equality, and human rights.
- o Economics: Analyzing sustainable development from an economic perspective, including sustainable consumption and production patterns.
- o Ethics and Values Education: Encouraging discussions on environmental ethics, equity, and justice.

2. Critical Thinking and Problem-Solving:

ESD encourages learners to critically assess environmental, social, and economic issues, fostering problem-solving skills essential for addressing sustainability challenges.

3. Participatory Learning:

ESD promotes active, participatory teaching methods that engage learners in discussions, debates, and hands-on projects. This approach encourages students to explore sustainable practices and collaboratively solve real-world problems.

4. Cultural Relevance:

ESD values cultural diversity and ensures that educational practices are locally relevant while promoting global citizenship. It adapts sustainability principles to local contexts, respecting indigenous knowledge and traditions.

5. Long-Term Perspective:

ESD emphasizes a future-oriented mindset, encouraging learners to consider the long-term impacts of decisions on future generations and the planet, ensuring sustainability is not just immediate but enduring.

By incorporating these core principles into education, ESD empowers learners to take informed and responsible action for a sustainable future.

SCOPE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Education for Sustainable Development (ESD) equips individuals with the knowledge, skills, and values needed to address both global and local challenges. It fosters a deep understanding of how environmental, social, and economic issues are interconnected, enabling students and communities to contribute to sustainable development not just globally, but within their own national and local contexts. ESD helps build resilience, promote equity, and ensure sustainability is culturally relevant and actionable. The scope of ESD is broad, encompassing various aspects:

1. Addressing Local Environmental Issues

While ESD tackles global challenges like climate change, it also focuses on local environmental concerns unique to specific regions. For example, in areas facing water scarcity, desertification, or deforestation, ESD can teach students and communities about sustainable water management, reforestation programs, and conservation practices tailored to their unique ecosystems.

2. Promoting Local Economies and Sustainable Practices

ESD can help students understand the importance of sustainable economic development in their own regions. For instance, in countries where agriculture is a key industry, ESD can promote sustainable farming practices, responsible use of natural resources, and innovation in renewable energy. This can lead to more resilient local economies that prioritize long-term sustainability over short-term profits.

3. Strengthening Cultural Identity and Indigenous Knowledge

ESD also plays an important role in recognizing and preserving local cultures and traditional knowledge systems. In many countries, indigenous practices offer valuable lessons on living in harmony with nature. By integrating local wisdom and indigenous knowledge into sustainability education, ESD can ensure that students appreciate the importance of cultural heritage and sustainable living practices rooted in their communities.

4. Building National Capacity for Sustainable Development

ESD helps build the capacity of educators, policymakers, and leaders to address sustainability challenges on a national scale. Through policies and curricula, ESD educates students on strategies for addressing urbanization, pollution, and energy dependence. This cultivates a generation of informed citizens who can actively participate in national efforts for sustainable development and policy advocacy.

5. Tackling Inequality and Social Justice Issues

ESD is crucial in addressing social inequalities by promoting access to quality education for all, particularly in regions with significant income disparities, gender imbalances, or marginalized communities. ESD programs empower disadvantaged groups, providing them with skills for economic inclusion, and fostering social justice. This supports national efforts to reduce inequality and promote social justice at both the local and national levels.

6. Aligning with National Development Goals

National development goals often align with the UN's SDGs but are adapted to local needs. ESD helps students and communities see how their actions support national priorities like clean energy, poverty reduction, and health improvements. For instance, integrating national priorities such as food security or urban planning into school curricula helps students understand how sustainability contributes to their country's future.

7. Encouraging Local Solutions to Global Problems

ESD fosters critical thinking by encouraging students to explore localized solutions to global problems. Whether it's community-based recycling, local renewable energy initiatives, or sustainable entrepreneurship, ESD empowers students to develop innovations that address global challenges in their own communities. This builds a sense of responsibility for local action with global impact.

8. Engaging Communities in Sustainable Practices

ESD extends beyond classrooms, engaging entire communities through workshops, awareness campaigns, and partnerships with local governments and businesses. These initiatives bring sustainability into daily life, encouraging people to actively reduce waste, conserve resources, and protect local wildlife or promoting sustainable urban development. Community engagement fosters a collective approach to solving sustainability issues.

9. Preparing Students for Green Jobs

ESD prepares students for the growing demand in green industries, including renewable energy, sustainable agriculture, environmental engineering, and green technology. This not only addresses global environmental needs but also supports national economic growth by aligning local job markets with sustainable practices, creating opportunities for employment and innovation in emerging sectors.

In sum, the scope of ESD is expansive, equipping individuals and communities to address sustainability challenges at local, national, and global levels, while fostering economic growth, social justice, and environmental stewardship.

HOW EDUCATIONAL SYSTEMS CAN JOIN TOGETHER THEIR EFFORTS FOR ESD:

To integrate Education for Sustainable Development (ESD) effectively, educational systems must collaborate across various levels and stakeholders. Here's how:

1. **Policy Alignment:** Align national policies with global ESD frameworks like the SDGs and integrate education with cross-sectoral policies in areas such as environmental protection and economic development.
2. **Curriculum Development:** Design curricula that incorporate sustainability principles and prepare students for careers in green technologies, renewable energy, and environmental sectors, tailored to local contexts.
3. **Teacher Training:** Provide ongoing professional development focused on ESD and create collaborative networks for educators to share resources, strategies, and best practices.
4. **Assessment and Evaluation:** Use inclusive assessment tools that measure both academic knowledge and sustainability-related skills and behaviours, while regularly evaluating and improving ESD programs.
5. **Community Engagement:** Engage local communities, NGOs, and the private sector in sustainability projects, allowing students to apply their learning in real-world contexts and creating awareness among parents and communities about ESD benefits.
6. **Global Cooperation:** Promote international student and teacher exchanges and share best practices globally to gain diverse perspectives on sustainability challenges and solutions.
7. **Technology and Innovation:** Utilize digital platforms and innovative teaching methods, such as project-based and experiential learning, to enhance the effectiveness of ESD.
8. **Monitoring and Improvement:** Use data to assess the impact of ESD initiatives, allowing for continuous adaptation, and foster collaborations between academia and industry to bridge the gap between theory and practice.
9. **Sustainable Practices in Schools:** Encourage schools to adopt green practices in operations, turning them into models for sustainability, and conduct orientation programs to build students' awareness of sustainability and future job opportunities.

Through these collaborative efforts, educational systems can effectively promote ESD and contribute to a sustainable future.

NEW EDUCATION POLICY (NEP) 2020 AND ESD

Sustainable development must be integrated into education and education must be integrated into sustainable development. ESD is holistic and transformational education and concerns learning content and outcomes, pedagogy and the learning environment (UNESCO, 2014).

India is making significant progress toward achieving the Sustainable Development Goals (SDGs) by 2030. Sustainable development requires transformation of education system. The National Education Policy (NEP) 2020 is a significant step aimed at building a modern, inclusive education system that meets global standards while addressing the country's specific needs.

NEP 2020 is closely aligned with the Education for Sustainable Development (ESD) goals particularly with SDG-4, which focuses on providing free, equitable, and quality education for all, with a particular emphasis on skills for employment and sustainable living.

To support these goals, the Indian government launched the **Samagra Shiksha Scheme**, offering financial assistance to states and union territories to achieve NEP 2020's objectives. This scheme promotes:

- **Quality education** and improved learning outcomes,
- **Equity and inclusion** for marginalized groups,
- **Vocationalization** of education and skill development,
- **Gender equality** in access to education,
- **Universal access** to lifelong learning and vocational training.

Through these initiatives, NEP 2020 strengthens India's commitment to sustainable development, empowering its citizens for a more equitable and resilient future.

ROLE OF SCERT FOR IMPLEMENTATION OF ESD

To implement ESD at the state level, the State Council of Educational Research and Training (SCERT) should focus on the following key actions:

Curriculum and Material Development: SCERT must develop and adapt educational materials that align with both the National Education Policy (NEP) 2020 and sustainability principles. This involves creating curricula that reflect local environmental, economic, and social realities, ensuring that the content is relevant and actionable for students across different regions.

Orientation and Training: SCERT should conduct regular training and orientation sessions for school heads, teachers, and teacher educators on sustainability. These sessions should focus on equipping educators with the knowledge and skills needed to effectively teach ESD, ensuring they stay updated on the latest practices and pedagogical approaches.

Collaborative Networks: Establish strong networks for educators to share best practices, resources, and strategies for ESD. SCERT should foster both national and international

collaborations to facilitate knowledge exchange and innovation in sustainability education. This can include organizing guest lectures, workshops, seminars, and conferences to keep educators and students informed about recent developments in sustainability.

International Programs and Exchanges: Promote international student and teacher exchanges to provide a global perspective on sustainability challenges and solutions. SCERT should collaborate with the state department of education to facilitate these programs.

Research and Development: Undertake research projects focused on ESD, such as studying interdisciplinary learning and sustainability-related topics. SCERT should use research findings to enhance ESD practices and inform educational strategies.

By focusing on these areas, SCERT can play a pivotal role in advancing ESD at the state level, supporting the broader goals of sustainable development.

ROLE OF SCHOOLS IN PROMOTING EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Schools play a vital role in fostering sustainable development by integrating ESD into their practices. Here's how schools can lead this transformation:

1. **Transforming into Green Schools:** Adopting eco-friendly practices like waste reduction, energy conservation, and biodiversity support turns schools into practical examples of sustainability.
2. **Student Awareness and Skill Development:** Conducting programs on sustainability to raise awareness of the importance of environmental and social responsibility and highlight career opportunities in green sectors. These programs should also highlight the growing job opportunities in fields like renewable energy, green technologies, and sustainable agriculture, equipping students with relevant skills.
3. **Sharing Best Practices Globally:** Schools should actively share successful ESD practices and resources on national and international platforms, learning from one another's experiences to continuously improve sustainability initiatives. By participating in global networks, schools can collaborate with other educational institutions to innovate and enhance their approach to sustainable education.
4. **Community and Stakeholder Engagement:** Schools should work closely with local communities to tackle real-world sustainability challenges, offering students hands-on experience in applying sustainable solutions to practical problems. Partnering with NGOs, businesses, and other organizations can provide schools with additional resources, expertise, and opportunities for students to participate in sustainability projects. Schools should organize programs for parents and the wider community to explain the benefits of the new sustainability-focused curriculum, encouraging collective responsibility for sustainable development.

5. **Student Participation in Projects:** Involving students in hands-on sustainability projects like clean-ups and tree planting to reinforce ESD principles and encourage active contribution to environmental and social well-being.

Through these actions, schools play a crucial role in fostering a culture of sustainability and prepare future generation who are environmentally conscious and socially responsible citizens.

CHALLENGES IN IMPLEMENTING ESD

- **Curriculum Overload:** Adding ESD to an already crowded curriculum can be challenging, requiring a rethinking of educational priorities.
- **Teacher Training:** Effective ESD implementation depends on teachers who are well-trained and committed to integrating sustainability into their teaching practices.
- **Resource Constraints:** Schools in resource-limited settings may struggle to provide the necessary materials and support for ESD.
- **Assessment of ESD Outcomes:** Measuring the effectiveness of ESD is complex, as it involves assessing changes in attitudes, behaviors, and competencies.
- **Lack of Modern Content:** A major challenge in implementing ESD is the absence of up-to-date content. Rapid advancements in sustainable development, climate crises, and new technologies make it difficult for educational institutions to provide relevant and effective ESD materials that keep pace with these changes.

CONCLUSION

Every form of education serves a purpose—Similarly, Education for Sustainable Development (ESD) goes beyond knowledge acquisition; it aims to shape the values, attitudes, and behaviors essential to address the global challenges of sustainability and securing the future of our planet.

By integrating ESD into education systems, we can empower individuals to contribute to a more sustainable and equitable future. This requires a collective commitment from educators, policymakers, and communities to prioritize sustainability in all aspects of learning, ensuring that future generations are equipped to create a resilient and just world.

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Integrating AI and Emerging ICT Tools in Education: Digital Knowledge Sharing Contents Describe How Classroom Practice can be Transformed For the 21st Century Learner

Dr. Apsara Ansari

Assistant Professor

SCERT

Delhi

ABSTRACT

"The use of AI, ICT in the education sector brings a fundamental change in teaching ways. In this paper, it is an attempt to pinpoint how AI and ICT achieve such features as individualization, involvement, and availability in the educational processes. IES and Predictive analytics are examples of AI technologies that provide appropriate educational experiences as well as appropriate timing of intervention, while educational ICT tools provide literature, gaming and virtual reality learning which provide enriched experiences. In addition to the benefits, the article highlights the challenges presented by most of these technologies in terms of inequities in access and quality of the infrastructure, teacher preparedness and skill, and ethics. In this paper, it will be shown how AI and ICT are changing the face of education, based on the analysis of the present state of the problem and trends of its further development.

Keywords: Artificial Intelligence, Information and Communication Technology, Personalized Learning, Educational Technology, Pedagogical Innovation.

INTRODUCTION

As educations continuously move carefully with the changes happening in the society, technology remains a force to reckon with. As for integration of Artificial intelligence (AI) and Information and communication technology (ICT) into educational context we can

state that it is not only a continuous development of technologies that transform the learning-teaching process but a revolution in the way it takes place. In this section, we investigate the truth of this innovative generation, based on ICT and AI, which conveyed a new paradigm of education that is more individual, whereby effective and collaborative also. It follows the complexity of the effects these technologies have on teaching, and elucidates how they can reconstitute instruction; at the same time, it raises questions and offers insights that concern teachers and students.

AI is a phenomenon which has revolutionized a number of sectors and the education sector is not an exempted one.

Artificial Intelligence earlier an imaginative computing concept in sci-fi films is now an indispensable part of the educational cricles. They go beyond simple automation of the learning process: they change the way it takes place. By far, the most important aspect of AI's influence in the sphere of education is the element of individualization.

PERSONALIZED LEARNING

Intelligent Tutoring Systems (ITS) supported by artificial intelligence is a great innovation in the sphere of individualized approach. These systems are expected to be able to address the needs of the individual students providing individual learning instructions and feedback. Just think about an academic situation where a student is working through mathematics, for instance—an ITS can track different aspects of this student's activity in real time, define possible weak points, and assign certain practice that can help eliminate these issues. That kind of assistance of course improves learning effectiveness but also serves to help the students overcome their difficulties and gain confidence.

In this respect, ITS has been proved to have a number of benefits by many researches. To be specific, the evidence points to the ITS learners getting better results than other learners in conventional education systems.

For example, Kulik and Fletcher (2016) meta analysis results highlighted showed that ITS leads to a enhancement of student achievement especially in STEM fields. ITS can therefore favorably help in that by tracing the progress of each student; it can then change the speeds and levels of work to be covered depending on the progress made by the students.

PREDICTIVE ANALYTICS

Their use is not only limited to the role of real-time tutoring, which involves providing instant guidance to students, but also as a tool for prediction, and AI gathers data with the purpose of predicting some sort of outcome. Performance management tools track different aspects of the students including attendance record, participation level, and academic achievement to assess the likelihood of students' failure among other things. For instance,

in cases where a student's participation or performance reduces significantly, AI can notify instructors, thereby helping avert an academic loss early enough.

This is done in consideration of the findings of Arnold and Pistilli (2012) who support the use of the 'predictive analytics for administrative management' strategy to enhance the rate of student retention in colleges and universities. By applying data in instructional decisions and in moderation of support elements, an instructor or tutor can give help at the proper time to help increase general student achievement.

AI IN PERSONALIZED LEARNING

The implementation of AI in special learning spaces is not only about delivering knowledge, but also about creating genuine, meaningful learning experience. AI facilitated LMS can develop individual learning trajectories based on their clients' preferences and needs. For example, if a particular style of learning is received in the form of audio, and the student is a more of a visual learner, then he or she will not be able to grasp the material effectively.

It also ensures the students remain interested in learning and at the same time get a better understanding of the matter at hand. A study conducted by Holmes et al. (2019) supports that the adoption of AI in learning help to provide differentiated instructions that can suit the various students' learning modes and competencies. AI helps in making the course more interesting and enjoyable and thus creates a better educational experience by offering the resources and activities that correspond with the student's preferences.

ICT TOOLS IN EDUCATION

ICT too has been playing a very important role in enabling modern education while AI is a novel innovation. These tools have brought changes in the traditional classrooms and made classrooms lively and innovative spaces to learn and to share knowledge among students.

- **Digital Learning Platforms**

Technological developments which includes the use of online learning platforms such as Massive Open Online Courses (MOOCs) have provided an opportunity to extend education to anyone. They are full of videos, quizzes and discussion forms, that enhance learning in different fields and topics. The ideas in MOOCs have been described flexibly and can be scaled to make them desirable for the learners with the intention of widen their knowledge outside classroom.

However, this also has its drawbacks, which are more characteristic for MOOCs, namely, low rates of completion and the quality of interaction of learners. In a study done by Reich and Ruipérez-Valiente (2019) noted that MOOCs has made education more accessible but achieving high completion rates is a problem. At the same time, this capability of MOOCs to offer education to the underprivileged and with flexibility is the mark of the accessibility advancement.

- **Gamification**

Where ICT is concerned one of the popular approaches in learning and instruction is gamification, a process that involves the use of game design in non-game environments. Hence by introducing features such leaderboards, badges and rewards, learning is made a fun and engaging activity as seen in gamification. This has the advantage of tapping on the self-motivation of students and has them taking an active interest in the learning issues at hand.

The works of Hamari, et al. (2014) are also reassuring in aspect of efficiency of gamification approaches in increasing student motivation and engagement. Thus, gamification increases appreciation of learning and promotes students' engagement in the process. The use of game elements also does not only make the learning process enjoyable but also enables the student to solve problems handily and be persistent.

- **Virtual and Augmented Reality**

Reminding about the meaning of ICT we can state that Virtual Reality (VR) and Augmented Reality (AR) are some of the most modern and useful tools provided in education area. These technologies provide education with interaction options that the normal methods cannot provide and in turn facilitate learning in a manner that resembles real life situations. For instance, students can be taken to a historical event or an alien planet through VR, thus getting feel of concepts that are hard to teach. Likewise, AR can place digital information on top of the real environment which enhances the learning process to be more interactive and context-based.

PEDAGOGICAL IMPLICATIONS

The use of ICT together with AI requires new paradigms of learning that can enhance the practice of regular instruction. This technology also presents some features that enable one to go from a teacher-based model moving to a learner-based model in which the learner is much more involved in the learning process.

