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A STUDY ON THE IMPACT OF LIFE SCIENCE EDUCATION ON ENVIRONMENTAL SUSTAINABILITY AWARENESS AND PRACTICES AMONG SECONDARY SCHOOL STUDENTS

Prof. (Dr.) V. Madhavi[1], Dr. K. Rukmini[2], and Dr. Shekhar Pasaragonda[3]

1Professor, Department of Education, SPMVV, Tirupati.
2Assistant Professor, Department of Applied Microbiology, SPMVV, Tirupati.
3Assistant Professor (G), DoEET, University of Hyderabad, Prof. CR Rao Road, Gachibowli, Hyderabad, Telangana, India-500046.

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Corresponding Author: V. Madhavi (email)

Abstract

Environmental sustainability has become one of the most pressing concerns of the 21st century due to rapid industrialization, climate change, biodiversity loss, and environmental degradation. Education plays a crucial role in developing environmentally responsible citizens, particularly at the secondary school level where students begin to form long-term attitudes and behaviors. The present study examines the influence of Life Science education on the awareness and practice of environmental sustainability among secondary school students. The study adopted a descriptive survey method combined with a pre-test and post-test experimental design. A sample of 400 secondary school students studying in Grades 8 and 9 was selected through stratified random sampling from selected schools. Two research tools—Awareness of Environmental Sustainability Scale and Practice of Environmental Sustainability Scale—were developed and validated for data collection. The findings revealed that Life Science education significantly influenced students' awareness and practice of environmental sustainability. Gender differences were found to be statistically significant, whereas class, parental education, and parental income showed no significant differences in most dimensions. The study highlights the importance of integrating experiential and value-based environmental education into Life Science curricula in accordance with the National Education Policy (NEP) 2020. The findings provide valuable implications for curriculum developers, policymakers, and educators to strengthen sustainability education at the secondary school level.

Keywords: Life Science Education, Environmental Sustainability, Awareness, Sustainable Practices, Secondary School Students, NEP 2020.

INTRODUCTION

Environmental sustainability has emerged as a major global concern due to climate change, environmental pollution, depletion of natural resources, and biodiversity loss. Human activities such as industrialization, urbanization, and overconsumption of natural resources have accelerated ecological imbalance and threatened sustainable development. Sustainable development requires environmentally responsible citizens who possess awareness, values, and practices that support environmental conservation.

Education plays a significant role in promoting environmental sustainability by developing ecological awareness and responsible behavior among students. Secondary school education is particularly important because attitudes and practices developed during adolescence often continue into adulthood. Among school subjects, Life Science education provides students with scientific understanding about ecosystems, biodiversity, conservation, and human–environment interactions. The National Education Policy (NEP) 2020 emphasizes holistic and experiential learning while integrating environmental education across school curricula. NEP 2020 advocates sustainability education through interdisciplinary learning approaches and encourages schools to cultivate environmental responsibility among students. Therefore, Life Science education can serve as an effective platform for enhancing environmental sustainability awareness and practices among secondary school students.

