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Utilizing the Driver-Pressure-State-Impact-Response Framework in Environmental Management Education

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Abstract
Individuals and societies must be environmentally literate to accept accountability and consequently work in partnerships to manage natural resources sustainably. There is a need for individuals and societies to gain wisdom regarding the complex and intertwined drivers that underlie environmental issues. This paper proposes the use of the Driver-Pressure-State-Impact-Response framework as a tool for environmental management education to effectively develop critical thinking skills among students. A narrative review of the literature was conducted to explore the possibility of using the framework as a pedagogical tool. The framework allows students to see a comprehensive and interdisciplinary perspective of environmental issues as a basis for formulating analytically sound solutions. The outcome of this teaching methodology is a balance between theory and practice. The framework promotes a methodical and organized approach to teaching environmental management--enabling the link between traditional input or student activity-oriented methods to complex, high-quality learning outcomes.

Keywords: DPSIR Framework; Environmental Management; Environmental Management Education; Sustainability; Sustainable Natural Resources Management

1. Introduction

The Driver-Pressure-State-Impact-Response (DPSIR) framework emphasizes an interdisciplinary process of solving real environmental problems. It describes how people put pressure on an environmental system in their quest for relative goods and services (drivers); how people mediate their uses of an environmental system by creating internal opportunity costs within their activities (pressures) or by shaping the impacts of their uses through a series of political decisions and market interventions; the conditions and trends of an environmental system as observable from the perspective of valuation, people's preferences, and indicators; and, finally, the environmental policy responses intended to discipline people's interactions with an environmental system to beneficially change conditions and trends and deter health hazards. The expected outcome of this interdisciplinary knowledge and critical thinking skill is a decision maker who can identify analytically sound solutions to complex environmental problems that is still politically acceptable. (Chen et al., 2020; Elliott and O'Higgins, 2020; Agramont et al., 2022)

There is an increasing need for environmental professionals who can identify analytically sound solutions to complex environmental problems. Successful problem-solving of this type often requires interdisciplinary knowledge and critical thinking skills developed through work experience with different teams of professionals.

Often it is difficult to build a broad interdisciplinary foundation in educational programs, while required communication and teamwork skills are commonly ignored. Instruction that incorporates the lessons of real cases within a framework for conceptualizing environmental analysis can provide a solid foundation in disciplines such as the law, ecology, economics, business management, and engineering. The DPSIR framework provides an ideal foundation for this type of environmental management education. (Gupta et al.2020; Kanwal et al.2022; Salehpour et al.2021; Chen et al.2022)

1.1. Importance of Teaching Environmental Management

Individually, or as a society, we must regain wisdom regarding the complex and intertwined drivers that underlie environmental issues. We must become accountable, and environmentally literate, and we must work in partnerships managing natural resources sustainably. This will only be achieved if we can focus on the environmental conversations of the future.

While the impacts of human activities have been superimposed on the natural environmental system for centuries, the acceleration of negative social, ecological, and economic impacts caused by environmental degradation has been a more recent concern. Due to the urgency of the problems stemming from environmental damage and social injustice, educators developed courses that attempt to integrate complex, amorphous constructs into campus learning environments. Audiences as diverse as future resource managers, business analysts, engineers, and scientists undertake interdisciplinary examination of interpersonal communications, environmental value systems, organizational dynamics, and global policy to develop critical thinking and applied skills that can be utilized to effect positive environmental change. (Zhang et al., 2021; Magazzino et al., 2022; Onifade et al., 2021; Sarkodie et al., 2020)

1.2. Frameworks in Environmental Management Education

Guidelines have not been absent, especially regarding using conceptual and methodological frameworks from economic, social, and environmental sciences in higher-level post-graduate courses and programs. Works produced thus far suggest the inclusion of commercial value, transaction costs, conflict, concepts of social demand, and determining critical production capacities aim to provide students with the ability to interpret institutional scenarios, regulate and measure business performance and situation, and intensify possible influences of devices such as market, state, and collective action. These works seem to be interested in reconciling the importance of enterprise comprehension with the challenges and implications of the fruitfulness of these subjects in managerial functioning. (Cuypers et al., 2021; Kazancoglu et al., 2021; Roeck et al., 2020; Chygryn et al., 2020)