Shifting Roles of Educators

Encroachment into the routine functions such as grading assignments and disseminating content means that the part of the educators is changing gradually as AI and ICT tools are being embraced. In the past, the teacher was seen as a dispenser of knowledge, however, with the changing pedagogy, teachers are more learners' enablers. This shift enables the educators to require the students through individualized learning processes and encouragement of critical thinking as well as problem solving abilities.

According to Luckin et al. (2016) teachers indicate that they are able to offer more personalized support and achieve a greater embeddedness with the content. This way, the utilization of AI and ICT tools can help teachers improve their ability to maintain a personalized approach towards the students' needs in the course of the learning process.

- **Collaborative Learning**

Technology has also impacted collaborative learning where the capability of ICT tools as a means for collaborative learning through peer to peer interaction and cooperation. Numerous free and commercial applications and websites aid in the coordinated completion of assignments, discussions, sharing of resources and group projects enabling students to engage in projects regardless the geographical area of the location of the students. Thus, this approach benefits students' social and cognitive development as they learn to work in teams while communicating effectively as is expected of them in today's workplace.

- **Ethical Considerations**

When it comes to adopting the AI and ICT in education, the question of ethical issues comes in. Modern problems that should be addressed consist of data privacy, equity, and bias, and these aspects have to be supervised to prevent unfair use of these technologies.

- **Data Privacy**

The collection and analysis of students' data create a lot of issues concerning their privacy as well as security. As seen in the case of AI and ICT tools, the data on which these tools base personalized learning is critical in maintaining students trust and safety of students and must be protected adequately. To address these concerns it is requisite to apply strong data protections and follow ethical norms.

- **Equity**

Another important factor is the need to provide equal records as regards to the AI and ICT tools. Though, these technologies will play positive role in increasing the educational opportunities for the students but lack of equal facilities and infrastructures will make it worse and the existing gaps. Reducing the digital divide and helping underrepresented and disadvantaged students are two ways which can serve as a beginning in creating a more fair educational system.

- **Bias and Fairness**

The bias in the AI system is even worse if not controlled as the machines will just amplify the information fed to them. Hence, it remains critical to check the freshness of the algorithms used in automating support for students to eliminate discrimination among the learners. Taking these issues into perspective, it is important to find a way to solve them to ensure that fairness is obtained in educational technology. The issues are brought about by the use of educational technology thus it is important that constant research and ethical oversight is done to warrant fairness.

CHALLENGES AND FUTURE DIRECTIONS

However, there are still some challenges that are attached to the AI and ICT use in education. To overcome these challenges the concerted effort of educators and policymakers as well as technologists are called for.

- **Infrastructure and Access**

This seems to be one of the general obstacles, that is, the evident deficit of the infrastructure conducive to the development of AI and ICT. The digital divide remains an important factor which prevents that all students will be able to take advantage of these technologies. There is need to enhance infrastructure and make efforts towards affordability and enabling literacies towards bridging this gap.

- **Teacher Training**

The Review also reveals that to enhance the teaching learning process with the use of AI and ICT tools, adequate teacher training is needed. Sadly, most teachers are still pedagogy incompetent to make efficient use of technology in their teaching methodologies. To ensure that the teachers are in appropriate position to use AI, ICT tool and other tool effectively, the professional development programs and other support services are important.

- **Open Research Problems and Further Developments**

Despite the abundance of research in the use of AI and ICT in education, there are outstanding research gaps. Future studies should consider examining the durability of the impact of these technologies on learning results, and the manner in which the currently implemented approaches can be adapted to fit different classrooms in large scale manner with minimal additional expense.

More future research has to be directed towards the consequences of the use of AI and ICT toward student learning in the long run as well as in other emergent environments and settings. At the same time, studies of the further application of these technologies in various contexts of education can help in overcoming current difficulties and improve the interaction in education systems.

CONCLUSION

It is there evident that the integration of AI and ICT tools in education means a shift in a new way of pedagogy. These technologies have unique possibilities to increase differentiation, interest and inclusiveness of learning. But for AI and ICT to reach their full advantages it is important to take into consideration challenges that comes with it and the ethical issues that are associated with it.

Therefore, future research collaborations with educators, technologists, and policymakers will be vital in advancing the opportunities for addressing these challenges as well as enhancing the use of AI and ICT. It is therefore high time that we encouraged sustained learning, supported development of human capital and infrastructure, and thinking about ethic to enhance an landscapes that is responsive, equitable and effective.

The process of implementing AI and ICT in education has only started and it holds great opportunity to change the learning environment. When we learn right practices and are willing to always be a work in progress, then we will have one of the best, personal, fun and flexible learning environment in the future. By enhancing cooperation and creativity we are able to achieve the maximum positive result in deploying these technologies and build a better future for learners around the globe.

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From Vision to Reality: Achieving the Dream for a Green Planet

Mr. Jai Bhagwan Mishra
Scholar
Army Institute of Education
Greater Noida

Dr. Jyoti Tiwari
Assistant Professor
Army Institute of Education
Greater Noida

ABSTRACT

The growing environmental challenges faced by our planet have spurred a global movement towards sustainable development, often encapsulated in the vision of a “dream for green.” This concept encompasses a multifaceted approach to achieving environmental sustainability, economic viability, and social equity. It examines how governments, businesses, and individuals can contribute to this dream through the adoption of renewable energy sources, sustainable agriculture, eco-friendly urban planning, and conservation efforts. Additionally, the paper discusses the challenges associated with implementing green initiatives, such as economic barriers, technological limitations, and the need for global cooperation. Through an analysis of case studies and current research, this paper aims to provide a comprehensive overview of the pathways to realizing a sustainable future. This paper explores the theoretical foundations and practical applications of the “dream for green” initiative.

Objectives of this paper are as follows:-

- To study fundamental foundations of achieving a green planet.
- To study the role of Sustainable developmental goals in achieving green planet.
- To study the practical application towards the green planet.
- To identify the challenges to achieving the dream of green planet.

Through the use of secondary sources, this research paper will use a qualitative research methodology.

Keywords: Sustainable, Renewable, Climate change, Agriculture, Environmental leadership.

INTRODUCTION

The concept of a “dream for green” represents the aspirational goal of creating a sustainable and environmentally friendly world. As climate change, pollution, and biodiversity loss threaten the planet’s ecological balance, the urgency for sustainable practices has never been more critical. This paper aims to delve into the various dimensions of this green dream, exploring both the theoretical underpinnings and the practical steps necessary for its realization.

The “dream for green” is not merely an abstract ideal but a concrete vision that necessitates a comprehensive shift in how we live, consume, and interact with the environment. This vision involves a harmonious integration of technological innovation, policy reform, and individual responsibility to reduce our ecological footprint. By fostering a culture of sustainability, where renewable energy sources, waste reduction, and conservation efforts are prioritized, this dream can gradually become a reality. However, achieving this vision requires collective action and a fundamental rethinking of economic and social structures to align with environmental imperatives.

PURPOSE OF THIS PAPER

The purpose of this paper is to provide a detailed analysis of the various pathways to realizing a sustainable future, with a particular emphasis on understanding and evaluating the “Dream for Green” initiative.

OBJECTIVE OF THIS PAPER

- To study fundamental foundations of achieving a green planet.
- To study the role of Sustainable developmental goals in achieving green planet.
- To study the practical application towards the green planet.
- To identify the challenges to achieving the dream of green planet.

METHODOLOGY

This research paper will employ a qualitative research approach, utilizing secondary sources. This methodology aims to provide valuable insights into the multifaceted nature of evaluating inclusion in facilities, informing policymakers, facility managers, and stakeholders about effective approaches for promoting and assessing inclusion within diverse settings.

LITERATURE REVIEW

- *Brundtland Commission, 1987*, Sustainability is defined by the Brundtland Commission as meeting present needs without compromising the ability of future generations to meet their own.

- *Jacobsson & Lauber*, 2006, Countries like Germany and Denmark have made significant strides in adopting renewable energy, setting examples for others to follow.
- *Gehl*, 2010, Cities like Copenhagen and Singapore have implemented policies that prioritize environmental sustainability in urban development.
- *Stern*, 2007, concerns about the economic impacts of phasing out fossil fuels, particularly in regions dependent on oil and coal industries.
- *Pacala & Socolow*, 2004, Issues such as energy storage, grid integration, and the scalability of sustainable practices remain challenges that need to be addressed.
- *Evans*, 2016, Costa Rica is recognized as a global leader in environmental sustainability, achieving nearly 100% renewable electricity generation and implementing ambitious biodiversity conservation programs.
- *Gomiero, Pimentel & Paoletti*, 2011, Sustainable agriculture practices enhance biodiversity, soil health, and reduce the carbon footprint of food production.
- *Morris & Jungjohann*, 2016, Case study of Germany's Energiewende or energy transition
- *United Nations*, 2015, Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), and Climate Action (SDG 13)
- *UNFCCC*, 2015, Paris Agreement represents a significant step towards global climate action, but its success depends on the commitment and collaboration of all signatory countries.

CASE STUDIES

• Germany's Energiewende

Germany's Energiewende, or energy transition, is a prominent example of a nation pursuing the green dream through a comprehensive strategy to shift from fossil fuels to renewable energy. The program includes policies for increasing renewable energy capacity, improving energy efficiency, and phasing out nuclear power (Morris & Jungjohann, 2016). While the transition has faced challenges, such as grid stability and rising energy costs, it remains a leading example of national commitment to sustainability.

• Costa Rica's Environmental Leadership

Costa Rica is often cited as a global leader in environmental sustainability. The country has achieved nearly 100% renewable electricity generation and has implemented ambitious conservation programs to protect its rich biodiversity (Evans, 2016). Costa Rica's success demonstrates the potential for small nations to lead the way in sustainable development.

FINDINGS (RESULTS)

Theoretical Foundations

The idea of sustainability is rooted in the Brundtland Commission's definition, which emphasizes meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987). This principle underlies the "dream for green," which envisions a world where economic growth is decoupled from environmental degradation, and social well-being is achieved in harmony with nature.

The concept challenges societies to innovate and adopt practices that not only fulfill current demands but also preserve natural resources, ecosystems, and social fabrics for the future. It promotes a balance between economic development, environmental stewardship, and social equity. The "dream for green" extends this vision by advocating for a world where economic advancement and environmental health are not mutually exclusive.

It emphasizes the need for sustainable practices that reduce environmental impact while fostering social equity. This dream envisions cities powered by renewable energy, industries that operate within the planet's ecological boundaries, and communities that thrive in harmony with nature. By embracing sustainability, we can create a future where both people and the planet can prosper together, ensuring that the needs of all, both present and future, are met.

SUSTAINABLE DEVELOPMENT GOALS (SDGs)

The United Nations' Sustainable Development Goals (SDGs) provide a framework for achieving the dream for green. Goals such as Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), and Climate Action (SDG 13) directly align with the vision of a sustainable future (United Nations, 2015). These goals serve as a roadmap for governments and organizations to implement green policies and practices.

The SDGs encourage global cooperation, urging nations to work together in addressing critical environmental challenges. By setting measurable targets, the SDGs foster accountability and progress tracking, ensuring that efforts toward sustainability are consistent and impactful. Furthermore, the SDGs promote the integration of sustainability into various sectors, including agriculture, industry, and urban development, creating a holistic approach to environmental stewardship.

Incorporating these goals into national and local policies enables the transition towards more resilient and sustainable economies. By focusing on areas such as renewable energy, resource efficiency, and climate resilience, the SDGs empower communities to build sustainable livelihoods while safeguarding the planet for future generations. As nations continue to align their policies with these global objectives, the collective action towards a greener future becomes increasingly achievable.

Practical Applications

- **Renewable Energy:-** The transition to renewable energy sources, such as solar, wind, and hydroelectric power, is crucial for reducing greenhouse gas emissions and combating climate change. Countries like Germany and Denmark have made significant strides in adopting renewable energy, setting examples for others to follow (Jacobsson & Lauber, 2006).
- **Sustainable Agriculture:-** Sustainable agriculture practices, such as organic farming, agroforestry, and permaculture, contribute to the green dream by promoting biodiversity, improving soil health, and reducing the carbon footprint of food production (Gomiero, Pimentel, & Paoletti, 2011). These methods not only protect the environment but also enhance food security and rural livelihoods.
- **Agroforestry Initiatives:-** Promote agroforestry, where trees are integrated into agricultural lands, enhancing biodiversity, improving soil health, and providing additional income streams for farmers through the sale of timber, fruits, and nuts.
- **Sustainable Transportation Infrastructure:-** Invest in public transportation, cycling lanes, and pedestrian-friendly infrastructure to reduce reliance on cars, decrease emissions, and promote healthier lifestyles in urban areas.
- **Eco-Friendly Urban Planning:-** Urban areas are significant contributors to environmental degradation, but they also offer opportunities for sustainable development. Green cities, characterized by energy-efficient buildings, extensive green spaces, and sustainable transportation systems, are emerging as models of eco-friendly urban planning. Cities like Copenhagen and Singapore have implemented policies that prioritize environmental sustainability in urban development (Gehl, 2010).
- **Educational Programs:-** Schools and universities can introduce programs focused on renewable energy technologies, preparing the next generation to contribute to a green economy.
- **Expansion of Green Spaces:-** Urban planners can prioritize the development of parks, community gardens, and green roofs, which improve air quality, reduce urban heat islands, and provide recreational spaces for residents.
- **Local Food Systems:-** Encourage the development of local food systems, such as farmers' markets and community-supported agriculture (CSA), to reduce the carbon footprint associated with food transportation.

CHALLENGES TO ACHIEVING THE GREEN DREAM

Economic Barriers

The transition to a green economy often requires substantial upfront investment, which can be a significant barrier for developing countries. Additionally, there are concerns about

the economic impacts of phasing out fossil fuels, particularly in regions dependent on oil and coal industries (Stern, 2007).

Technological Limitations

While technological advancements are crucial for achieving sustainability, there are still significant gaps in the development and deployment of green technologies. Issues such as energy storage, grid integration, and the scalability of sustainable practices remain challenges that need to be addressed (Pacala & Socolow, 2004).

GLOBAL COOPERATION

Achieving the dream for green requires coordinated global efforts. However, differing national interests, economic disparities, and political conflicts often hinder international cooperation on environmental issues. The Paris Agreement represents a significant step towards global climate action, but its success depends on the commitment and collaboration of all signatory countries (UNFCCC, 2015).

CONCLUSION

The dream for green is both an urgent necessity and a realistic possibility. While significant challenges remain, the pathways to a sustainable future are becoming increasingly clear. Through the combined efforts of governments, businesses, and individuals, it is possible to achieve a world where economic growth, environmental health, and social well-being coexist in harmony. The examples of Germany and Costa Rica show that with the right policies and commitment, the dream for green can become a reality.

The journey toward a sustainable future is not without its hurdles, but the momentum is undeniable. Innovations in renewable energy, sustainable agriculture, and eco-friendly technologies are laying the groundwork for a world where prosperity does not come at the expense of the planet. Grassroots movements are also gaining strength, with communities around the globe demanding and creating change from the bottom up. This collective awakening is pushing us closer to a tipping point, where sustainable practices become the norm rather than the exception. However, the dream for green is both an urgent necessity and a realistic possibility.

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Empowering Girls Through Education: The Success of Government Policies in Delhi

Ms. Anchal Aggarwal
Assistant Professor
SCERT
New Delhi

ABSTRACT

The research paper focuses on the evaluation of the effectiveness of government intervention to enhance the enrollment of girl students in schools of Delhi and the future prospects. The educational system of Delhi has recorded enhanced Gross Enrollment Ratio (GER) for girls whereby the U-DISE+ for 2021-22 shows that Girl's GER is higher than that of Boys at various level of education. This achievement indicates that some policies at the central and state level have been implemented to reduce the gender disparities and enhance the gender sensitive education to every child.

The paper also explores how these policies have impacted the attainment of barriers to girls' education such socio cultural, economical and infrastructural challenges. It also looks at how monetary rewards, public health educational programs, and facility development have impacted on education for a girl child especially in the less privileged society. What makes the effectiveness of these policies evident is that in Delhi financial year 2020-21 enrollment rates for girls have not only achieved targets but in most cases girls enrollment is more than hundred percent which shows a healthy system that has got right re-enrollment, pupils retention and access ratio within a fiscal year.

However, the paper also sheds light on present day challenges that still surround the realization of high enrollment rates in improving education results and student retention especially in the higher levels of learning. Therefore, the study is a holistic review of the policy change process and efforts that need to be made in the future in order to improve girl child education in Delhi, based on both qualitative and quantitative analysis of the changes.

Key Words: Beti Bachao Beti Padhao (BBBP), Girls' Education, Government Policies, Gross Enrollment Ratio (ER), Sarva Shiksha Abhiyan (SSA).

INTRODUCTION

Girl child enrollment in schools has been one of the most important concern in reformation and policies in India for the past decades. However, Delhi has been one of the success stories with great progress in the provision of proper education needs and opportunities for the girl child. As can be seen from the above graphs, the GER for girls in Delhi has not only reached but in some cases slightly cross the GER of the boys at different levels of education. This shows a clear upward trend of the participation of girls in education system of Delhi, in connection with government intervention and other social factors.

The available national policies that have contributed to this growth include; BBBP, SSA, and the RTE Act for girls' education in Delhi, while at the state level, there is the Kanya Vidya Dhan Scheme. These programs aim at promoting education for girls, by making people aware of the importance of education for girls, offering financial incentives to parents to ensure that girls are taken to school, the construction of girls' only toilets, provision of school fees, uniforms and textbooks among others. These efforts why and wherein are particularly targeted towards the reduction of drop out rates and general retention of girls in schools.

Three other distal factors have also played a part in enhancing girls' enrollment in Delhi apart from policies: Delhi again experiences more highly developed school structures, greater availability of school facilities and stronger political action in the sphere of education, which has also worked to eliminate the gap of gender. There is also awareness that has hiked up awareness about the impacts of education to girls hence their education unlike other places where girls drop out from school, the city has relatively high literacy levels and relatively developed economy.

Amidst several of these is the fact that the enrollment rate for girls is now above 100 percent in most of the categories especially at the primary and upper primary levels. This is so because the respondents include children who are older than the age appropriate for their class levels, which is an indication that there are efforts in use to get out-of-school girls back to school. The effectiveness of these policies shows Delhi's willingness in working towards gender equity in education despite the following existing challenges; low retention rates of girl child through to the higher secondary classes and quality education delivery systems.

This paper will seek to examine whether these government policies have worked in enhancing the GER enrolment of girls and also look at the GER and discuss on general the socio-political and economic factors that have tinged this progress. Further, it precisely defines the barriers that remain and outlines the directions of improving girls' access to education at every level.