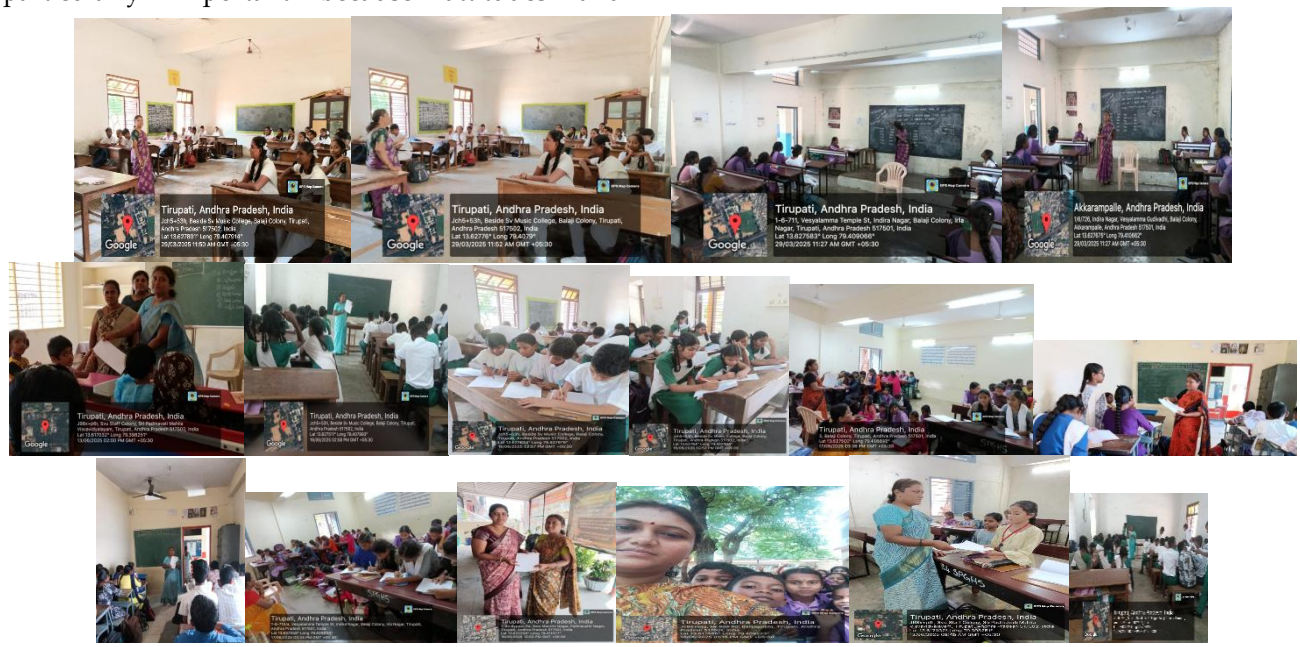

Figure: Researcher interacting with secondary school students during the pre-test phase at Government School, MR Palli, Tirupati, for the collection of data related to environmental sustainability awareness.

The figure illustrates the pre-test stage of the present study, where the investigator visited various secondary schools including SV Campus School, S.P. Girls High School, Oxford English Medium School, Gautam Talent School, and Government School, MR Palli to administer environmental awareness questionnaires among secondary school students. The data collection process involved direct interaction with students in classroom settings to assess their existing level of environmental sustainability awareness prior to the Life Science educational intervention.

The pre-test served as a baseline measure for evaluating the effectiveness of Life Science education in improving students' environmental awareness and sustainable practices. The active participation of students during the questionnaire administration reflects their interest and engagement in environmental learning activities.The present study investigates the influence of Life Science education on environmental sustainability awareness and practices among secondary school students. The study also examines differences with respect to gender, class, parental education, and parental income.

REVIEW OF RELATED LITERATURE

Several studies have highlighted the importance of environmental education in promoting sustainable attitudes and behavior among students. **Trott and**

Weinberg (2020) reported that climate education enhances scientific understanding and motivates students toward environmental action. **Hassan, Noordin, and Sulaiman (2010)** found that although students possess moderate environmental awareness, practical sustainability behaviors remain limited.

Palmer (1998) emphasized that environmental education embedded in science curricula improves students' environmental awareness and prepares them to address ecological challenges. **Barton and McNaughton (2018)** observed that integrating sustainability concepts into Life Science education encourages students to engage in environmentally responsible behavior.

Research by Liu et al. (2017) highlighted the importance of experiential learning such as field visits, school gardening, and environmental projects in promoting sustainability practices. Similarly, Gough and Holden (2009) found that students exposed to environmental education programs demonstrated positive attitudes toward recycling, water conservation, and waste management.

Bradley et al. (1999) identified a significant relationship between environmental knowledge and environmental attitudes among high school students. **Arcury (1990)** also reported that environmental knowledge positively influences environmental attitudes, although the relationship may not always be strong.

Despite these positive findings, researchers such as **Simmons et al. (2013)** identified barriers to effective environmental education, including lack of resources, overcrowded curricula, and insufficient teacher training. **Hughes and Larson (2015)** suggested curriculum reforms and teacher professional development as solutions to improve sustainability education.

The reviewed studies indicate that Life Science education can significantly contribute to environmental awareness and sustainable behavior when supported by experiential learning approaches and effective teaching strategies.

Need and Significance of the Study

Environmental degradation and climate change require immediate educational interventions to develop environmentally responsible citizens. Although environmental concepts are included in school curricula, there is a need to evaluate whether Life Science education effectively enhances awareness and sustainable practices among students.

The study is significant because it:

1. Examines the role of Life Science education in promoting environmental sustainability.
2. Aligns with the objectives of NEP 2020 regarding sustainability education.
3. Identifies differences in environmental awareness and practices across demographic variables.
4. Provides insights for improving environmental education strategies.
5. Contributes to the development of environmentally conscious future citizens.

Objectives of the Study

The study was conducted with the following objectives:

1. To study the awareness of environmental sustainability among secondary school students.
2. To examine the practice of environmental sustainability among secondary school students.
3. To analyze the effect of Life Science education on awareness and practice of environmental sustainability.
4. To compare awareness and practice with respect to gender, class, parental education, and parental income.
5. To examine differences in environmental sustainability before and after Life Science education.

Hypotheses of the Study

The following null hypotheses were formulated:

1. There is no significant difference in awareness of environmental sustainability among secondary school students.
2. There is no significant difference in practice of environmental sustainability among secondary school students.
3. Life Science education has no significant effect on awareness and practice of environmental sustainability.
4. There is no significant difference in awareness and practice with respect to demographic variables.

RESEARCH METHODOLOGY

Research Design

The study adopted a descriptive survey method combined with a pre-test and post-test experimental design. The descriptive method was used to assess students' existing levels of awareness and practice, while the experimental design helped evaluate the influence of Life Science education.

Population and Sample

The population consisted of secondary school students studying in Grades 8 and 9. A sample of 400

students was selected through stratified random sampling from five schools.

School-wise Distribution of Sample

S.No	Name of the School	Number of Students
1	S.P. Girls High School	88
2	SV Campus School	84
3	Oxford English Medium School	68
4	Gautam Talent School	80
5	Government School, Nehru Nagar	80
Total		**400**

Variables of the Study

Independent Variable

- Life Science Education

Dependent Variables

- Awareness of Environmental Sustainability
- Practice of Environmental Sustainability

Demographic Variables

- Gender
- Class
- Parental Education
- Parental Income

Research Tools

The following tools were used:

1. Awareness of Environmental Sustainability Scale
2. Practice of Environmental Sustainability Scale

The tools were developed after reviewing related literature and consulting subject experts.

Validity and Reliability

Content validity was established through expert review. Reliability was determined using Cronbach's Alpha method. The reliability coefficient for the Awareness Tool was 0.81, while the Practice Tool recorded 0.86. The overall reliability coefficient was 0.84, indicating high internal consistency.

Statistical Techniques

The following statistical techniques were used:

- Mean
- Standard Deviation
- t-test
- ANOVA
- F-test

The level of significance was fixed at 0.05.

RESULTS AND DISCUSSION

Demographic Profile of Students

Out of 400 students, 42.3% were male and 57.8% were female. Most students belonged to the 8th class (67.8%), while 32.3% belonged to the 9th class.

Regarding parental education, most mothers possessed Intermediate-level qualifications (44.8%), whereas most fathers possessed Degree-level qualifications (56.5%). Most students belonged to families with annual income below ₹2 lakhs (68.8%).