OBJECTIVES

- To analyze the impact of key government policies on the enrollment of girls at various levels of schooling in Delhi.
- To examine the Gross Enrollment Ratio (GER) data for girls in comparison to boys, to understand the extent of progress made in ensuring gender parity in education.

STATE AND NATIONAL POLICIES FOR GIRLS' ENROLLMENT

National policies with state specific policies, together, help in improving the enrollment, retention and achievement of girl students in Delhi besides addressing barriers related to gender disparities in the schooling system.

Delhi through the education policy aims at enhancing quality education to every child with special emphasis to the girls in a bid to solve the issue of gender parity. Some of these are construction and provision of separate toilets for girls, provision of free educational items such as uniforms and text books besides special projects aimed at improving learning opportunity of girls from poor background.

1. **Beti Bachao Beti Padhao (BBBP) Scheme (2015)**

The BBBP scheme focuses to reducing child sex ratio and increasing education of the girl child. It aims at changing the perception that society has towards girl child and promoting education and the status of the girl child through the use of awareness creation and community outreach programs. The components of this scheme are awareness programs, financial incentives and education of girls at all education levels. It also has programmes to enhance school structural development and female students' facilities among other projects.

2. **Sarva Shiksha Abhiyan (SSA- 2000)**

SSA is a high profile Programme of the Government of India to provide free and compulsory education to the age group of 6-14 years. It seeks to enhance access, persistence as well as quality of learning and teaching particularly for the vulnerable groups such as girls. Some of the reforms contained in this program include provision of social capital through infrastructure development such as construction of separate toilets for girl students, teacher capacity building, provision of free text books and fighting gender pandemonium in education. Sarva Shiksha Abhiyan is now upgraded in Samagra Shiksha.

3. **Right to Education (RTE) Act (2009)**

The RTE Act ensures education for all children in the age ranging from 6-14 years and has been established to focus on the quality aspect in the equity. It is an important tool that can be used in safeguarding education for all the children including the girl child. Education becomes a legal right, no child can be retained or expelled and special

consideration for children in need of care and protection including girls from economically weaker section forms the essence of this act.

4. National Scheme of Incentive to Girls for Secondary Education Act (2008)

NSIGSE offers financial compensation to economically needy girls who continue with their education beyond elementary classes. The key activities of this scheme are provision of scholarship for secondary education, emphasis on enrolment and eradicating drop out by girls in particular.

5. Kanya Vidhya Dhan Scheme (2004)

This is a state-specific programme that focuses on the promotion of girl's education with an emphasis on issues to do with financial assistance for girl's education especially to attend university. The major components of this scheme include scholarships and financial aid for girls particularly in the higher grades with an aim of increasing school dropouts and enhancing higher levels of education.

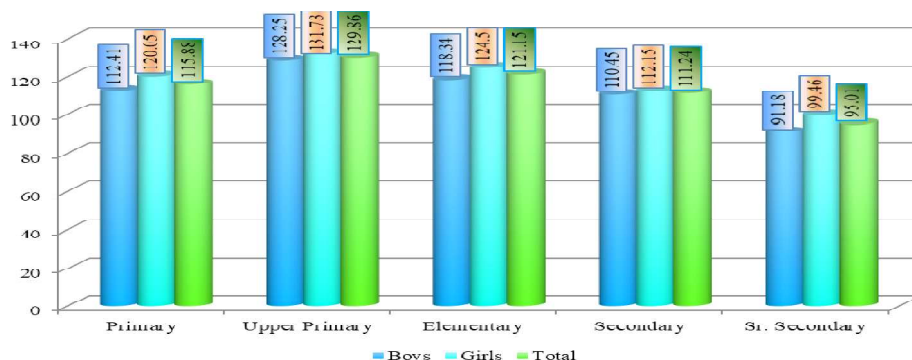
6. Delhi Government's Mission Buniyaad (2018)

This mission Launched to enhance students literacy and numeracy levels, Mission Buniyaad also to targeted the girl child so that she does not drop behind in the basics of education. It emphasizes on learning by increasing achievement through remedial lessons, special learning resources and qualified trainer for teachers together with concern for gender imbalance on education.

7. Sukanya Samriddhi Yojana (2015)

If there is a centrally sponsored scheme as in this case freeing of to promote savings and investment in education of the girl child, its operations in Delhi will have certain modifications in the overall structure of the state. Incentives for higher education, financial savings scheme where parents are encouraged to invest for girls' education in the long run are characteristic features of this scheme.

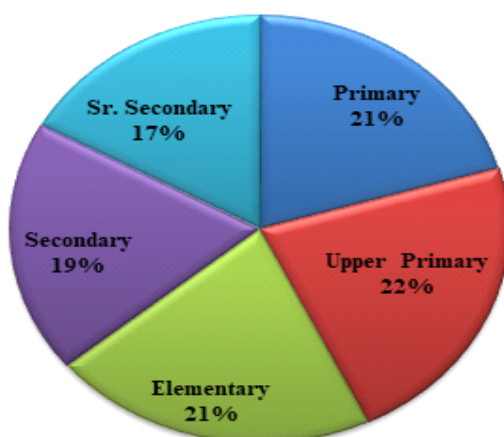
ANALYSIS AND FINDINGS



Source: U-DISE+ 2021-22

Figure 1: Gross Enrolment Ratio (GER) - Delhi (2021-22)

As the enrollment data of Delhi state show, India has made great progress towards meeting the goal of education for girls and gender equality. The latest statistics for GER for the current year 2021-22 of U-DISE+ also revealed that GIR is higher than the boy's GER for primary (120.05% for girls against 112.41% for boys), upper primary (131.73 % girls against 128.25% boys), secondary (112.15 % girls against 110.45 % for boys), and senior secondary levels. As illustrated in this trend this shows that government policy intervention has enhanced both enrollment and retention of girl child. Better school facilities, more overall enrollment in schools and GER for girls and most importantly financial incentives.



Source: U-DISE+ 2021-22

Figure 2: Gross Enrolment Ratio of Girls at different levels in school- Delhi (2021-22)

The data represented in the above figure provides the GER of girls by level of education in Delhi. In the primary level, the GER ratio is 120.05 which were higher than the official age cohort in this stage meaning that there is access to education by more girls. At the upper primary level the GER further rises to 131.73. The above figure shows that pass rate is higher at general level and it further increase in upper primary level and slightly increases at secondary level, which can be considered as good enrollment figure and might show better retention or some projects related to middle school girls' education. In the elementary level the GER is slightly low at 124.5 but is still quite high this indicates that although girls are dropping out of school at this phase overall access to education for girls is still high. But, as the girls join secondary education the GER reduces to 112.15 which are likely to indicate flow back or poor transition to the next classes or poor retention rates. The decline is even so steeper at the senior secondary level having a GER of 99.46, it crosses below 100 level and show a declining trend which depicts that the teenage girl is leaving her higher secondary education incomplete.

REASONS FOR INCREASED ENROLLMENT OF GIRLS IN DELHI

These are some of the reasons making a contribution to the high enrolment rates that are being recorded among girls and Delhi as an illustration that policies, infrastructural developmental and socio-economic enhancements do ensure the achievement on such objectives and goals as the gender parity in education is concerned.

1. Improved Infrastructure

Delhi as an urban terrain provides an enabling interface for improved infrastructure of educational institution. Government schools are located near people's homes and hence, students attend schools with less time used to travel. The construction of girls' toilets in schools, supply of free and quality uniforms and textbooks have assisted girls in attending and sustaining school.

2. Financial Incentives

Providing scholarships as an inducement for those education past primary level tends to bring down the drop-out rates and have the girls continue with education at tertiary levels. Financial incentives like Kanya Vidya Dhan Scheme comes as a helping hand for the families by off loading some of the economic burden towards the education of the girl child and for this reason parents come forward to make their daughters go to school.

3. Community Support and Engagement

The families through the efforts of NGO have embraced the need to educate girls hence more children are enrolled to school. Support from fellow communities and support systems have supplemented basic needs and motivated girls to go to school especially in areas that are not well endowed.

4. Socio-Economic Factors

The past few years have seen an influx of girl child in school going population in Delhi because of the better standard of living as compared to other parts of the country and easy access to educational resources. With the improvement in its economy coupled with raised literacy levels Delhi has become more friendly for education. Families with children especially those living in the urban areas tend to invest in education of their children including the female child.

5. Educational Programs and Interventions

Special education programs aimed at offering remedial lessons and additional teaching to the children; or girls especially have highly contributed to the enhanced enrolment and reduced drop-out rates.

CHALLENGES AND FUTURE DIRECTIONS

1. Retention and Dropout Rates

High enrollment rates can be attributed to numerous factors including the social trends, poverty being an economic factor is likely to lead to high drop out rates especially among girls in higher secondary education. Some families can be poor hence they tend to work and the girls drop out from school in order to generate income.

Teenage marriages are still the order of the day in some of the communities resulting in early dropout from school for the girls. But often for social reasons education is set aside even where there is laws that prohibit such conduct, girl may drop out of school.

Increasing the number of scholarships as well as other types of financial aid for students can actually assist in relieving as much economic strain on those families and further dropout rates. The special attention should be paid to providing financial aid to girls through targeting the financial assistance to higher education and vocational training. With this the socio-cultural barriers to education particularly for girls can be dealt with by enhancing the community participation. Engagement of economic value of education and encouraging family's economic status through community based programs can improve retention rates.

2. Quality of Education

Although there have been some improvements concerning enrollment, there are still concerns with regard to the quality of infrastructure. Lack of adequate school facilities including well equipped classrooms, schools libraries, laboratories etc may cause poor learning environment and hence poor quality of education in some schools.

This fact proves that the process of improving the quality of teaching should be continuous, so teachers need professional development. Lack and inadequate training can affect the quality of educational programs and more so the special needs that girls

may require to be addressed. Additional investments on schools' facilities are also necessary in order to ensure supportive learning environment. This covers such areas as; enhancing the quality of the physical environment in classrooms, provision of learning materials and general school physical environment.

3. Gender Bias and Socio-Cultural Barriers

People's mentality about girl's education may still be a problem especially in the developing or rural regions. These biases also act against the increase in the achievement of gender parity in education and may deter girl child from pursuing education. Sexism may remain prevalent, and hence education for boys may still be valued a little more as compared to that of girls. This may lead to negative impact on the opportunities provided for the girl child whereby there are very limited support and resources to ensure that the girl child completes her education without dropping out of school.

To overcome gender biases of discriminating against the girl child in education, there is the need to make awareness campaigns aimed at changing people's perception regarding the need to educate the girl child. Particularly, gender equality and the importance of education for girls and women should become the focus of programs. On the cultural level, therefore, legal frameworks and policy measures should be strengthened in order to avoid early marriages and to defend girls' rights to education. Compliance to existing policies and put in place policies that can advance education for girl can also be helpful.

4. Access to Higher Education

Although the participation of girls at the primary and secondary classes is high, accessing to higher education is still a nightmare. Some streams have very few colleges/universities for higher studies and girls from the below economic background have more problem to join higher studies. Lack of career information and guidance in the school setting can act as a barrier to the flow of information regarding the available career and college openings for girls hence making right decisions concerning the future difficult.

Availability and growth of institutions for higher learning especially at the remotest areas should be encouraged so as to favor those girls. There is need to ensure that scholarships and financial aid for the girls so as to enable them to further their studies. Improve the career guidance and counseling services being offered in schools since this will assist the girl child to make better decisions on her future. It is therefore important to avail to them career information, vocational training and education and training information at post-secondary levels.

5. Data and Monitoring Issues

Lack of accurate and complete data may become a factor useful in hampering the effective implementation and the evaluation of the policies made. Sustained social and

government support to girls' education may lack adequate gender disaggregated data especially in hard to reach areas thus creating a gap in the monitoring and evaluation of the progress and other challenges facing girls' education.

The data collection and monitoring methods prove a good way of getting correct data on enrollment, dropout, and performance. This will aid policy makers to take wise decisions and handle certain difficulties as well. Stemming from the findings above, it is suggested that conducting assessment and evaluation of educational programs and policies will assist in the identification of the existing problems or challenges and of them. Student, parents and educators' opinion may be valuable in future planning and implementing of interventions.

CONCLUSION

This study in relation to the effectiveness of the government policies on enrollment of girl students in Delhi claims that it has recorded a major progressive step towards the gender equality in education. GER data shed light on the fact that schemes like BBBP scheme, SSA and the RTE Act have gone a long way in improving the GER as well as the effectiveness of enrollment and attendance by girls in different levels of education. Girls have higher GER than boys in primary, upper primary, secondary and senior secondary stage which clearly exaggerate the overall policy and strategy implementation curtain. Other related findings include the urban infrastructure of Delhi. The above mentioned financial incentives and active socio-political encouragement have made such positive trends possible. However, there are still some barriers today; the problem connected with the quality of education and the high level of early school leaving. There is need to make further progress in order to maintain the gains, improve on education standards and empower the girl child through her education cycle. Thus, facing these challenges and continuing the path of 'Girl Child Education' Delhi can act as an example to show how gender equality in education can be empowered effectively to ensure that every girl child should get a proper and quality education and be provided with the tools necessary to succeed. To build on this momentum, it is crucial for policymakers and educational authorities to address the existing gaps in quality education. This involves investing in teacher training programs, improving classroom resources and implementing effective monitoring systems to ensure that schools meet educational standards. Moreover, community engagement plays a pivotal role in sustaining these advancements. By involving parents and local organizations in the educational process, a supportive environment can be created that values girls' education. Awareness campaigns highlighting the importance of retaining girls in school can challenge societal norms that often prioritize boys' education over that of girls. In addition to addressing qualitative issues, ensuring safe learning environments is essential. Many families hesitate to send their daughters to school due to concerns about safety and harassment. Implementing strict policies against such behaviors and enhancing security measures within schools will foster an atmosphere

where girls feel secure and are encouraged to pursue their studies without fear. Furthermore, expanding access to technology will also play a key role in bridging gaps especially relevant as we navigate more digital forms of learning post-pandemic. Providing resources like computers or tablets alongside internet connectivity can greatly enhance learning opportunities for girl students.

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Adoption of Climate Change: A Study of the Climate Change and its Impacts on Human Behaviour and their Lifestyle in Indian Perspectives

Ms. Aarushi

Department of Psychology
IGNOU
New Delhi

Mr. Suraj Kumar

Associate Professor
Department of Education
Lingaya's Lalita Devi Institute of Management & Sciences
New Delhi

ABSTRACT

In the present era, climate change has emerged one of the significant pressing and complex challenges confronting humanity and the planet. It plays a crucial responsibility in forming the future of Earth, affecting ecosystems, economies, and communities worldwide. Just as the heart is crucial to sustaining human life, the climate acts as the lifeblood of our planet Mother Earth, crucial for sustaining the delicate balance that supports all living organisms. However, this balance is being increasingly disrupted by human activities, leading to severe and widespread consequences. It is one of the humanity's most urgent and complex challenges, profoundly impacting ecosystems, economies, and communities worldwide. As the planet's climate serves as the lifeblood of Earth, its disruption by the human activities invent an alarming rise in the frequency & intensity of natural disasters, affecting nearly half the world's population. These climate-related disasters threaten global health, with dire projections of increased mortality and economic burdens, particularly in vulnerable regions. Yet, hope lies in reducing greenhouse gases and adopting sustainable practices across key sectors, which not only mitigate climate impacts but also bring significant public health benefits. The fight against change of the climate is a fight for the future, requiring global cooperation, innovative solutions, and a steadfast commitment to sustainability to ensure a liveable world for future generations.

Keywords: Climate change, Natural disasters, Ecosystems, Vulnerable communities, Health impacts, Greenhouse gases, Global cooperation, Sustainability etc.

INTRODUCTION

The objective of this study is mainly to focus on the result of climate change on human survival and their daily life behaviour. It is literally said that private and government organizations, whether at local or international level, all have their particular role in reducing the increasing effects of climate change. If we talk about the global level, many countries are still holding serious talks for the change in climate and adoption. The emphasis is on the serious use of natural resources and reduced carbon use. If we talk about climate change, it will not only change human life but has affected the entire ecosystem. If we talk about human existence, climate change has affected every aspect of the living being such as health, behaviour, individual, psychological, economical and social.

OBJECTIVE

To study the adoption of changing the climate and its effect in human behaviour and their lifestyle in Indian perspective by examining adaptation strategies and highlighting some of the case studies that demonstrate their effectiveness.

METHODOLOGY

This research uses the qualitative significant, which are primarily based on the study and analysis of standards in climate change. It synthesizes the work of current scholars on climate change & impact on the lifestyle and behaviour of humans.

CLIMATE CHANGE IN INDIAN PERSPECTIVE: AN OVERVIEW

Climate change is an crucial issue of concern for India, as its geographical location is dynamic, population is large and being an agricultural country it is dependent on climate-sensitive areas like agriculture, where intensity of climate can also be seen, from rural areas to mountains and deserts every venue has its own importance. Apart from agriculture, absence of excessive resources has become a matter of great concern, due to shortage of resources the demand in markets has increased from before. The temperature has increased a lot due to which inflation in India has risen to its highest level. Not only the environment is getting damaged due to climate change but a major change is also witnessed in the lives of all living beings living in the ecosystem. During the period of development, due to domestication, humans are playing with nature for their personal interests.

CLIMATE CHANGE IMPACTS INDIA FROM VARIOUS PERSPECTIVES:

Changing Weather Pattern: Due to change of the climate, India has witnessed a boost in temperature in the last few decades. Every year, some degree of increase is being made in the

temperature, due to which fearful drought and extreme cold are being witnessed. This trend is expected to continue. The waves of more intense and severe heat have increased significantly in both urban & rural areas. The Indian monsoon, which is important for agriculture, is rapidly becoming unpredictable. Owing to the change in the pattern of monsoon, it is becoming extremely difficult to predict the weather. In some areas, there is severe drought and, in some areas, there is flood. Human life has been greatly impacted by the monsoon change. In the past, the pace of natural disasters has also increased due to the climate change and its harmful effects are also visible.

Impact in Health: Recent research has discovered that the increase in temperature on the global level is increasing the self-insurance of hepatic stroke and heat related health problems. Vector-borne changes in the climate have expanded the range of vector-borne diseases like malaria and dengue fever, which have directly impacted human life, giving rise to additional public health challenges.

Policy and Adaptation: India is working actively in both international climate change discussions and national policies to deal with climate change and its dire consequences. Initiatives like the National Action Plan on Climate Change (NAPCC) focus on mitigation and adaptation strategies and efforts include improving agricultural practices, enhancing disaster preparedness, investing in innovative projects and developing water resource-efficient infrastructure.