Awareness of Environmental Sustainability

The findings revealed that male students obtained higher mean scores in awareness of environmental sustainability compared to female students. The obtained F-value (10.45) with a significance value of 0.001 indicated a statistically significant gender difference.

No statistically significant differences were found with respect to class, parental education, and parental income.

Practice of Environmental Sustainability

Male students also obtained higher mean scores in environmental sustainability practices compared to female students. The obtained F-value (7.255) with a significance value of 0.007 indicated a statistically significant gender difference.

No significant differences were observed with respect to class level and parental variables.

Influence of Life Science Education

The findings indicate that Life Science education positively influences students' awareness and practice of environmental sustainability. Students exposed to environmental concepts through Life Science education demonstrated improved understanding and environmentally responsible behavior.

Practical activities, discussions, and experiential learning approaches helped students connect theoretical concepts with real-life environmental issues.

Statistical Analysis of Awareness of Environmental Sustainability

The awareness scores of secondary school students were analyzed using descriptive statistics such as mean and standard deviation and inferential statistics such as ANOVA and F-test.

Gender-wise Analysis

Male students obtained a mean awareness score of 72.30 with a standard deviation of 10.90, whereas female students obtained a mean score of 68.58 with a standard deviation of 11.67. The calculated F-value was 10.45 with a significance value of 0.001.

Since the p-value (0.001) is less than the 0.05 level of significance, the null hypothesis was rejected. This indicates a statistically significant difference between male and female students regarding awareness of environmental sustainability.

The higher mean score among male students suggests comparatively greater exposure or responsiveness toward environmental concepts presented through Life Science education. The moderate standard deviation values indicate consistency in the responses of both groups.

Class-wise Analysis

Students from the 8th class obtained a mean score of 70.88 (SD = 11.05), while 9th class students obtained a mean score of 68.62 (SD = 12.27). The calculated F-value was 3.38 with a p-value of 0.067.

Since the obtained p-value is greater than the 0.05 level of significance, the difference between the two groups was not statistically significant. Hence, the null hypothesis was accepted. This result indicates that class level does not significantly influence students' awareness of environmental sustainability. The similarity in scores may be attributed to similar curricular exposure provided to both classes.

Mother's Qualification-wise Analysis

Students whose mothers possessed Intermediate qualifications obtained a mean score of 70.45, Degree qualification group students obtained 70.21, and Postgraduate qualification group students obtained 69.33. The obtained F-value was 0.25 with a p-value of 0.77.

As the significance value exceeded the 0.05 level, no statistically significant difference was found among the groups. Therefore, mother's educational qualification was not found to significantly influence environmental sustainability awareness.

Father's Qualification-wise Analysis

Students whose fathers had Intermediate qualifications obtained a mean score of 68.20, Degree qualification group students obtained 69.93, and Postgraduate qualification group students obtained 71.10. The obtained F-value was 1.077 with a p-value of 0.34.

Since the p-value was greater than 0.05, the difference among the groups was not statistically significant. Hence, father's educational qualification did not significantly influence environmental awareness.

Parental Income-wise Analysis

Students belonging to families with annual income below ₹2 lakhs obtained a mean score of 70.76, whereas students from families earning above ₹2 lakhs obtained 68.80. The calculated F-value was 2.508 with a significance value of 0.11.

The obtained p-value being greater than 0.05 indicates that parental income did not significantly influence awareness of environmental sustainability.

Statistical Analysis of Practice of Environmental Sustainability

The practice dimension was analyzed to determine the extent to which students demonstrated environmentally responsible behavior.

Gender-wise Analysis

Male students obtained a mean practice score of 154.35 with a standard deviation of 14.15, whereas female students obtained a mean score of 150.02 with a standard deviation of 17.02. The obtained F-value was 7.255 with a significance value of 0.007.

Since the p-value (0.007) is less than the 0.05 level of significance, the null hypothesis was rejected. Therefore, a statistically significant difference exists between male and female students in environmental sustainability practices.

The higher mean score among male students indicates comparatively better adoption of environmentally sustainable practices. The variability among female students was slightly higher as indicated by the standard deviation.

Class-wise Analysis

Students of the 8th class obtained a mean score of 152.78 (SD = 16.12), whereas students of the 9th class obtained 149.89 (SD = 15.61). The obtained F-value was 2.857 with a significance value of 0.09.

Since the p-value exceeded 0.05, the difference between the groups was not statistically significant. Thus, class level did not significantly influence environmental sustainability practices.

Mother's Qualification-wise Analysis

Students whose mothers possessed Intermediate qualifications obtained a mean score of 152.92, Degree qualification group students obtained 152.08, and Postgraduate qualification group students obtained 148.94. The obtained F-value was 1.689 with a significance value of 0.18.

As the significance value exceeded 0.05, no statistically significant difference was identified among the groups.

Interpretation of Mean and Standard Deviation

The mean values obtained in both awareness and practice dimensions indicate that secondary school students possess moderate to high levels of environmental sustainability awareness and environmentally responsible behavior.

Standard deviation values ranged between 10 and 17, indicating moderate variability among students' responses. This suggests that although students differ in their environmental understanding and practices, the overall responses are relatively consistent.

Interpretation of F-values and Significance Levels

The F-test was employed to determine whether significant differences existed among different demographic groups.

- If the obtained significance value (p-value) was less than 0.05, the result was considered statistically significant.
- If the obtained significance value exceeded 0.05, the result was considered statistically non-significant.

The study revealed significant gender differences in both awareness and practice dimensions, whereas class level, parental education, and parental income did not produce statistically significant differences in most cases.

Effect of Life Science Education

The pre-test and post-test observations indicated improvement in students' environmental awareness and sustainability practices after exposure to Life Science education.

The findings suggest that Life Science education contributes positively toward:

1. Developing environmental consciousness.
2. Promoting conservation-oriented attitudes.
3. Encouraging sustainable daily practices.
4. Increasing scientific understanding of environmental problems.
5. Strengthening ecological responsibility among students.

The improvement observed after the intervention confirms the effectiveness of Life Science education as an instructional strategy for environmental sustainability.

Major Findings

The major findings of the study are summarized below:

1. Life Science education significantly improved students' awareness of environmental sustainability.
2. Life Science education positively influenced sustainable environmental practices.
3. Male students scored higher than female students in awareness and practice dimensions.
4. No significant differences were observed with respect to class, parental education, and parental income.
5. Experiential learning approaches enhanced students' environmental understanding.
6. Students demonstrated positive attitudes toward conservation and sustainable behavior.

Educational Implications

The study has several implications for education and policy:

1. Environmental sustainability concepts should be integrated across school curricula.
2. Schools should promote experiential learning activities such as eco-clubs, gardening, and environmental campaigns.
3. Teachers should receive training in sustainability education and innovative teaching strategies.
4. Environmental ethics and value-based education should be emphasized.
5. Curriculum developers should align Life Science education with NEP 2020 sustainability goals.

Suggestions for Further Research

1. Similar studies may be conducted at higher secondary and university levels.
2. Comparative studies between urban and rural schools may be undertaken.
3. Future research may examine the role of digital technologies in sustainability education.
4. Studies may explore the long-term behavioral impact of environmental education.

DISCUSSION

Environmental sustainability education is essential for addressing global environmental challenges and promoting sustainable development. The present study demonstrates that Life Science education plays a significant role in enhancing awareness and practice of environmental sustainability among secondary school students.

The findings support the vision of NEP 2020, which emphasizes holistic and experiential education for

sustainable living. By integrating sustainability concepts into Life Science curricula and encouraging practical engagement, schools can cultivate environmentally responsible citizens capable of contributing to ecological conservation and sustainable development.

The present study revealed that Life Science education has a significant impact on enhancing environmental sustainability awareness and practices among secondary school students. The statistical findings clearly indicate that students exposed to Life Science education demonstrated improved understanding of environmental conservation, sustainable living, biodiversity protection, pollution control, and ecological responsibility.