Biodiversity and Ecosystems: Life diversity is under threat due to changing climate patterns and habitat destruction. One of the private causes of the change of climate is excessive cutting of forests and nowhere this, poisonous smoke and liquid waste coming out of factories enter our atmosphere and water system through water and air. These contain excessive number of harmful gases like carbon and methane which is creating problems like global warming due to which climate is changing a lot. Species adapted to specific climate are getting extinct and changes in temperature and rain affect the ecosystem. Due to which, there is a possibility of seeing convert in the distribution of species and in the inoperative of the historical system.

ADAPTING TO CLIMATE CHANGE IN THE INDIAN CONTEXT: CHANGES IN HUMAN BEHAVIOUR AND LIFESTYLE

The climate change is having a deep impact on human behaviour and living conditions all over the world. Its effects are expansive which affect daily life, social structures and even various aspects of mental health like weakening of memory and not being able to fully develop mentally. If we talk of social areas, then wide-ranging changes are visible in human behaviour. The inclusion of feelings like loneliness and selfishness can be seen in humans in many ways.

Cultural and Social Norms: If we talk about the Indian context, the culture here is leaning towards the eternal nature. The life of humans was dependent on these aspects, but today

all these have disappeared somewhere, but now cultural changes are becoming more prominent by accepting few of the past events and giving importance to environmental responsibility. In this, awareness is being raised about the issues like re-cycling, reducing poverty and conservation of resources and they are being included in our culture.

Changing Lifestyle: People are rapidly investing in climate-friendly homes and are also becoming aware of its importance and adopting new methods like better insulation, energy-efficient system and homes with better security. Inspiration is also growing towards household construction practices. There is a commute in the sources of energy like renewal of solar lights for bright and pure energy, along with that, the use of energy-efficient tools and practices for reducing carbon footprints is increasing. People are becoming aware of green energy through various activities, this change can be seen in every area like electric vehicles have now replaced fuel run vehicles, solar energy is being used in large amount in different types of factories and industries.

Effect on Economy System: To reduce the accomplishment of climate change, some industries are directly impacted by climate change. If we talk from the perspective of examples, agriculture is also impacted by the changing climate, which can lead to changes in crop yield and demand for agricultural produce. On the contrary, green industrial and innovative energy sectors are expanding and due to climate change, the frequency and severity of natural calamities are increasing and facilities like insurance are increasing. If we talk about climate change in today's time, it has made the life of humans extremely busy. According to the changing times and needs, humans are adjusting themselves to this situation. Due to the feeling of increasing security of life, humans have started adopting facilities like insurance.

Social Behaviour: Climate change, serious weather events, increase in sea levels and many environmental stresses are contributing to the migration of people from rural areas. If we talk about migration then it is not limited from one place to another, lack of resources and gradual destruction of rural areas is also a major reason for it, due to this there is internal migration within the countries and even international migration. In affected areas, there is often a shift to community-based resilience efforts, which include local emergency preparedness and stabilization initiatives.

Water conservation and Management: Rain Water Storage: Be applied to commercial results of climate change in the past few decades is the adoption of rain water storage systems in homes and communities to reduce water shortage and the benefits arising from it have enhanced agriculture and water conservation and have also helped a lot in stabilizing the underground water system. Efficient water use: Systems like drip irrigation in villages and efficient water connections in homes can help reduce water wastage. Promoting awareness about the crucialness of water conservation and encouraging practices like efficient utilization of water and preventing wastage of water not only in Indian society but also in the behavioural changes taking place at the global level.

Urban development and Infrastructure: The effect of climate change is also visible in the enclosure of infrastructure development as the construction and construction of such building and infrastructure structures is being promoted which can face the natural disasters like floods, earthquakes and extreme weather events like hot winds strongly and can minimize the losses caused due to these calamities. To reduce excessive heat due to climate change, to reduce heat loss and to improve air quality, it is extremely important to develop and protect urban greenery and rural areas and to increase the crucialness of utility. In this era of darkness, human health and mental problems are also greatly affected. According to research done in the last few years, life of humans has been greatly impacted by darkness and living time of humans is gradually decreasing. To reduce emissions and obesity, and for human health and well being, this problem can be reduced to a great extent by promoting public transport, cycling and pedalling instead of using private vehicles.

Changing Agricultural Practices: For the purpose to deal with the changing rain pattern and temperature due to changing climate, there is a requirement to change the pattern of sowing crops consisting owed to the weather. The crops which are dependent on the weather should be adjusted properly and the crops grown in extremely dry weather need more protection. Currently, due to the changing environment, pollution can be seen on every level, be it land pollution or air pollution, and water pollution is affecting every area. If we talk about land pollution then the land production is getting weakened due to chemical farming which is happening in excessive amount, apart from this, it is necessary to give options like crop cycle, organic farming, and reducing dependence on chemical fertilizers and pesticides. Use of technologies such as weather forecasting to take informed decisions regarding planting and harvesting for better development of agricultural crops so that it can be protected in a better way and the losses affect by climate change can be reduced

CONCLUSION

The study of climate change & effects on human behavior and living conditions from the Indian environment highlights the important difference. As India is facing the challenges arising out of the change of climate, whose effects can be seen both negative and positive on various aspects of human life, it becomes transparent that both individual and collective reactions are important for adapting to the effects. The research highlights topics such as increasing awareness about the crucialness of sustainable practices among Indian citizens, use of natural resources, promoting green energy, water conservation and promoting organic farming, which is inspired by visible changes in climate pattern, increasing frequency of natural events and increased sense of environmental responsibility. The findings indicate a positive shift towards adopting environmentally friendly practices, but socio-economic constraints, green technologies, lack of access to reduced carbon use and inadequate policy support remain significant obstacles. This suggests a contradiction that while grassroots movements and local initiatives are promoting behavioral change.

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Challenges Faced by School Teachers and Students Using ICTs for Effective Teaching and Learning During Covid-19 Pandemic

Mr. Mohd Aquib Shah
Scholar
JMI
Delhi

ABSTRACT

Information and communication technologies (ICTs) are crucial for effective teaching and learning because they encourage, optimize, enhance, and assist knowledge acquisition. ICT- based learning has undergone a complete metamorphosis because of Covid-19. This study sought to examine the difficulties that teachers and pupils had when using ICT in the teaching and learning process during the epidemic, followed by recommendations. Systematic examination of the qualitative findings revealed that there were a number of issues that both communities had to deal with, including issues with electricity, internet accessibility, a lack of ICT infrastructure, the high cost of ICT equipment, a lack of ICT expertise and training, the ability to manage classrooms, and more. Rather than relying just on financial support, nations must create new policies and methods to encourage the use of ICT in the teaching-learning process.

Keywords: ICTs, school teachers, students, teaching and learning, COVID-19 pandemic, challenges, adoption, attitudes.

INTRODUCTION

Learning is a lifelong and continuous process that plays a paramount role for both teachers and students. The acquisition of necessary skills and knowledge through learning enables individuals to achieve their desired goals in life. However, the COVID-19 pandemic, considered one of the biggest crises faced by education systems and humanity in recent times, has significantly impacted this process.

As schools were forced to close due to the pandemic, the education process was interrupted, and children had to transition to home-based learning. This shift to the “new normal” has affected educational and teaching practices, leading to various challenges. COVID-19, the first pandemic caused by a novel coronavirus, was first identified in Wuhan, China, in late 2019 and rapidly spread worldwide, causing a serious acute respiratory syndrome (WHO, 2020). Beyond being a public health issue, this pandemic has had far-reaching effects on all aspects of life, with the education sector being one of the most significantly impacted domains (OECD, 2020).

According to estimates from UNESCO, 195 nations had nationwide school closures in effect during the first week of April. A total of 1,598,099,000 students, or roughly 91.3 percent all students globally, have been impacted by such countrywide suspensions (UNESCO, 2020). Through the usage of ICT, courses have been transitioned from offline learning to online learning. Remote learning resulting from the COVID-19 pandemic’s forced school closings differs greatly from well-planned online learning. It is not just online teaching-learning; it is Emergency Remote Teaching (ERT), Emergency Remote Learning (ERL), or Pandemic Pedagogy (Rahiem, 2020).

TEACHING AND LEARNING USING ICTS DURING COVID-19 PANDEMIC

During COVID-19 Pandemic the suspension of classes had an impact on was the teaching-learning process. The long-standing chalk-talk teaching method has been replaced by e-learning, which makes extensive use of ICT to address digital media, thanks to this pandemic. The educational environment has changed as a result of its intervention, and providing high-quality instruction at all levels now presents more obstacles. This technological revolution is still in the experimental stage. It is still challenging to adjust to a full online learning environment as a quick paradigm shift and, in the long run, create a robust educational system (Shettar et al., 2021).

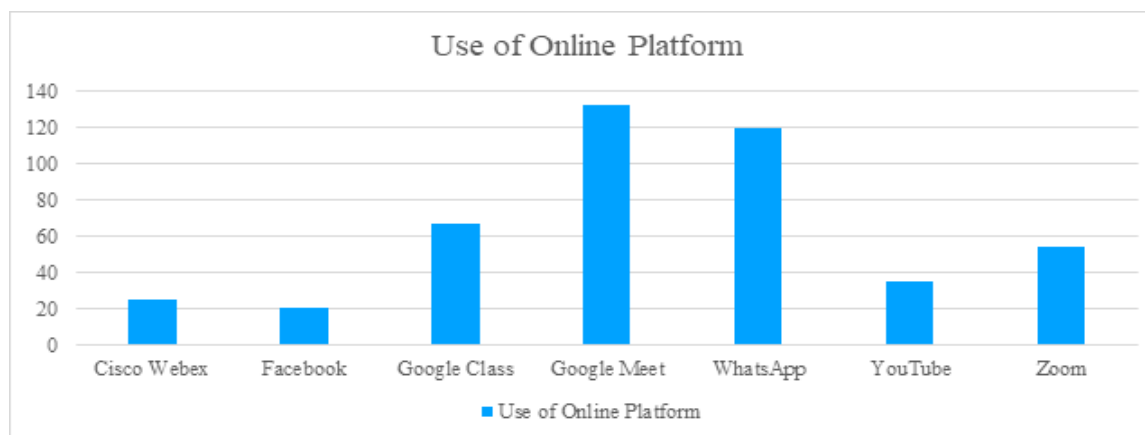
Teachers began employing the media or techniques that they were accustomed to and found handy. They lacked adequate preparation, and many had no idea how to adapt their current learning strategy for online learning. Even though the circumstances were not perfect, the children persisted and the teachers were determined to do their best. During COVID-19 pandemic, blended learning—a combination or mixing of conventional and unconventional methods—was used remotely. The use of many educational strategies, methods, techniques, or media is known as a blended learning method. Blended learning combines traditional face-to-face learning with ICT tools, as well as traditional lectures and web-based content.

Learning during the emergency remote learning period had paradoxical effects, simultaneously offering flexibility but also presenting challenges for students. They utilized a range of digital platforms for their studies, including e-books, e-journals, PDF files, messaging apps like WhatsApp, educational videos, online meeting tools, social media,

learning management systems, search engines, podcasts, and presentation software (Boonmoh et al., 2022). While ERL provided more time for personal pursuits, students also struggled to effectively manage their time. Technology-related issues, such as access to devices and the internet, emerged as significant problems encountered during the online learning process. A study conducted by Rahman (2021) in Assam explored the predominant online platforms used for teaching and learning during the COVID-19 pandemic.

Use of online Platform (N=132)

Online Platform	Frequency	Percentage
1. Cisco Webex	25	18.93
2. Facebook	21	15.90
3. Google Class	67	50.76
4. Google Meet	132	100
5. WhatsApp	120	90.90
6. YouTube	35	26.51
7. Zoom	54	40.90



METHOD

This study examined the technological challenges faced by both teachers and students in using ICTs for teaching and learning during the COVID-19 pandemic, and explored ways to overcome these challenges. The researcher conducted a comprehensive literature review of

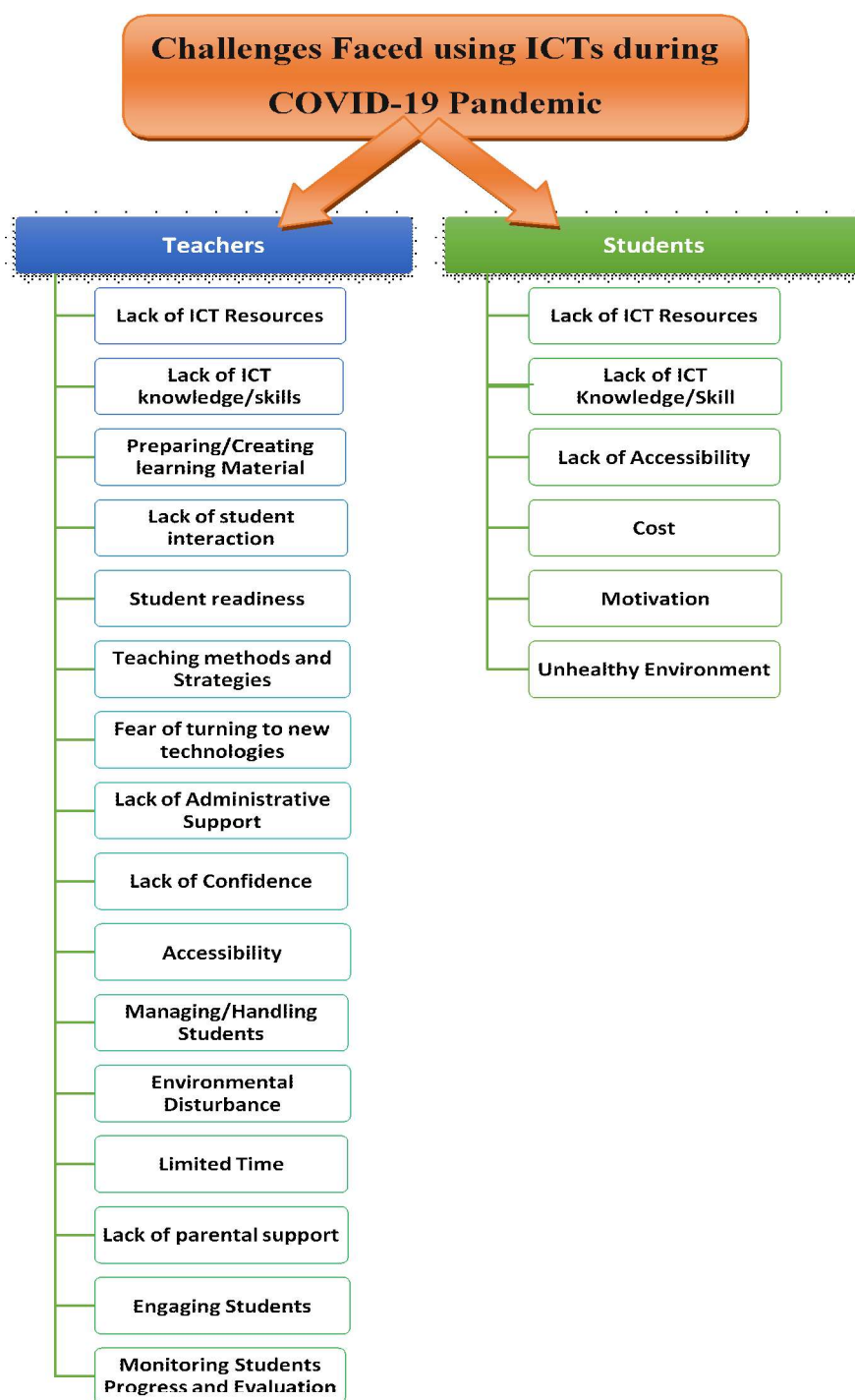
studies published from 2020 to 2022, primarily in India and other countries, to illustrate the technological challenges encountered while studying online during the pandemic. Even though the pandemic is over, many nations, including India, the USA, Australia, and Indonesia, have given importance to online education in their national document, making it crucial to identify and address these concerns for the future.

The study employed a narrative review framework to provide a thorough analysis of the challenges faced by school teachers and students in using ICTs for effective teaching and learning during the COVID-19 pandemic. The researcher carried out an extensive literature review, examining primary databases and manually searching reference lists for relevant studies published within the past three years. The search criteria focused on the difficulties, issues, and challenges encountered by school teachers and students when utilizing ICTs during the pandemic, as well as broader topics related to ICT in education and teaching and learning through ICTs. The review followed specific inclusion criteria, considering peer-reviewed studies, conference proceedings, and book chapters written in English. The researcher followed a two-step process to select the studies, first screening titles and abstracts, and then reviewing the full texts. The final selection consisted of 23 studies that met the quality standards and were carefully analyzed to draw useful conclusions. The paper synthesizes the major challenges faced by teachers and students in using ICTs for teaching and learning during the COVID-19 pandemic.

CHALLENGES FACED USING ICTS DURING COVID-19 PANDEMIC

The challenges and difficulties of using ICTs for teaching and learning during COVID-19 have attracted a lot of attention from researchers and educators. The literature sources showed that the use of ICTs for teaching and learning during COVID-19 was mostly about delivering information rather than facilitating active and meaningful learning, meaning that teachers used digital technologies to pass on information rather than to encourage learning (Pozo et al, 2021). The literature sources also pointed out various obstacles that prevented the effective use of ICTs in education, such as: lack of technology policy, equipment, infrastructure, and training; slow internet speed, load shedding, and technical issues; lack of online teaching experience and skills; and lack of assessment and feedback methods.

Apart from these, some of the major findings from various studies have been discussed below separately, such as the challenges faced by school teachers and the challenges faced by students using ICTs in their teaching and learning during COVID-19.



CHALLENGES FACED BY TEACHERS

Lack of ICT Resources

Online education requires a robust internet infrastructure and cutting-edge technologies. Most teachers continued remote teaching using their own equipment and internet services. The quality of available Internet equipment varies greatly between regions within a country, country, and between urban and rural areas. Because of poor internet services and a dearth of technological tools in many areas, teachers cannot maintain the required and sufficient level of remote instruction. Teachers must create a non-synchronous substitute that don't need a quick internet connection to fill the aforementioned gap.

Due to absence of laws governing distant learning and the lack of requisite technology for learning at home, at least 463 million children worldwide still cannot acquire an education (UNICEF, 2020). The dearth of infrastructure in remote learning is cited as a significant factor in several research. Most educators feel it is their duty to create alternatives for students who are failed to attend distance education and to continue their education. Despite the danger of spreading COVID-19, teachers occasionally even employ techniques like offline learning or home visits. The public school system, they claimed, made it difficult for the school's most important indicators, namely teachers and students, by lacking basic equipment (Robosa1 et. al., 2021).

Lack of ICT knowledge/skills

Most teachers are unable to use technological tools in the online teaching-learning process due to a lack of training opportunities and access to ICT tools. ICT utilization by teachers in the classroom was unusual since most of them were reluctant to embrace cutting-edge technology. Teachers must be given specialized training in using modern technology, which must be incorporated into the classroom. Instructors require some basic training in order to develop the abilities, know-how, and attitudes necessary for the efficient use of computers to enhance learning. Lack of training was one of the top three issues with instructors implementing ICT in the educational setting.

Teacher training is a multifaceted endeavor that requires careful consideration to ensure its effectiveness. During fundamental teacher preparation programs, there are designated hours for instruction, pedagogical guidance, skill development, and ICT integration. Alongside teaching teachers how to leverage ICTs, it is crucial to provide them with comprehensive pedagogical training as well.

Accessibility

This was one of the key difficulties of using ICT. Software that was unreliable, pirated, frequently changed, and strenuous to use successfully in the teaching-learning process might be found in the computer laboratories. It was found that most of the time, teachers and students had to share the few available ICT resources with other teachers. ICT tools could

not be accessible for a number of reasons, such as a lack of ICT equipment, software, or other required resources within the schools and colleges. It might be the result of various problems, such as a bad system for organizing the resources, poor technology, a lack of personal access for teachers, bad software, or flawed software.

Preparing/Creating learning Material

During the Covid-19 epidemic, teaching and learning had to transition from a conventional method to a modern mode using ICTs, such as online learning or e-learning. The fact that teaching and learning began at home made it necessary for teachers to provide digital learning materials for their children, which was a difficult undertaking for those with limited ICT resources, expertise, and inadequate internet connectivity. Kamal and Illiyan (2021) found that creating digital content for students was one of the challenges that teachers in online classes had to deal with during Covid-19.

Teaching methods and Strategies

The COVID-19 pandemic has caused a significant shift in schooling not just in India but worldwide. Due to this many countries have suspended all in-person activities, including education. Colleges, secondary schools, and elementary schools in a number of countries have used the online learning approach during the pandemic. Consequently, teachers and students have had to quickly modify their teaching methods, regardless of their prior understanding of or preparedness for online education. Throughout the pandemic, school teachers were compelled to use methods and tactics that they were unfamiliar with, which was problematic for them. As a result, in order to comply with mandated remote education, teachers must adapt their pedagogical strategies (Shagiakhmetova et al. 2022).

Students' readiness

Student readiness is the ability to learn with confidence, willingness and an open mind, in addition to the necessary foundational abilities. The pandemic situation in the education sector put a great deal of mental strain on both the students and the teachers. Due to a lack of resources and expertise, online teaching has become a significant issue for the majority of teachers as well as students (Baral et al. 2021). It was challenging to communicate with students using technology, and several of them seemed disinterested in their studies. The biggest challenge, according to a high school instructor, was motivating every kid to participate and finish their projects. It was challenging to determine whether students were actively participating in the lesson, even if they joined a live session. Teachers also believed that many students weren't prepared for distance learning (Francom et al. 2021).

Lack of student interaction

Teachers found it challenging to keep in contact with students, keep up a dialogue with them, encourage them to participate in class, and hold them accountable for their learning. Using technology to interact with pupils proved difficult, and some of them seemed uninterested in their studies (Francom et al., 2021). Similarly, Kamal and Illiyan (2021)

discovered that most teachers encountered a “lack of interaction with students” in e-learning, which made it difficult for them to identify the psychological and emotional requirements of their students, communicate with them, and effectively allay their fears.

Fear of turning to new technologies

The integration of computers into teaching and learning was significantly influenced by instructors’ attitudes and perceptions towards these technological tools. Numerous studies have found that instructors’ opinions regarding educational technologies are key predictors of their successful adoption and use in instructional settings. In reality, the manner in which instructors employ computers in educational institutions, as well as their beliefs about the effectiveness of computer-aided instruction, are largely dependent on their perspectives towards these emerging technologies. According to extensive research, one of the major obstacles to the successful integration of ICTs in education is instructors’ resistance or aversion to adopting these new technological advancements.

Afonso et al., (2020) argues that incorporating new technology into learning environments necessitates change and that various teachers will approach this transformation in various ways. According to him, it is crucial to consider different teacher attitudes because they have an effect on how teachers behave in the classroom. According to An et al., (2021), teachers’ attitudes toward the use of technology are critically dependent on their comprehension of how it would enhance their instruction and students’ learning. Despite believing that there is more than enough technology available, it was found that instructors did not think that their use of technology in the classroom was rewarded, reinforced, or encouraged.

Lack of Administrative Support

Any institution’s performance or achievement of its goals depends greatly on the management. Without administrative support, a school or institution cannot be successful, and good teaching and learning cannot occur. It was noted that there was a dearth of administrative assistance for both teachers and students during COVID-19. However, they have also increased the burden for both teachers and students, which has presented difficulties for them. This lack of support included a lack of communication, teaching support, and training on new technology (Pressley et.al 2022).

Lack of Confidence

A key factor hindering teachers’ adoption of information and communication technologies in their instruction is a lack of confidence. The study investigated the underlying reasons for teachers’ low confidence in their ICT skills, revealing that many instructors’ “fear of failure” leads them to underestimate their own ICT proficiency, consequently causing them to feel anxious about utilizing such technologies in front of students. Limitations in teachers’ ICT understanding, according to Khanna & Prasad (2020) cause them to feel uneasy about using ICT in the classroom and subsequently lack confidence in doing so.

Managing/Handling Students

With the COVID-19 pandemic forcing the closure of schools and universities and isolating its participants socially, distance learning was the only way to continue the learning process. There were many students in each class, which made managing and lesson planning more difficult. Teachers have to wait longer while students use teleconferencing software to join the class (Ansi et al. 2021). Robosa et.al (2021) revealed that the majority of teachers faced considerable obstacles, including a shortage of supplies, how to deal with kids, and workloads and submissions that increased stress and burnout. Most teachers in public schools were restrained by the emergence of the digital era. Due to insufficient resources, it is difficult for them to communicate with students, provide a good learning environment, and carry out specific duties for the students electronically.

Limited Time

According to Habibu et al. (2012), although many teachers are proficient in using computers in the classroom, they only seldom do so due to a lack of time. It was necessary to switch from classroom instruction to online or e-learning during COVID-19. Many new apps are being used by teachers, and they all need a fast internet connection to function. Teachers find it difficult to explain a topic clearly and effectively in a short amount of time because of inadequate internet connectivity and lack of accessibility. In addition, many teachers talked about not having enough time to prepare for online learning (Francon et al. 2021).

Environmental Disturbance

When the COVID-19 pandemic hit, schools and universities were forced to close owing to social isolation, forcing teachers to conduct classroom instruction from their homes. Given the circumstances in which they lived, unwanted noises, and inadequate internet connectivity, teachers found it extremely difficult to teach from home. Heshan and Wanniarachchi (2022) revealed that one of the challenges they faced by teachers was the environmental disturbance. They found that 50% of the instructors who responded to the study claimed to have issues with their home environments, such as loud noises, etc. These issues must be lessened among teachers as well.

Lack of parental support

The support of one's parents is really beneficial. Parents think that the standard of the educational experiences for their kids has improved as a result of the use of online learning. When parents realized that the educational institution where their kids attend will be introducing an online teaching-learning system, they were overjoyed. Parental support dwindled after more than a month. Since most parents were at work and younger children required parental assistance with live class activities like technology setup or typing, it was not possible to have every student online all day. The fact that parents cannot utilize contemporary technology or distant learning programs is another issue. Francom et al., (2021) revealed that teachers observed a lack of parental support and involvement. Since

many children lacked the motivation or readiness for online learning, it was challenging for teachers to connect with and engage them without parental support. Many teachers found it difficult to get in touch with parents or realized that they couldn't give their students the help they needed.

Engaging Students

Teaching-learning can be effective and fruitful only when the communication between the teacher and the student is good and the teacher engages the students in learning activities. Teaching and learning had to rely on remote learning during the COVID-19 pandemic, and both instructors and students began adopting online tools like Google Meet, Zoom, and WhatsApp. Aidoo (2022) found that teacher had to face difficulty in engaging students in online discussions. Thosare (2021) argued that when the teachers introduce Educational Technology through proper methods, it keeps the students engaged. It improves their knowledge retention, improves collaboration.

Monitoring Students Progress and Evaluation

Effective teaching and learning require consistent assessment and evaluation of student performance. Assessments should encompass learning, grading, and student motivation. Robust evaluation techniques can provide valuable insights into student learning, enabling educators to ascertain what students have learned, how well they have grasped the content, and where they have faced difficulties. During the COVID-19 pandemic, a majority of teachers reported encountering various challenges in their work, such as the abrupt need to transition from in-person to remote instruction, difficulties in effectively utilizing online software, and challenges in differentiating instruction for diverse learners. Additionally, they faced obstacles in evaluating students online and conducting online examinations (Kamal and Illiyan, 2021). Similarly, Sindhya (2022) noted that the assessment of students and the efficacy of the online education they received during this period were the most pressing issues encountered. On one hand, there were no robust methods for conducting transparent online evaluations for the general public, while on the other, students frequently engaged in examination malpractice when participating in online assessments conducted by their teachers.

CHALLENGES FACED BY STUDENTS

Lack of ICT Resources

It was difficult for many teachers and pupils to study online from home. Not everyone had access to technology that allowed for full learning. Due to incompatible equipment or devices, they had trouble accessing some of the software or programs such as Zoom and Google Meet, etc. during their teaching-learning sessions. Since many gadgets used by teachers and students were incompatible with online teaching and learning programs, many of them had to be shared with other family members, especially by students from lower socioeconomic backgrounds (Raheim, 2022).

Lack of ICT Knowledge/Skill

The majority of educational institutions worldwide closed as a result of COVID-19 and switched all of their traditional educational operations to virtual courses. It was crucial for both teachers and students to understand ICTs and know how to effectively use them for teaching and learning. It was difficult for students to learn remotely online. Few people had access to gadgets that allowed them to learn fully, and those who did had trouble using Zoom or other programs used by lecturers while they were studying (Raheim, 2022).

Lack of Accessibility

One of the biggest obstacles to online teaching-learning during the COVID-19 pandemic period was access to the Internet, electricity. While some from remote areas didn't even have access to the internet, they had to deal with bad internet service (Raheim, 2022). Moreover, Sahito et al. (2022) supported that common problems that students have encountered, including losing internet or data while enrolled in an online course, having trouble loading content, and having poor audio or video during lectures as a result of slow internet. Sometimes, even the students themselves were unable to access the internet at home. Students frequently needed to travel a short distance to nearby locations in order to acquire appropriate and strong signals to attend their classes and finish their homework online.

Cost

It was also a challenge faced by both teachers and students that they had to pay much amount of money to get internet access from internet service providers or they had to buy internet plans which were costly and also, they get limited internet data. As online teaching learning consumes more internet data, they had to buy again and again. Due to the incompatibility of the devices, both the teachers and students especially students had to face issues in teaching-learning process which led them to buy new gadgets and it was not easy for students who come from lower economic backgrounds (Aidoo et al. 2022).

Motivation

Motivation plays very important role in effective teaching-learning process. A motivated student learns and understands the concepts very easily and quickly. Due of the social isolation caused by the COVID-19 Pandemic, face-to-face instruction had to give way to distant or online learning. As a result, both teachers and students had to deal with a number of challenges, such as a lack of ICT resources, poor ICT usage skills, poor internet connection, and high levels of stress that made it difficult to motivate learners (Shagiakhmetova et al. 2022).

Unhealthy Environment

The current pandemic situation in the education sectors put a great deal of mental strain on both the students and the teachers. Due to a lack of ICT resources and expertise, this online teaching and learning has become a significant issue for the majority of teachers and students.

The biggest barriers to a disrupted teaching and learning process are technical problems, sharing devices with siblings and family members, and an uncomfortable environment such as bad noises and improper home environment (Baral et al. 2021).

RECOMMENDATIONS

For information and communication technologies in education to be fully adopted and integrated, both teachers and students must have adequate access to the necessary hardware, software, digital resources, and network. In addition, teachers should be provided with sufficient opportunities to prepare instructionally relevant technological tools in advance. Furthermore, teachers should be offered elaborate training in the utilization of digital technology for purposes of teaching and learning, coupled with regular hardware and software updates to maintain the respective infrastructure. Finally, the government should offer continued and equal funding and support for all schools, including those that may be technologically disadvantaged, such as schools with unstable internet connectivity and those lacking the essential digital tools and equipment.

Despite the challenges associated with remote instruction and communication, teachers must remain strong in their motivation and commitment to the process of educating the student. In order to promote the full incorporation of ICT in the process of teaching and learning, the government should develop new policies and strategies that closely guide the process. These should encompass close monitoring and provision of appropriate guidance for student learning, regular parent-teacher communication, a limited number of students with an appropriate teacher-student ratio, a blend of learning in the teaching process for safe learning, resource sharing among teachers, and manageable content coverage. In addition, effective learning largely relies on transparent online assessment platforms. Ultimately, teachers' abilities to appropriately adapt to and utilize their technology will highly facilitate their function as successful online and hybrid teachers. As such, it is essential for teachers to familiarize themselves with these online pedagogical practices, thus adequately fulfilling their role as educators.

LIMITATIONS

This study mainly focused on analyzing the technological challenges faced by both schoolteachers and students while using information and communication technologies (ICTs) for teaching and learning during the COVID-19 pandemic. The review encompassed studies conducted in India and outside India from 2020 to 2022.

CONCLUSION

In conclusion, this paper examined the challenges that teachers and students encountered when using ICT to facilitate an efficient teaching-learning process during the Covid-19

pandemic. The difficulties faced by both communities were identified as inadequate ICT resources and skills, high internet service costs, students' readiness and motivation, accessibility, a lack of student interaction, an unhealthy home environment, a lack of administrative and parental support, monitoring students' progress and evaluation, etc. The study made the following recommendations based on its findings: sufficient funding for ICT programs, the provision of ICT facilities, and the supply of reliable electricity, internet services, training to use ICTs for effective teaching-learning, administrative and parental support should be provided to both teachers and students, teachers should motivate learners and proper monitoring of students' progress and transparent evaluation should be made.

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Climate Change Education and Awareness: Strategies for Schools and Communities

Ms. Asha Kumari

Scholar

*Army Institute of Education,
Greater Noida*

Ms. Khushboo Kumari

Scholar

*Army Institute of Education,
Greater Noida*

Mrs. Kriti Guleria

Assistant Professor

*Army Institute of Education
Greater Noida*

ABSTRACT

With the growing urgency of climate action, educating the public and fostering awareness are essential for building climate-resilient societies. The study begins by assessing current practices in climate change education, identifying strengths and weaknesses in existing strategies, and highlighting the challenges faced by educators and community leaders. Through a comprehensive analysis, the research identifies successful approaches, including the integration of climate topics into school curricula, experiential learning opportunities, teacher training, and community outreach programs. The study also emphasizes the crucial role of local governments, NGOs, and media in promoting climate awareness. By promoting best practices and encouraging community engagement, the study aims to enhance climate literacy and empower individuals to take action against climate change. The findings contribute to the development of more inclusive and impactful strategies, supporting the global effort to mitigate environmental impacts and achieve sustainability goals.

Keywords: Climate Change Education, Public Awareness, School Curriculum Integration, Community Outreach.

INTRODUCTION

Climate change is an urgent global issue, with far-reaching consequences that impact ecosystems, economies, and communities worldwide. As the effects of climate change become increasingly evident, the role of education in fostering awareness and action is paramount.

Schools and communities are uniquely positioned to cultivate climate literacy, empowering individuals to make informed decisions and take meaningful action.

Integrating climate change education into school curricula and community programs is not just beneficial—it is essential for preparing future generations to confront the environmental challenges ahead. Research shows that when students are educated about climate change, they are more likely to engage in pro-environmental behaviors and advocate for sustainable practices (Anderson, 2019). Moreover, community-based initiatives can amplify the impact of school-based education, fostering a culture of environmental stewardship across all age groups (Hossain & Salem, 2021).

This article will explore various strategies for enhancing climate change education and awareness in schools and communities, drawing on best practices and case studies from around the world.

BACKGROUND INFORMATION

A. OVERVIEW OF CLIMATE CHANGE AND ITS GLOBAL IMPACT

Climate change, characterized by significant alterations in global climate patterns, is primarily driven by anthropogenic activities such as the burning of fossil fuels, deforestation, and industrial emissions. These activities have led to an increase in greenhouse gases in the atmosphere, resulting in global warming and disrupted weather patterns. The impacts of climate change are far-reaching and multifaceted, affecting ecosystems, economies, and human health across the globe. For instance, rising global temperatures contribute to the melting of polar ice caps and glaciers, leading to sea-level rise and increased flooding in coastal regions (IPCC, 2021). Additionally, the frequency and severity of extreme weather events, including hurricanes, droughts, and heatwaves, have escalated, posing significant challenges to agriculture, water resources, and biodiversity (NASA, 2022). Vulnerable populations, particularly in developing countries, are disproportionately affected by these changes, exacerbating social inequalities and hindering sustainable development (World Bank, 2020). The global nature of climate change underscores the need for coordinated international efforts to mitigate its impacts and promote adaptation strategies.

Importance of education and awareness in addressing climate change

Education and awareness are crucial in addressing climate change as they empower individuals and communities with the knowledge, skills, and attitudes needed to understand the causes and consequences of climate change, and to take informed action. Education fosters climate literacy, enabling people to grasp complex environmental issues, make sustainable choices, and advocate for effective policies (UNESCO, 2019). By integrating climate change into educational curricula, students are equipped not only with scientific knowledge but also with the critical thinking skills necessary to analyze environmental challenges and develop innovative solutions (Anderson, 2019).

Awareness campaigns play a complementary role by reaching broader audiences beyond the classroom, promoting public understanding, and motivating behavioral change. These campaigns can mobilize communities to adopt sustainable practices, support climate policies, and participate in local and global initiatives aimed at reducing greenhouse gas emissions (Hossain & Salem, 2021). Ultimately, education and awareness are foundational to building a society that is both informed and proactive in mitigating the impacts of climate change.

B. OBJECTIVES OF THE STUDY

1. To assess current practices of climate change education.
2. To explore effective strategies for climate change education and raising awareness in schools and communities.
3. To explore Challenges and Barriers in raising awareness in schools and communities.
4. To enhance Community Engagement climate change education.

C. RESEARCH QUESTIONS

- What are the current approaches to climate change education?
- How can schools and communities effectively raise awareness about climate change?