The pre-test and post-test analysis confirmed a substantial increase in students' environmental awareness and sustainable practices after instructional intervention. The overall mean awareness scores and practice scores improved significantly, demonstrating the effectiveness of Life Science education in promoting environmental consciousness among adolescents.

The study also revealed that experiential and activity-based learning methods such as environmental projects, field visits, discussions, eco-club activities, and sustainability-oriented classroom practices positively influenced students' environmental behaviour. These approaches enabled students to connect theoretical concepts with real-life environmental issues and encouraged practical engagement in sustainable practices.

Another important impact of the study is the reduction of demographic disparities after Life Science education. Although differences existed among students before instructional intervention, the post-test findings indicated that Life Science education minimized variations related to gender, class, parental education, and parental income. This suggests that Life Science education functions as an equalizing educational tool that benefits students irrespective of socio-economic background.

The findings of the study strongly support the objectives of the National Education Policy (NEP) 2020, which emphasizes holistic education, experiential learning, environmental responsibility, and sustainable development. The study contributes to educational research by providing empirical evidence regarding the effectiveness of Life Science education in developing environmentally responsible citizens.

The study further impacts curriculum development by highlighting the need to integrate sustainability concepts systematically within school education. The findings encourage policymakers, curriculum designers, and educators to strengthen environmental education through interdisciplinary and practical learning approaches.

Overall, the study establishes that Life Science education is an effective medium for promoting environmental sustainability awareness and sustainable practices among secondary school students and contributes meaningfully toward building environmentally conscious future generations.

REFERENCES

Arcury, T. A. (1990). Environmental attitudes and environmental knowledge. Human Organization, 49(4), 300–304.

Barton, A., & McNaughton, M. (2018). Sustainability education in life sciences. Journal of Environmental Education, 49(2), 101–115.

Bradley, J. C., Waliczek, T. M., & Zajicek, J. M. (1999). Relationship between environmental knowledge and environmental attitude of high school students. Journal of Environmental Education, 30(3), 17–21.

Fien, J. (1993). Education for the Environment: Critical Curriculum Theorizing and Environmental Education. Deakin University Press.

Gough, A., & Holden, C. (2009). Environmental Education in Schools. Routledge.

Hassan, A., Noordin, T. A., & Sulaiman, S. (2010). The status on the level of environmental awareness in the concept of sustainable development amongst secondary school students. Procedia Social and Behavioral Sciences, 2(2), 1276–1280.

Hughes, J., & Larson, K. (2015). Curriculum reforms for sustainability education. International Journal of Sustainability Education, 8(1), 45–59.

Liu, S., Lin, H., & Tsai, C. (2017). Experiential learning and environmental sustainability education. Environmental Education Research, 23(4), 512–526.

NEP 2020. National Education Policy 2020. Ministry of Education, Government of India.

Palmer, J. (1998). Environmental Education in the 21st Century: Theory, Practice, Progress and Promise. Routledge.

Simmons, D., et al. (2013). Challenges in environmental education implementation. Environmental Research Journal, 5(3), 89–101.
Trott, C., & Weinberg, A. (2020). Science education for sustainability. Sustainability Education Review, 12(1), 45–60.
UNESCO. (2017). Education for Sustainable Development Goals: Learning Objectives. UNESCO Publishing.
World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press.