D. SIGNIFICANCE OF THE STUDY

The role of education in fostering climate-resilient societies

Education plays a pivotal role in fostering climate-resilient societies by equipping individuals with the knowledge, skills, and attitudes necessary to adapt to and mitigate the impacts of climate change. A climate-resilient society is one that is capable of anticipating, preparing for, responding to, and recovering from climate-related disruptions. Education contributes to this resilience in several key ways.

Firstly, education enhances climate literacy, enabling individuals to understand the science behind climate change, its potential impacts, and the importance of sustainable practices (UNESCO, 2019). By incorporating climate change education into curricula, schools and universities can raise awareness about environmental issues and promote a culture of sustainability. This foundational knowledge is critical for developing informed citizens who can make decisions that reduce their carbon footprint and support climate adaptation measures.

Secondly, education fosters critical thinking and problem-solving skills, which are essential for innovation in climate adaptation and mitigation strategies. Through experiential learning, students can engage in projects that address real-world environmental challenges, such as designing energy-efficient buildings, developing sustainable agricultural practices, or participating in community-based conservation efforts (Anderson, 2019). These experiences not only build technical skills but also encourage collaborative problem-solving, which is crucial for addressing the complex and interconnected issues posed by climate change.

Furthermore, education promotes social equity and inclusion, which are vital components of climate resilience. Vulnerable populations, such as those in low-income communities, are often the most affected by climate change. Education can empower these communities by providing them with the knowledge and resources needed to adapt to changing environmental conditions and to participate in decision-making processes (World Bank, 2020). This inclusive approach ensures that all members of society have the opportunity to contribute to and benefit from climate resilience initiatives.

Lastly, education serves as a platform for advocacy and leadership in climate action. By cultivating environmental stewardship and leadership skills, education can inspire individuals to become advocates for climate policies and to lead initiatives that promote sustainability at the local, national, and global levels (Sterling, 2020). These leaders play a crucial role in mobilizing communities, influencing policy, and driving the systemic changes needed to build climate-resilient societies.

Thus, education is a fundamental tool in fostering climate-resilient societies. It builds the necessary knowledge, skills, and values to address the challenges of climate change, while also promoting equity and empowering individuals to lead in climate action.

LONG-TERM BENEFITS OF CLIMATE CHANGE AWARENESS IN MITIGATING ENVIRONMENTAL IMPACTS

The long-term benefits of climate change awareness are substantial in mitigating environmental impacts, as awareness serves as the foundation for informed decision-making, sustainable practices, and collective action. When individuals and communities are well-informed about the causes and consequences of climate change, they are better equipped to take proactive measures that reduce their environmental footprint and support the global effort to combat climate change.

Firstly, climate change awareness promotes the adoption of sustainable behaviors, which significantly contribute to the reduction of greenhouse gas emissions. As people become more aware of the environmental impact of their daily activities, such as energy consumption, transportation, and waste production, they are more likely to adopt eco-friendly practices. For example, awareness campaigns and educational programs have been shown to increase the use of renewable energy, reduce energy consumption, and encourage recycling, all of which help to lower carbon emissions over time (UNEP, 2021).

Secondly, climate change awareness fosters innovation and the development of green technologies. An informed public is more likely to support and invest in research and development of sustainable technologies, such as electric vehicles, energy-efficient appliances, and carbon capture systems. These innovations not only reduce the environmental impact of human activities but also create new economic opportunities and drive the transition to

a low-carbon economy (IEA, 2020). The widespread adoption of green technologies is essential for achieving long-term climate goals and reducing the overall environmental impact of industrial and commercial activities.

Moreover, climate change awareness strengthens community resilience to environmental impacts. Communities that understand the risks associated with climate change, such as rising sea levels, extreme weather events, and biodiversity loss, are better prepared to implement adaptation strategies. These strategies may include building climate-resilient infrastructure, adopting sustainable agricultural practices, and preserving natural ecosystems that provide critical services such as flood control and carbon sequestration (IPCC, 2021). By enhancing community resilience, climate change awareness helps to mitigate the long-term impacts of environmental changes and protect vulnerable populations.

Furthermore, widespread climate change awareness can influence policy decisions at the local, national, and global levels. An informed electorate is more likely to support policymakers and leaders who prioritize environmental protection and climate action. This can lead to the implementation of stronger environmental regulations, the expansion of protected areas, and increased funding for climate adaptation and mitigation projects (UNFCCC, 2022). Over time, these policy changes can result in significant reductions in environmental degradation and help to stabilize the global climate.

Thus the long-term benefits of climate change awareness are manifold, encompassing the promotion of sustainable behaviors, the advancement of green technologies, the enhancement of community resilience, and the influence on policy decisions. By fostering a deep understanding of climate change and its impacts, awareness initiatives play a crucial role in mitigating environmental impacts and ensuring a sustainable future for generations to come.

LITERATURE REVIEW

Anderson, A. (2019). "Climate Change Education for Sustainable Development: An Assessment of Student Knowledge and Attitudes". This study found that students who received climate change education demonstrated higher levels of climate literacy and were more likely to engage in pro-environmental behaviors. The research emphasized the importance of integrating climate change education across various subjects to foster a deeper understanding among students.

Sterling, S. (2020). "Sustainable Education: Re-visioning Learning and Change". Sterling advocates for a transformative learning approach in climate education, where the focus is on developing critical thinking and problem-solving skills. This approach helps students challenge existing paradigms and promotes the adoption of innovative solutions to environmental challenges.

Hossain, M., & Salem, A. (2021). "Community Engagement in Climate Change Education: A Pathway to Environmental Sustainability". The authors highlight the role of community-based education initiatives in amplifying the impact of school-based programs. They found that community engagement, through workshops and awareness campaigns, significantly increases public knowledge and fosters a culture of environmental stewardship.

Monroe, M. C., et al. (2019). "Identifying Effective Climate Change Education Strategies: A Systematic Review of the Research". This systematic review identified the most effective strategies for climate change education, including experiential learning, inquiry-based learning, and professional development for educators. The study also noted the challenges faced by educators, such as a lack of resources and training, which can hinder the effective delivery of climate education.

Beck, S., & Marlow, C. (2020). "The Politics of Climate Change Education: Discourses of Skepticism and Denial in Schools". Beck and Marlow explored the political and cultural challenges in implementing climate change education. They found that skepticism and denial of climate change can create significant barriers to integrating climate topics into school curricula, particularly in regions where climate change is politically contentious.

Stevenson, K. T., et al. (2018). "The Influence of Personal Beliefs on Climate Change Awareness and Action among Youth". This study examined the influence of personal beliefs on climate change awareness and found that students with higher climate literacy were more likely to engage in actions that support sustainability. The research underscores the importance of addressing personal beliefs and values in climate education to encourage meaningful behavioral change.

METHODOLOGY

Research Design- The researchers adopted the qualitative approach based on the secondary sources.

FINDINGS AND DISCUSSION

A. Analysis of Current Climate Change Education Practices

Strengths and weaknesses of existing strategies

Current climate change education practices encompass a range of strategies aimed at enhancing climate literacy and fostering proactive behaviours among students and communities. These practices are influenced by various factors, including regional educational policies, available resources, and pedagogical approaches.

Strengths of Existing Strategies

1. Integration into Curricula:

Many educational systems have integrated climate change into science and environmental studies curricula. This integration ensures that students gain a

foundational understanding of climate science and its implications (UNESCO, 2019). This approach helps to raise awareness from an early age and embeds climate education into a broader context of environmental stewardship.

2. Experiential and Inquiry-Based Learning:

The adoption of experiential and inquiry-based learning methods has been shown to significantly enhance student engagement and understanding of climate change (Sterling, 2020). Projects such as community-based sustainability initiatives, energy audits, and hands-on experiments make learning more relevant and actionable, encouraging students to apply their knowledge in real-world contexts.

3. Community-Based Initiatives:

Community engagement efforts, including public workshops, environmental campaigns, and partnerships with local organizations, extend the impact of climate education beyond schools (Hossain & Salem, 2021). These initiatives help to raise public awareness and foster a culture of sustainability within communities, creating opportunities for students to connect their learning with community action.

4. Development of Educational Resources:

The creation of a variety of educational resources, such as online tools, interactive simulations, and curriculum guides, supports teachers in delivering climate change education effectively. These resources provide valuable materials and strategies for engaging students and facilitating discussions on climate-related topics.

Weaknesses of Existing Strategies

1. Inconsistent Implementation:

The depth and quality of climate change education vary widely across different regions and educational systems. In some areas, climate change is treated as a supplementary topic rather than a core component of the curriculum (Monroe et al., 2019). This inconsistency leads to disparities in climate literacy among students and limits the overall effectiveness of educational efforts.

2. Lack of Teacher Training and Resources:

Many educators report inadequate training and resources for teaching climate change (Monroe et al., 2019). This lack of support can result in a superficial treatment of the topic or the reliance on outdated materials. Professional development programs and up-to-date resources are crucial for empowering teachers to deliver high-quality climate education.

3. Political and Cultural Barriers:

The politicization of climate change and cultural resistance can hinder the implementation of effective climate education. In some regions, climate science is

contested, leading to resistance from educators and policymakers and the presentation of climate change alongside scientifically unsupported viewpoints (Beck & Marlow, 2020). This undermines the credibility of climate education and creates confusion among students.

4. Limited Focus on Action and Advocacy:

While current strategies often emphasize knowledge acquisition, there is less focus on developing students' skills for climate action and advocacy. Effective climate education should not only inform but also empower students to take meaningful actions and engage in advocacy efforts (Sterling, 2020). Strategies that integrate action-oriented components can help bridge the gap between knowledge and behavior.

B. Effective Strategies for Schools

1. Integration of Climate Change into School Curricula

Integrating climate change into school curricula involves embedding climate science and sustainability topics across various subjects, ensuring that students encounter these issues throughout their education rather than as isolated lessons.

Strategies:

- **Cross-Disciplinary Approach:** Incorporate climate change topics into multiple subject areas, including science, geography, social studies, and mathematics. For example, math lessons can involve analyzing climate data, while social studies can explore the socio-economic impacts of climate change (UNESCO, 2019).
- **Curriculum Frameworks:** Develop and adopt comprehensive curriculum frameworks that include climate change as a core component. This ensures that all students, regardless of their specific courses, receive a consistent and thorough education on the subject (Anderson, 2019).
- **Curriculum Resources:** Utilize and update educational resources and textbooks that include current climate science and its implications. Incorporating multimedia resources, such as documentaries and interactive simulations, can enhance understanding and engagement (Hossain & Salem, 2021).

2. Experiential Learning Opportunities (e.g., Field Trips, Projects)

Experiential learning opportunities involve hands-on activities that allow students to engage with climate change issues in real-world contexts. This approach helps deepen understanding and fosters practical skills.

Strategies:

- **Field Trips:** Organize visits to local environmental sites, such as nature reserves, recycling centers, or renewable energy facilities. Field trips provide students with firsthand experiences and practical insights into how climate change affects their community (Sterling, 2020).

- **Projects and Simulations:** Implement project-based learning where students work on climate-related projects, such as developing sustainability plans for their school or conducting energy audits of their homes. Simulations and role-playing activities can also help students understand the complexities of climate policy and adaptation strategies (Monroe et al., 2019).
- **Community Partnerships:** Collaborate with local organizations and experts to provide students with real-world problems and solutions. These partnerships can offer mentorship, resources, and opportunities for students to engage in meaningful environmental projects (Hossain & Salem, 2021).

3. Teacher Training and Resources for Climate Change Education

Effective climate change education depends on well-prepared teachers who have access to up-to-date resources and professional development opportunities.

Strategies:

- **Professional Development:** Provide teachers with regular training on climate change science, pedagogy, and resources. Workshops, online courses, and seminars can help educators stay informed about the latest research and effective teaching strategies (Sterling, 2020).
- **Teaching Resources:** Develop and distribute high-quality teaching materials, including lesson plans, activity guides, and digital resources. Resources should be aligned with curriculum standards and offer practical guidance on integrating climate change topics into lessons (UNESCO, 2019).
- **Support Networks:** Establish support networks and communities of practice where teachers can share experiences, discuss challenges, and exchange ideas related to climate change education. These networks can provide ongoing support and foster collaboration among educators (Beck & Marlow, 2020).

C. Effective Strategies for Communities

1. Community Outreach Programs and Public Awareness Campaigns

Community outreach programs and public awareness campaigns aim to educate the public about climate change, promote sustainable practices, and encourage community-wide actions.

Strategies:

- **Workshops and Seminars:** Organize workshops and seminars on climate change topics, such as energy conservation, waste management, and sustainable living. These events can provide practical tips and foster discussions about local climate impacts and solutions (Hossain & Salem, 2021).
- **Public Events:** Host public events like climate fairs, clean-up drives, or tree-planting days to engage community members actively. These events not only raise awareness but also create opportunities for hands-on involvement (Beck & Marlow, 2020).

- **Educational Materials:** Distribute brochures, flyers, and fact sheets on climate change and sustainability. These materials can be made available at community centers, libraries, and local businesses to reach a broad audience (UNESCO, 2019).

2. Role of Local Governments and NGOs in Fostering Awareness

Local governments and non-governmental organizations (NGOs) play crucial roles in promoting climate change awareness and implementing community-based initiatives.

Strategies:

- **Policy and Planning:** Local governments can develop and implement policies that support sustainability and climate resilience. Examples include incentives for renewable energy adoption, waste reduction programs, and green building standards (Hossain & Salem, 2021).
- **Collaborative Projects:** NGOs often partner with local governments to carry out climate-related projects. These collaborations can involve initiatives such as community gardens, public transportation improvements, or environmental education programs (Beck & Marlow, 2020).
- **Grants and Funding:** Local governments and NGOs can provide grants and funding opportunities for community-based climate projects. Financial support can help communities implement innovative solutions and expand the reach of their climate awareness efforts (Sterling, 2020).

3. Engagement Through Media, Technology, and Social Platforms

Media, technology, and social platforms are powerful tools for reaching and engaging a wide audience with climate change information and campaigns.

Strategies:

- **Social Media Campaigns:** Utilize social media platforms to run awareness campaigns, share information, and mobilize community action. Engaging content, such as infographics, videos, and personal stories, can increase visibility and impact (Leiserowitz et al., 2020).
- **Online Platforms and Apps:** Develop and promote online platforms and apps that provide resources for climate education, track individual carbon footprints, or facilitate community climate actions. These tools can offer interactive and personalized experiences (Sterling, 2020).
- **Media Partnerships:** Partner with local media outlets to feature climate change stories, interviews with experts, and updates on community initiatives. Media coverage can help amplify messages and reach a broader audience (UNESCO, 2019).

CONCLUSION

Incorporating effective strategies for enhancing climate change education is crucial for equipping individuals and communities with the knowledge and skills needed to address the urgent challenges posed by climate change. The integration of climate change into school curricula ensures that students develop a comprehensive understanding of the issue from an early age. Experiential learning opportunities, such as field trips and community-based projects, provide practical, hands-on experiences that deepen students' engagement and connection to climate action. Teacher training and access to high-quality educational resources are essential for empowering educators to deliver effective climate education.

At the community level, outreach programs and public awareness campaigns play a significant role in raising consciousness and encouraging sustainable behaviors. Local governments and NGOs are pivotal in fostering awareness and implementing initiatives that support climate resilience. Utilizing media, technology, and social platforms further amplifies the reach and impact of climate education efforts, engaging diverse audiences and promoting widespread action.

Policy recommendations such as integrating climate change into national curricula, investing in teacher training, and supporting community-based projects provide a roadmap for strengthening climate education. Addressing challenges such as inconsistent implementation, lack of resources, and political resistance is vital for maximizing the effectiveness of these strategies.

By adopting and advancing these strategies, societies can better prepare individuals to understand, respond to, and mitigate the effects of climate change, fostering a more informed and proactive global community. Ensuring that climate change education is comprehensive, accessible, and action-oriented will contribute significantly to building a sustainable future.

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Sustainable Development in Education: Integrating Global Goals and Building a Future-Oriented Curriculum

Ms. Monalisa Mandal
Scholar
Army Institute of Education
Greater Noida

Ms. Raina Banerjee
Scholar
Army Institute of Education
Greater Noida

Dr. Azkia Khan
Assistant Professor
Army Institute of Education
Greater Noida

ABSTRACT

Sustainable development in education represents a critical, evolving concept that aligns with the global imperative to create a more equitable and environmentally responsible society. This paper delves into the integration of Sustainable Development Goals (SDGs) and Millennium Development Goals (MDGs) within educational frameworks. By conducting a comprehensive historical analysis, the paper traces the origins and evolution of sustainability in educational contexts, providing a nuanced understanding of how educational practices have shifted to incorporate sustainability principles. The paper underscores the significance of embedding sustainability into educational programs, policies, and institutional practices. It examines how the SDGs and MDGs have influenced educational strategies, exploring the ways in which these global frameworks have guided the development of curricula, pedagogical approaches, and institutional reforms. The analysis reveals that while there has been notable progress in incorporating sustainability into education, substantial challenges persist. Among the key findings is the observation that achieving education that is inclusive, universally accessible, sustainable, and equitable remains a formidable challenge. Despite advances in policy and practice, disparities in educational access and quality continue to hinder the realization of these goals. The paper identifies several barriers, including insufficient resources, inadequate policy frameworks, and a lack of cross-sectoral collaboration, which impede progress toward a more sustainable educational system. In response to these challenges, the research proposes a series of strategic recommendations aimed at enhancing the integration of sustainability into education. One of the

primary recommendations is the need for strengthened cross-sectoral collaboration. By fostering partnerships between educational institutions, governments, non-governmental organizations, and the private sector, it is possible to create a more cohesive approach to sustainability in education. The paper also advocates for policy interventions that address the systemic issues affecting educational equity and access, such as targeted funding for underserved communities and the development of inclusive educational practices. Furthermore, the research highlights the importance of embedding sustainability into educational curricula at all levels. By integrating sustainability topics into standard educational frameworks, students can be better equipped to address global challenges and contribute to sustainable development. The paper calls for the development of comprehensive sustainability education programs that are adaptable to diverse educational contexts and that emphasize both theoretical understanding and practical application. In conclusion, the paper contributes to the ongoing discourse on sustainable development in education by presenting a detailed analysis of current practices and proposing actionable strategies for improvement. It emphasizes the necessity of aligning educational practices with global sustainability goals and the crucial role of collaborative efforts in achieving these objectives. By addressing the identified challenges and implementing the proposed recommendations, it is possible to advance towards a more inclusive, equitable, and sustainable educational system that supports the broader aims of sustainable development.

Keywords: Sustainable Development, Education, SDGs, MDGs, Curriculum, Policy, Inclusion, Cross-sectoral Cooperation.

INTRODUCTION

Sustainable development, a comprehensive framework designed to meet current needs without compromising the ability of future generations to meet their own needs, has become a focal point of global discourse. Its principles extend to different sectors, where education stands out as a crucial mechanism to promote sustainability. Education serves not only as a means of imparting knowledge, but also as a means of forming values, attitudes and behaviors essential to adopt a sustainable lifestyle. This research paper investigates the integration of sustainability in educational systems, tracing its historical evolution, evaluating the current landscape and proposing strategies for future improvements. The shift from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs) represents a paradigm shift in international priorities, with a significant emphasis on education. The MDGs, which focused on addressing fundamental issues such as poverty, hunger and disease, laid the foundation for the SDGs, which take a more holistic and interconnected approach. Among the 17 SDGs, Goal 4 stands out: "Ensure quality, inclusive and equitable education and promote lifelong learning opportunities for all". This goal emphasizes the central role of education in the promotion of sustainable development, emphasizing the need for educational systems to be inclusive, equitable and consistent with the principles of sustainability. Historically, the integration of sustainable development in education has evolved in several stages. At the end of the 20th century, the concept of "Education for Sustainable Development" (ESD) began to take shape, influenced by major international conferences such as the Earth

Committee of 1992 in Rio de Janeiro and the 2002 World Conference on Sustainable Development. Johannesburg. These events highlighted the need for educational reforms to respond to environmental, social and economic challenges in a more integrated way. Educational frameworks are beginning to incorporate sustainability principles, with an emphasis on raising awareness of environmental issues and promoting sustainable practices among students. In recent years, the focus has moved beyond simple awareness to include more holistic approaches that integrate sustainability into curricula, teaching methods and institutional practices. Educational institutions are increasingly seen as catalysts for social transformation, with the ability to influence not only individual behavior but also broader social norms and practices. This change reflects a growing awareness that sustainable development cannot be achieved without fundamental changes in the functioning of educational systems and their goals. Current efforts to integrate sustainability into educational systems are multidimensional. Schools and universities adopt sustainable practices in their operations, such as reducing energy consumption, minimizing waste and implementing green infrastructure. The programs have been redesigned to include topics related to sustainability, including climate change, resource management and social equity. Teachers also use innovative teaching methods, such as project-based learning and interdisciplinary approaches, to engage students in real-world sustainability challenges. Despite these advances, significant challenges remain. There is often a gap between the ideals of sustainability and the practical realities of educational settings, such as limited resources, inadequate teacher training and resistance to change. In addition, inclusion and equity in education remain a critical issue, as disparities in access to quality education persist across regions and demographic groups. To meet these challenges and advance the integration of sustainable development in education, several strategies can be considered. First, there must be a concerted effort to align educational policies and practices with sustainability principles. This includes revising school curricula to emphasize sustainability and providing teachers with professional development to equip them with the necessary skills and knowledge. Thus, promoting partnerships between educational institutions, governments and the private sector can help mobilize resources and skills to support sustainability initiatives. Third, promoting a culture of sustainability in educational institutions through leadership and community engagement can lead to systemic change. In conclusion, the integration of sustainable development in education represents an essential part of achieving the SDGs and promoting a more sustainable future. By integrating sustainability into education systems, we can not only improve individual knowledge and skills, but also drive broader social change that promotes long-term sustainability.

LITERATURE REVIEW: EDUCATION FOR SUSTAINABLE DEVELOPMENT

Overview

Education for Sustainable Development (ESD) has evolved significantly over the past few decades, reflecting broader shifts in global priorities towards sustainability. This review

synthesizes key contributions from seminal works in the field, highlighting the progression from foundational concepts to contemporary educational strategies.

Foundational Documents

Brundtland's Report (1987), *Our Common Future*, is a cornerstone in the discourse on sustainability. The report, produced by the World Commission on Environment and Development, introduced the concept of sustainable development and emphasized the need for integrating environmental considerations into developmental practices. This report laid the groundwork for subsequent discussions on sustainability and educational approaches to address it. The United Nations (2000) Millennium Development Goals Report** provided a framework for global development targets with a focus on alleviating poverty and improving living conditions. This framework was instrumental in shaping the initial direction of ESD by emphasizing the need for education to contribute to achieving these global goals.

Transition to Sustainable Development Goals

The shift from the Millennium Development Goals to the 2030 Agenda for Sustainable Development (United Nations, 2015) marked a significant evolution in global sustainability priorities. This agenda introduced 17 Sustainable Development Goals (SDGs), with Goal 4 specifically addressing the need for inclusive and equitable quality education and promoting lifelong learning opportunities. This transition underscored the critical role of education in achieving broader sustainability targets.

ESD Frameworks and Objectives

UNESCO's (2017) *Education for Sustainable Development Goals: Learning Objectives* provided a detailed framework for integrating ESD into educational curricula. This document outlines specific learning objectives that aim to foster skills and knowledge necessary for addressing sustainability challenges, guiding educators in designing curricula that align with the SDGs. Leitch, Heiss, and Byun (2018) examined ongoing issues and trends in ESD, highlighting how educational practices and policies have adapted to address emerging sustainability challenges. Their work emphasizes the dynamic nature of ESD and the need for continual adaptation to ensure relevance in a changing global context. Tilbury's (2011) *Expert Review of Processes and Learning*** offers an in-depth analysis of how ESD has been implemented across various educational settings. Tilbury identifies key processes and pedagogical approaches that have been effective in promoting sustainability learning, emphasizing the importance of integrating ESD into institutional practices.

Transformative Learning and Institutionalization

The concept of transformative learning is central to the understanding of ESD. Wals and Corcoran (2006) explore how transformative learning processes can lead to sustainability outcomes, arguing that education must go beyond traditional methods to foster deep, systemic changes in individuals' attitudes and behaviours towards sustainability. Sterling's

(2001) *Sustainable Education: Re-visioning Learning and Change* advocates for a radical shift in educational paradigms to support sustainability. Sterling argues that education must be re-visioned to address the complex, interconnected nature of sustainability issues, promoting a more holistic and systems-oriented approach. Barth and Michelson (2013) discuss the institutionalization of ESD, focusing on how educational institutions can integrate sustainability into their structures and practices. Their work provides insights into the challenges and strategies for embedding ESD within educational frameworks, emphasizing the need for institutional commitment and systemic change. The literature on Education for Sustainable Development reflects a rich evolution of thought from the early days of sustainability discourse to contemporary educational practices. Key documents and research contributions highlight the importance of integrating sustainability into educational frameworks, fostering transformative learning, and institutionalizing ESD practices. This body of work underscores the critical role of education in achieving global sustainability goals and the ongoing need for adaptive and forward-thinking educational strategies.

METHODOLOGY

This research paper will employ a qualitative research approach, utilizing secondary sources. This methodology aims to provide valuable insights into the multifaceted nature of evaluating inclusion in facilities, informing policymakers, facility managers, and stakeholders about effective approaches for promoting and assessing inclusion within diverse settings.

CONTEXT AND HISTORICAL SIGNIFICANCE

The concept of sustainable development gained prominence in the late 20th century, driven by heightened awareness of environmental degradation and social inequalities. The Brundtland Report, published in 1987, defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This definition highlights the interdependence of environmental, social, and economic dimensions, advocating for a holistic approach to development. In the educational context, sustainable development has evolved from a peripheral concern to a central principle of educational policies and practices. Initially, the focus was primarily on environmental education aimed at raising awareness about environmental issues. However, as the concept of sustainability expanded, so did the scope of education for sustainable development (ESD). Today, ESD encompasses a wide range of topics, including climate change, biodiversity, poverty reduction, and human rights, reflecting the multidimensional nature of sustainability.

THE LEGACY OF THE MILLENNIUM DEVELOPMENT GOALS (MDGS)

Before the Sustainable Development Goals (SDGs) took precedence, the Millennium Development Goals (MDGs) played a crucial role in shaping global development initiatives

from 2000 to 2015. Among these, MDG 2 focused specifically on achieving universal primary education. This goal emphasized the importance of ensuring that every child had the opportunity to receive a basic education, a crucial step in addressing global educational disparities. The MDGs made substantial strides in education, particularly in increasing primary school enrollment rates across the globe. Many developing countries saw significant improvements in school attendance, reflecting the success of international efforts to enhance educational access. This progress was driven by a concerted push to build schools, train teachers, and implement policies designed to increase student enrolment. However, despite these achievements, the legacy of the MDGs in education is nuanced and multifaceted. One major success of the MDGs was their ability to galvanize global attention and resources towards educational issues, particularly in low-income countries. The MDGs served as a powerful framework for aligning international aid and national policies, leading to noticeable improvements in the number of children attending school. The focus on quantitative targets, such as enrolment rates, provided a clear metric for success and facilitated substantial investments in educational infrastructure. Yet, this focus on quantitative outcomes also highlighted several limitations. The MDGs' emphasis on achieving specific numerical targets sometimes overshadowed critical qualitative aspects of education. For example, while increasing enrolment rates was a significant achievement, the quality of education remained uneven. Issues such as poor learning outcomes, inadequate teaching resources, and the relevance of curricula were often neglected. The narrow focus on getting children into school did not fully address the broader objectives of education, such as fostering critical thinking, promoting sustainable development, and preparing students for the complexities of modern life. The transition to the SDGs was, in part, a response to these shortcomings. The SDGs introduced a more comprehensive approach to education by emphasizing inclusion, equity, and lifelong learning. Unlike the MDGs, which concentrated on primary education, the SDGs advocate for education that spans all levels and stages of life, recognizing the need for ongoing learning opportunities beyond basic education. This shift aims to address the gaps left by the MDGs by incorporating qualitative improvements into educational systems and ensuring that education contributes more broadly to sustainable development. The SDGs also focus on reducing educational inequalities and ensuring that no one is left behind. This includes addressing disparities related to gender, disability, and socio-economic status, and promoting educational practices that are inclusive and equitable. By highlighting these dimensions, the SDGs seek to build on the MDGs' successes while correcting their limitations, fostering a more holistic and sustainable approach to global education. In summary, while the MDGs were instrumental in advancing educational access and enrolment, they also highlighted significant gaps in educational quality and equity. The SDGs build upon this legacy by striving for a more inclusive and comprehensive educational framework, aiming to achieve not only higher enrolment rates but also improved learning outcomes and broader educational benefits.

INTEGRATION OF SUSTAINABILITY IN EDUCATIONAL FRAMEWORKS

Integrating sustainability into educational frameworks demands a multifaceted strategy that encompasses curriculum reform, teacher training, policy development, and community engagement. Each of these components plays a critical role in ensuring that sustainability is effectively embedded within educational settings. At the heart of this integration is curriculum reform. To instill a deep understanding of sustainability, it is essential to incorporate sustainability principles across a range of subjects. For example, science curricula can cover topics related to environmental science and the impact of human activities on ecosystems. Social studies can address the social dimensions of sustainability, such as social equity and community resilience, while economics can explore sustainable economic practices and the role of businesses in promoting sustainability. By weaving sustainability into various subjects, students gain a holistic view of how environmental, social, and economic factors intersect and influence one another. Interdisciplinary approaches further enhance this integration by helping students understand the interconnectedness of sustainability issues. For instance, a project that combines science, social studies, and economics can provide a comprehensive perspective on a specific sustainability challenge, such as climate change. This approach encourages students to think critically about how solutions to sustainability problems must address multiple dimensions simultaneously. Teacher training is another critical component. Educators must be equipped with the knowledge and skills to effectively teach sustainability concepts and integrate them into their lessons. Professional development programs should focus on building teachers' capacity to deliver content that addresses sustainability issues and to use pedagogical methods that promote critical thinking and problem-solving. Training should also emphasize the importance of modelling sustainable practices within the school environment, which can serve as a practical example for students. Policy development is crucial in supporting the integration of sustainability into education. Policies should encourage and mandate the inclusion of sustainability in school curricula and provide resources for schools to implement these changes. Additionally, policies can support professional development for teachers and ensure that sustainability education is given adequate attention and funding. Community engagement is vital for reinforcing the lessons learned in the classroom. Schools can partner with local organizations, businesses, and government agencies to provide students with real-world experiences related to sustainability. Community projects, internships, and local environmental initiatives offer practical applications of classroom learning and help students connect theoretical knowledge with real-world challenges. In summary, integrating sustainability into educational frameworks involves a comprehensive approach that includes reforming curricula to cover sustainability issues, training teachers to effectively deliver these concepts, developing supportive policies, and engaging with the community. By addressing these areas, educational systems can prepare students to understand and tackle sustainability challenges, fostering a generation that is equipped to contribute to a more sustainable future.

Curriculum Reform

Reforming the curriculum is a critical step toward integrating sustainability into education. This involves embedding sustainability concepts across various disciplines and adopting interdisciplinary teaching methods that help students understand the complex relationships between environmental, social, and economic systems. Examples include integrating climate change education into science courses, teaching sustainable economic practices in economics, and exploring human rights and social justice in social studies. Such comprehensive curricular reforms are essential in equipping students with the knowledge and skills necessary to address sustainability challenges.

Teacher Training

Teacher training is another critical component in embedding sustainability within education. Educators need to be equipped with the knowledge, skills, and attitudes necessary to effectively teach sustainability. This involves not only understanding the content but also adopting pedagogical strategies that promote active learning, critical thinking, and problem-solving. Therefore, professional development programs for teachers should include comprehensive modules on sustainability education, ensuring that educators are well-prepared to guide students in addressing complex sustainability challenges.

Policy Development

Policy development plays a pivotal role in creating an enabling environment for education for sustainable development. Governments and educational institutions must develop policies that support the integration of sustainable development at all levels of education, from early childhood to higher education. This includes setting standards for sustainability education, providing resources to schools and teachers, and creating incentives for institutions that demonstrate leadership in sustainability. Policies should also encourage innovative teaching methods that foster critical thinking, problem-solving, and participatory learning.

Community Engagement

Community engagement is equally vital in promoting education for sustainable development. Schools and universities can serve as community learning centers, offering resources and opportunities for individuals of all ages to engage in sustainability initiatives. By fostering partnerships with local organizations, businesses, and governments, educational institutions can extend the reach of sustainability education beyond the classroom and into the broader community. This approach can create a more inclusive and participatory form of education that empowers communities to take collective action toward sustainability.

ANALYSIS

The integration of sustainable development into education systems has yielded varied results. On one hand, there is a growing awareness and understanding of sustainability issues among students and educators. Numerous schools and universities have successfully

incorporated sustainability into their curricula and implemented campus-wide sustainability initiatives, such as energy conservation, waste reduction, and sustainable procurement practices. However, significant challenges remain in achieving a truly transformative approach to education for sustainable development. One of the primary challenges is the gap between policy and practice. While many countries have developed policies and frameworks for education for sustainable development, their implementation has been uneven, with disparities in access to resources and support. Additionally, the emphasis on standardized testing and performance metrics in many educational systems can sometimes impede the integration of sustainability, as teachers may feel pressured to prioritize exam preparation over broader educational goals. Another challenge is the need for more comprehensive teacher training programs that equip educators with the skills and knowledge necessary to effectively teach sustainable development. While there are examples of successful teacher training initiatives, these are often limited in scale and scope. Greater investment is needed to ensure that all teachers, regardless of their location or field of study, are prepared to integrate sustainability into their teaching. Furthermore, while students are increasingly aware of sustainability issues, there remains a need for action-oriented education that empowers students to take an active role in addressing these issues. This requires a shift away from traditional, lecture-based teaching methods toward more participatory and experiential learning approaches that engage students in real-world sustainability projects. Experiential learning, which emphasizes hands-on activities and problem-solving, can help students better understand the complexities of sustainability and develop the skills necessary to contribute to sustainable development.

DISCUSSION

Sustainable development in education presents both challenges and opportunities. While considerable progress has been made in raising awareness and integrating sustainability into educational settings, much work remains to be done to achieve a truly transformative approach. To advance sustainability in education, it is crucial to bridge the gaps between policy and practice, invest in comprehensive teacher training, and adopt more participatory and experiential learning methods. Additionally, cross-sectoral collaboration is essential to ensure that educational institutions, governments, businesses, and communities work together to create a more sustainable and equitable future. Moving forward, educational institutions must focus on creating environments that not only impart knowledge about sustainability but also inspire and empower students to take action. By embedding sustainability into the fabric of educational systems, we can equip future generations with the tools and mindset necessary to navigate and address the complex challenges of the 21st century, ultimately contributing to the realization of a more just, equitable, and sustainable world.

CONCLUSION

Sustainable development in education is a dynamic and evolving field that offers both significant challenges and immense opportunities. While progress has been made in integrating sustainability into educational frameworks, there is still a long way to go to achieve the transformative changes needed to align educational practices with global sustainability goals. This paper highlights the importance of comprehensive curriculum reform, robust teacher training programs, supportive policy frameworks, and active community engagement in promoting sustainable development through education. To create a sustainable and equitable future, it is essential to close the gaps between policy and practice, invest in the professional development of educators, and foster a culture of active learning and community participation. By doing so, educational institutions can play a central role in advancing global sustainability goals, ensuring that future generations are equipped with the knowledge, skills, and values needed to build a more sustainable world.

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Professional Development Programs for Science Teachers: Global Perspectives and Best Practices

Ms. Sapna Raj
Resource Person
SCERT
Delhi

ABSTRACT

This essay investigates the vital role that science teachers' professional development programs play in raising the standard of scientific instruction across the world. It highlights the necessity of educators' ongoing professional development in order to stay up to date with changing curriculum, pedagogical approaches, and scientific discoveries. This study examines model professional development programs from a number of nations, such as the US, Finland, Singapore, Australia, and others, emphasizing how they support multidisciplinary education, integrate technology, and encourage inquiry-based learning. It also describes the best methods for successful professional growth, including mentorship, collaborative learning groups, and ongoing support networks. In order to show how coordination at the national and state levels is achieved, the functions of the National Council of Educational Research and Training (NCERT) and State Councils of Educational Research and Training (SCERTs) in India are studied.

Keywords: Professional Development, Science Teachers, Inquiry-Based Learning, STEM Education, Pedagogical Strategies, Global Best Practices, Curriculum Implementation, NCERT, SCERT.

INTRODUCTION

Programs for professional development for scientific educators are crucial to preserving excellent instruction in the classroom. These programs enable science teachers to keep up with their continuously evolving subject while gaining new educational skills and techniques to bring to the classroom. With a growing global focus on innovation and development, students must develop comprehensive knowledge and skills across scientific disciplines. Almost

every field seeks new hires with skills in science, technology, engineering, and mathematics (STEM).

High-quality science instruction is instrumental in laying the groundwork for students' educational goals and achieving lifelong success in their future careers. Our review of professional development programs for science teachers delves into the benefits of these programs, examines successful examples from around the world, and highlights best practices.