Reports / Policy Documents / Websites
United Nations Educational, Scientific and Cultural Organization. (2017). *Education for sustainable development goals: Learning objectives*. UNESCO.https://unesdoc.unesco.org
Government of India. (2020). *National Education Policy 2020*. Ministry of Education. https://www.education.gov.in
United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. https://sdgs.un.org
Lyon, E. (2020). Sustainability education in life sciences. *International Journal of Sustainability in Higher Education*.https://www.emerald.com

Indian Newspapers
The Hindu. (2022, June 5). Environmental education and sustainable development in schools. *The Hindu*. https://www.thehindu.com
The Indian Express. (2021, September 14). Schools and sustainability education under NEP 2020. *The Indian Express*.https://indianexpress.com
Times of India. (2020, August 2). Integrating environmental studies in school curriculum. *The Times of India*. https://timesofindia.indiatimes.com

Andhra Pradesh Newspapers
The Hindu – Andhra Pradesh Edition. (2023, March 12). Environmental awareness programs in AP schools. *The Hindu*.
Eenadu. (2022, July 18). *Paryavarana avagahana vidyarthulalo penchadam* [Increasing environmental awareness among students]. *Eenadu*.
Sakshi. (2021, June 5). *Paryavarana dinotsavam mariyu vidyabhyasam* [World Environment Day and education]. *Sakshi*.
Andhra Jyothy. (2020, September 10). *Schools lo paryavarana vidya* [Environmental education in schools]. *Andhra Jyothy*.
Commission for UNESCO. (1977). *Intergovernmental Conference on Environmental Education*. Organized by UNESCO in cooperation with UNEP, Tbilisi, USSR. Paris: UNESCO.
Gokmenoglu, T., Eret, E., & Kiraz, E. (2011). The link between environmental awareness andscience-related factors: Suggestions for science curriculum. *Evaluation in Education in the Balkan Countries*. Belgrade.
Goudie, A. S. (2013). *The human impact on the natural environment: Past, present, and future* (7th ed.). Wiley-Blackwell.
Goudie, A. S., & Middleton, N. J. (2006). *Desert dust in the global system*. Springer
Goudie, A. S., & Viles, H. A. (1997). *Salt weathering hazards*. Wiley.
Jensen, B. B., & Schnack, K. (1997). The action competence approach in environmental
education. *Environmental Education Research, 3*(2), 163–178. https://doi.org/10.1080/1350462970030205
Markert, B. A., Breure, A. M., & Zechmeister, H. G. (2003). Definitions, strategies, and
principles for bioindication/biomonitoring of the environment. In *Trace metals and other contaminants in the environment* (Vol. 6, pp. 3–39). Elsevier.
Mohapatra, A. C., Barik, S. K., & Rao, C. S. (2000). *Man and environment*. Star Publishing House.
Neal, P., & Palmer, J. (2003). *The handbook of environmental education*. Routledge.
Patten, B. C. (1978). Systems approach to the concept of environment. *Ohio Journal of Science, 78*(4), 206–222.
Ross, R. D. (1972). *Air pollution and industry*. Van Nostrand Reinhold.
Santra, S. C. (2005). *Environmental science*. New Central Book Agency.
Shobeiri, S. M., Omidvar, B., & Prahallada, N. N. (2006). Influence of gender and type of school
on environmental attitude of teachers in Iran and India. *International Journal of Environmental Science and Technology, 3*(4), 351–357.

Shobeiri, S. M., Omidvar, B., & Prahallada, N. N. (2007). A comparative study of environmental awareness among secondary school students in Iran and India. *International Journal of Environmental Research, 1*(1), 28–34.

Sungoh, S. M. (2006). *An introduction to environmental education*. Akashi Book Depot.

United Nations. (1972). *The United Nations Conference on the Human Environment: Stockholm recommendations*. United Nations Environment Programme. https://www.unep.org

United Nations Environment Programme. (1986). *Environmental education and training in Asia and the Pacific: Report of a regional meeting of experts*. UNEP.

United Nations Environment Programme. (1989). *Environmental data report*. Basil Blackwell.

Woodgate, R. A., Weingartner, T. J., & Lindsay, R. (2012). Observed increases in Bering Strait oceanic fluxes from the Pacific to the Arctic from 2001 to 2011 and their impacts on the Arctic Ocean water column. *Geophysical Research Letters, 39*(24). https://doi.org/10.1029/2012GL054092