WHY PROFESSIONAL DEVELOPMENT FOR SCIENCE TEACHERS MATTERS

Professional development programs for science teachers allow educators to stay up-to-date with the latest information in their subject, refresh their classroom skills, and stay current with the curriculum. Science education in the United States has undergone a transformation, bringing new improvements to the classroom, adding relevance to students' lives, integrating it with other subjects, and prioritizing application over memorization.

These improvements are driven by the Next Generation of Science Standards (NGSS), which emphasize three dimensions of learning:

Crosscutting Concepts: These concepts show students the connections between sciences (physical, life, earth, and space) and engineering design with an emphasis on "cause and effect."

Science and Engineering Practices: These practices illustrate what scientists do in their careers while investigating the natural world and what is involved when engineers design and build.

Disciplinary Core Ideas: These are the primary ideas and concepts that stretch across all sciences and engineering. As students progress in their studies, these might be expanded upon.

NGSS has brought monumental changes to how science is taught in schools since its introduction. Professional development for science teachers ensures educators can implement the new standards, using new tools and instructional material to support student learning as science advances. In short, professional development programs for science teachers enable high-quality success in the classroom so teachers can lead their students to their goals.

QUALITIES OF AN EXCELLENT SCIENCE TEACHER

Excellence in science teachers varies from professional to professional. But there are certain traits that all effective science teachers have in common. Any science teacher may achieve success by concentrating on these aspects.

Foster Scientific Literacy

Understanding scientific ideas, procedures, and phenomena goes beyond memorization of data and theories in order to promote scientific literacy. Understanding how to use science

in practical situations is necessary. Teachers of science are unable to teach to the test. Teachers must now demonstrate to pupils how the subject's foundations apply to the natural world and provide them with the tools they need to learn outside of the classroom.

By designing lesson plans that incorporate current national and local issues—such as the construction of a new dam and climate change—teachers may help their students become more scientifically literate. These concrete, everyday examples show how scientific principles are used.

Inspire Scientific Thinking

By acquiring data and drawing conclusions, science helps us make sense of the world. But without using a scientific approach, our conclusions might not be accurate. The goal of scientific thinking is to acquire information by using an investigation, testing, and observational method based on logic. The knowledge obtained via the use of a methodical approach is significant to science.

Proficient science instructors encourage their pupils to cultivate the ability to utilize scientific reasoning in order to comprehend the earth and cosmos. Equipped with the logic-based system of discovery, students may move beyond just reciting facts to address concerns about their everyday experiences, such as why rainbows appear in the sky occasionally or what happens to steam when it escapes a boiling pot. Rather than just providing a test answer, students who apply scientific thinking acquire genuine knowledge and comprehension of the reasoning behind the “answer,” making the information applicable to a wider range of situations.

Generate Curiosity

Youngsters are inherently curious. Instead of employing conventional, lecture-based teaching strategies, exceptional scientific instructors foster and use such interest to successfully teach the topic. When instructors cultivate curiosity in their students, it frees them from having to rely on their teachers to provide them with the answers to their questions. Rather, teachers take on the role of guides, assisting students in gathering data (e.g., by conducting a laboratory experiment) so they may test ideas and evaluate and debate their findings.

Apply an Interdisciplinary Approach

Science and engineering do not exist in a vacuum. Success in STEM careers requires interdisciplinary skills. Consequently, NGSS standards require an interdisciplinary approach in the science classroom. Top science teachers integrate other skills into their lesson plans, including:

- ❖ Reading comprehension
- ❖ Mathematics
- ❖ Researching historical figures in science and engineering, discoveries, and events

- ❖ Illustration
- ❖ Writing
- ❖ Presentation
- ❖ Multi-media and online tools

GLOBAL EXAMPLES OF EFFECTIVE PROFESSIONAL DEVELOPMENT PROGRAMS

Country	Professional Development Programs	Brief
United States	The National Science Teachers Association (NSTA)	The NSTA offers a comprehensive array of professional development programs, including workshops, webinars & conferences. Their programs are aligned with NGSS and focus on integrating technology, fostering scientific inquiry, and developing effective classroom strategies. The NSTA Learning Center provides resources such as lesson plans, classroom activities, and professional development modules tailored to the needs of science educators.
Finland	LUMA Centre Finland	Finland is renowned for its education system, and the LUMA Centre Finland is a testament to its commitment to science education. LUMA offers professional development programs that emphasize inquiry-based learning and hands-on science. Their programs include workshops, online courses, and collaborative projects with universities and research institutions. Finnish science teachers are encouraged to integrate real-world scientific research into their classrooms, fostering a deeper understanding of scientific principles among students.
Singapore	Science Teachers Academy for the Regions (STAR)	Singapore's STAR provides professional development programs that focus on pedagogical content knowledge, inquiry-based learning, and the integration of technology in science education. STAR offers workshops, seminars, and mentoring programs that aim to enhance teachers' content knowledge and teaching skills. The academy collaborates with local universities and international organizations to ensure that science teachers are well-prepared to meet the challenges of modern science education.
Country	Professional Development Programs	Brief

Australia	Primary Connections and Science by Doing	In Australia, the Australian Academy of Science has developed two notable professional development programs: Primary Connections and Science by Doing. Primary Connections focuses on integrating science with literacy in primary schools, providing teachers with resources and training to deliver effective science lessons. Science by Doing targets secondary school teachers, offering curriculum resources, professional learning modules, and a community of practice to support science teaching.
United Kingdom	STEM Learning	STEM Learning in the UK offers a wide range of professional development opportunities for science teachers. Their programs include face-to-face courses, online training & blended learning options. STEM Learning's National STEM Learning Centre provides teachers with access to high-quality resources, expert advice, and a network of educators. Their focus on practical, hands-on learning experiences helps teachers bring science to life in the classroom.
Japan	RIKEN Science Education Program	RIKEN, Japan's largest comprehensive research institution, provides professional development programs for science teachers through its Science Education Program. This program includes workshops, seminars, and collaborative projects with researchers, focusing on cutting-edge scientific research and its applications in the classroom. Japanese science teachers benefit from exposure to advanced scientific knowledge and techniques, which they can incorporate into their teaching.
Canada	Let's Talk Science	Let's Talk Science, a Canadian national charitable organization, offers a variety of professional development programs aimed at enhancing science education. Their programs include workshops, webinars, and hands-on activities that promote inquiry-based learning and the integration of STEM concepts. Let's Talk Science also provides resources and support for teachers to develop engaging science lessons that inspire students to explore scientific concepts.
Germany	Teacher Training Centers (TTZs)	Germany's Teacher Training Centers (TTZs) provide professional development programs for science teachers, focusing on the latest educational research and teaching methods. TTZs offer workshops, seminars, and collaborative projects with universities and research institutions. German science teachers are encouraged to engage in continuous professional development, ensuring they stay current with advancements in science education and pedagogy.

India	The Centre of Excellence in Science and Mathematics Education (CESME) at HBCSE	The Centre of Excellence in Science and Mathematics Education (CESME) at HBCSE aims to enhance science and mathematics education in India by developing research-based teacher professional development programs and creating a resource pool of teachers/educators. CESME focuses on capacity building, content and pedagogy improvement, and producing field-tested educational materials.
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Table :01

BEST PRACTICES FOR SCIENCE TEACHER PROFESSIONAL DEVELOPMENT

Collaborative Learning Communities

Establishing collaborative learning communities allows science teachers to share best practices, discuss challenges, and develop solutions collectively. These communities can be formed within schools, across districts, or even internationally. Regular meetings, online forums, and collaborative projects foster a culture of continuous improvement and professional growth.

Mentorship and Coaching

Pairing experienced science teachers with novice educators through mentorship and coaching programs can significantly enhance the professional development process. Mentors provide guidance, support, and practical advice, helping new teachers navigate the complexities of science education. Coaching sessions can focus on specific teaching strategies, classroom management, and curriculum implementation.

Inquiry-Based Professional Development

Professional development programs should model the inquiry-based learning approach that teachers are expected to implement in their classrooms. Workshops and training sessions should encourage teachers to engage in scientific inquiry, explore new teaching methods, and reflect on their practice. This hands-on approach helps teachers experience the benefits of inquiry-based learning firsthand and apply it effectively in their classrooms.

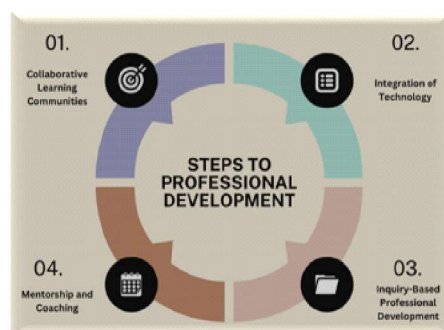


Figure : 01

Integration of Technology

The integration of technology in science education is crucial for preparing students for the digital age. Professional development programs should provide teachers with the skills and tools needed to incorporate technology into their teaching. This includes training on using digital resources, conducting virtual experiments, and leveraging online collaboration tools to enhance student learning.

Ongoing and Sustained Support

Professional development for science teachers should not be a one-time event but an ongoing process. Schools and districts must provide sustained support through regular training sessions, access to resources, and opportunities for professional growth. Continuous professional development ensures that teachers stay current with advancements in science education and are well-equipped to inspire their students.

ROLE OF NCERT AND SCERT IN PROFESSIONAL DEVELOPMENT OF SCIENCE TEACHERS

NCERT (National Council of Educational Research and Training) and SCERT (State Council of Educational Research and Training) collaborate in organizing professional development programs for science teachers, each playing distinct but complementary roles. Here's how they work together to enhance science teacher professional development:

Area	Role of NCERT	Role of SCERTs
Curriculum Development & Implementation	❖ National Curriculum Framework (NCF): NCERT is responsible for developing the National Curriculum Framework, which provides the guidelines for curriculum design across the country, including science education. The NCF outlines the pedagogical approaches, content, and assessment strategies that should be used in schools ❖ Textbook Creation: NCERT develops science textbooks and teaching materials based on the NCF. These resources are used across many states, ensuring a standardized approach to science education	❖ State-Level Adaptation: SCERT adapts the NCERT curriculum to meet the specific needs of the state. This may include translating materials into the local language, modifying content to reflect regional context, and integrating state-specific topics. ❖ Implementation Support: SCERT provides training to science teachers on how to effectively implement the NCERT curriculum in their classrooms. This includes understanding the content, using the textbooks, and applying the recommended pedagogical approaches.

Professional Development Programs	❖ National Training Programs: NCERT organizes national-level training programs for science teachers and teacher educators. These programs focus on new teaching methodologies, curriculum updates, and emerging trends in science education. ❖ Capacity Building: NCERT also conducts capacity-building programs for SCERT faculty and state-level master trainers, who in turn train teachers at the local level	❖ State-Level Training: SCERT organizes state-level workshops, seminars, and training sessions for science teachers based on the guidelines and resources provided by NCERT. These sessions focus on the practical aspects of teaching, classroom management, and the use of teaching aids. ❖ Follow-Up and Monitoring: SCERT is responsible for the follow-up and monitoring of the training programs to ensure that teachers effectively implement what they have learned in their classrooms.
Research and Innovation	❖ Educational Research: NCERT conducts research on various aspects of science education, including teaching practices, student learning outcomes, and curriculum effectiveness. The findings are used to inform policy and practice at both the national and state levels. ❖ Innovation in Teaching: NCERT promotes innovative teaching practices through its research and pilot programs, which are then shared with SCERTs for wider implementation.	❖ State-Specific Research: SCERT conducts research on educational issues relevant to the state, including challenges in science education. This research helps in tailoring professional development programs to address specific needs. ❖ Implementation of Innovations: SCERT is responsible for implementing innovative teaching practices and research findings from NCERT at the state level. This includes piloting new approaches in select schools and scaling them up based on success.
Resource Development and Dissemination	❖ Development of Educational Resources: NCERT develops a wide range of educational resources, including teacher handbooks, e-learning modules, and supplementary materials for science education. ❖ Dissemination of Resources: NCERT ensures that these resources are disseminated to SCERTs and teachers across the country through various channels, including online platforms like DIKSHA (Digital Infrastructure for Knowledge Sharing)	❖ Localization of Resources: SCERT adapts and localizes the resources provided by NCERT to make them more relevant and accessible to teachers in the state. ❖ Training on Resource Utilization: SCERT trains teachers on how to effectively use these resources in their teaching, ensuring that they are integrated into everyday classroom practice.

Policy Alignment and Coordination	❖ National Educational Policies: NCERT plays a key role in the formulation of national education policies, which guide the direction of professional development programs for science teachers across country. ❖ Coordination with SCERTs: NCERT coordinates with SCERTs to ensure that national policies & programs are implemented effectively at state level	❖ State-Level Policy Implementation: SCERT implements national education policies at the state level, making necessary adjustments to align with state-specific needs and priorities. ❖ Feedback to NCERT: SCERT provides feedback to NCERT on the challenges and successes of implementing national policies, contributing to continuous improvement in science education.
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LITERATURE REVIEW

TIMMS Assessment Frameworks (2023) For science instructors, professional development is an essential part of continuing education as it gives them chances to improve their methods of instruction. Good professional development gives instructors time for reflection, is continuous and continuing, and involves them in tangible responsibilities. When teachers feel supported and encouraged, they are more inclined to engage. The Teacher Questionnaire, used by the Trends in International Mathematics and Science Study (TIMSS) to collect data on professional development, asks teachers about the subjects they have taught and the areas in which they believe more training is necessary. The efficient use of digital devices in the classroom is influenced by a number of factors, including teacher self-efficacy, on-site technological assistance, and the availability of training. Integration of technology in scientific education is a significant topic for professional development.

Teaching and Learning International Survey (TALIS) is an OECD-sponsored study that explores teaching and learning environments through questionnaires completed by teachers and principals. Targeting ISCED level 2 (lower secondary) teachers and principals, TALIS is unique in its comparative international approach, collecting data from nationally representative samples. The survey covers teacher backgrounds, professional development, work environments, and attitudes towards teaching. First administered in 2008, TALIS has subsequent rounds in 2013 and 2018, with the U.S. participating since 2013. The most recent data collection in 2018 included 49 education systems, providing crucial insights into international teaching practices.

Zhang, Shaoan; Shi, Qingmin; Lin, Emily 2020 Using data from 1,508 US secondary teachers in the TALIS 2013, this study examines the professional development (PD) needs and barriers for both new and veteran teachers. Both groups need PD on curriculum standards, technology, and individualized learning, but many lack financial or non-monetary support. New teachers more frequently receive salary supplements for PD outside working hours,

while veteran teachers face greater barriers related to cost, incentives, and time. The study suggests improvements for PD design and implementation.

ASER 2023 report provides insights into the state of education in rural India, focusing on children and youth aged 14-18. While it highlights improvements in basic literacy and numeracy, it also underscores the ongoing challenges in professional development for teachers, particularly in science education. The report indicates that many rural teachers receive training, but it often lacks relevance and effectiveness in addressing classroom needs, especially in science. ASER 2023 also emphasizes the need for targeted teacher training programs to enhance educational outcomes, especially in underserved areas.

The NGSS Implementation Reports highlight the ongoing efforts to align science education in the U.S. with the Next Generation Science Standards (NGSS). These reports focus on professional development aimed at enhancing teachers' content knowledge, instructional practices, and assessment strategies. Key findings emphasize the importance of sustained, content-rich professional development that fosters teacher collaboration and reflection. Challenges include the need for more resources and dedicated time for effective implementation of NGSS-aligned instruction.

NSTA reports and surveys provide insights into the state of science education and professional development needs for educators in the U.S. Key focus areas include inquiry-based learning, STEM integration, and the effective use of technology. NSTA emphasizes that the most beneficial professional development for teachers is interactive, sustained, and directly applicable to classroom practices. Additionally, there is a strong need for support in adapting to new educational standards and technologies to enhance science teaching effectively.

The National Survey of Science and Mathematics Education (NSSME+) conducted by Horizon Research, Inc., offers a comprehensive view of K-12 science and mathematics education in the U.S., covering teacher qualifications, instructional practices, curriculum, and professional development. The survey focuses on the types, duration, and alignment of professional development activities with teachers' instructional needs, highlighting gaps that can impede effective learning. Key findings stress the necessity for ongoing, targeted professional development tailored to classroom realities, as well as addressing barriers that limit access to quality professional development opportunities.

National Academies of Sciences, Engineering, and Medicine Reports: The National Academies' reports, including "A Framework for K-12 Science Education" and "Promising Practices in Undergraduate Science and Engineering Education," provide expert guidance on the professional development of science teachers. These reports advocate for sustained, content-rich, and research-aligned professional development that is continuous and job-embedded. They emphasize the importance of tailoring professional development to the specific content areas teachers handle and highlight the critical role of professional learning communities in fostering teacher growth and enhancing instructional practices.

CONCLUSION

The professional development of science teachers is essential for enhancing the quality of science education and preparing students for the demands of the 21st century. Across the globe, effective professional development programs emphasize the integration of innovative pedagogical strategies, inquiry-based learning, and technology, all of which are vital for fostering critical thinking and scientific literacy. In countries like the United States, Finland, Singapore, and Australia, best practices include creating collaborative learning communities where teachers can share experiences, engage in reflective practice, and receive ongoing mentorship. These programs often focus on the application of scientific concepts to real-world problems, ensuring that teachers are not only content experts but also skilled in facilitating active learning environments.

In the context of India, the professional development landscape is shaped by the collaborative efforts of national and regional institutions such as NCERT and SCERT. These bodies play a crucial role in designing and implementing training programs that are responsive to the unique needs of different regions while aligning with broader national educational goals. The professional development initiatives provided by these organizations include workshops, online courses, and hands-on training sessions that equip teachers with the necessary skills to implement inquiry-based and student-centered approaches in their classrooms. Additionally, these programs address the specific challenges faced by science teachers in India, such as large class sizes, diverse student populations, and limited resources.

By drawing on the best practices from both global and local contexts, the professional development of science teachers can lead to significant improvements in science education. Teachers who are well-prepared and supported are more likely to inspire curiosity, encourage critical thinking, and help students develop a deep understanding of scientific concepts. This, in turn, can contribute to a scientifically literate society capable of addressing complex global challenges. The ongoing investment in professional development for science teachers is therefore not just a commitment to education but also a strategic investment in the future.

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Awadh Centre of Education

(COMM-IT Career Academy & Institute of Vocational Studies)

Awadh Bhawan

FC-31, Sheikh Sarai, Phase – II

Institutional Area,

New Delhi – 110017, India

Phone: +91 11 29257793/94

E Mail: info@awadh.org.in

Site: www.awadh.org.in