Despite the wide proliferation of environmental management programs at the undergraduate, master, and doctoral levels and the international and transnational efforts towards designing environmental management systems, tools, and norms aimed at standardizing those programs, there is some consensus that, on balance, environmental management education has been largely isolated from theoretical and academic approaches that could provide it with high analytical capabilities. Indeed, there have been special attempts to integrate aspects of the social question in business administration, social sciences, and environmental sciences. Such programs, by attracting more professionals in different sectors to work on aspects of the social question of the environment, could, in part, attenuate the critical points encountered in traditional environmental management programs. (Ardoin & Bowers, 2020; Fawehinmi et al., 2020; Lackéus, 2020)

2. Overview of the DPSIR Framework

In this review, we propose that the use of these integrated systems frameworks may facilitate the critically needed integration and application of multiple set assessment methods necessary for the formation of adaptive environmental management strategies.

The DPSIR framework is based on general cause-effect relationships which can be used to describe the drive for greater use of the natural environment, to assess the deterioration in environmental quality, and to relate human activities to the status of the environmental resources that support them. Characterizing relationships among drivers, human activities, environmental pressures, state of the environment, and environmental response

requires a substantial amount of data. Moreover, there exists a multitude of formal frameworks, developed for other purposes, that are designed to support environmental science. (Qu et al., 2020; Mandić, 2020; Salehpour et al., 2021)

The requirements of environmental monitoring and assessment are changing. The scope of environmental problems is broadening, the situation is more complex, and the nature of environmental issues is more diverse than ever before. In these circumstances, a comprehensive assessment is needed to determine the nature, extent, and consequences of the pressures of human activities on the environment to design coherent policies and to evaluate the efficacy of their implementation.

The DPSIR framework, developed by the European Environment Agency, is designed to provide structure to the assessment and reporting of environmental resource management information. The framework is based on the view that environmental policy and management are concerned with the management of human activities in relation to the global environment, but that the most direct and feasible management interventions are at the national and regional level based on readily available environmental and socio-economic data. (Mosaffaie et al., 2021; Elliott and O'Higgins, 2020)

2.1. Definition and Components of DPSIR

The four major components (Driving forces, Pressures, States, and Impact) of the DPSIR framework are described below. Driving forces ("D") reflect the social and economic aspects that express human purposes to meet specific needs and wants, while pressures ("P") are the stress caused by driving forces that are exerted upon the environment. The state ("S") is derived from the environment, which absorbs the pressures, and finally, the impact ("I") is the result of the state's release, which has direct or indirect consequences on the environment. The driving forces of environmental change are the demographic, societal, economic, technological, behavioral, and cultural factors that underpin human influence on the environment. These factors include population trends and characteristics, which determine the demands placed on the environment, and societal and economic characteristics which determine the way human beings meet their demands. (Gupta et al.2020; Mandić, 2020; Tesfaldet & Ndeh, 2022)

The DPSIR framework is a scientifically based tool that can increase our understanding and provide a clearer view of the complex interactions between the driving forces of the economy, the pressures exerted on the environment, the degradation or improvement of the environment, and the response strategies formulated. The framework is based on the recognition that the changes caused in the environment or changes in the use of the environment due to human activities result from a linear sequence of interactions and relationships among key elements in society, the economy, and the environment. Inversely, society's well-being is dependent upon the state of the environment from which a variety of outputs are produced. In addition, the framework emphasizes the fact that the success of human intervention and economic activities is influenced by the current state of the environment and the changes taking place in that state.

3. Integration of DPSIR in Teaching

The suggested teaching concept is based on the classical DPSIR approach used in environmental science and policy. Transferring this concept to environmental education and a theory-practice mixed classroom setting enables us to link traditional input or student activity-oriented methods to complex, high-quality learning outcomes. At least, the high consistency of the DPSIR concept used in this study appears as a general strength in the context of teaching environmental sciences (ES). These findings can influence future research as well as curricula development in the field of environmental education and education for sustainable development. The overall approach is a teacher and lecturer-related movement away from the prevalent stimulus-gathering challenges towards recent dilemmas in the teaching of these fundamental concepts, especially if ES are in the focus of education. (Dzoga et al., 2020; Salehpour et al., 2021; Obubu et al., 2022)

Our teaching concept is based on the DPSIR framework used in environmental policy and science. We suggest that driver-pressure (DP) and state-impact (SI) descriptions and beliefs co-define environmental situations and

problems. Teacher and lecturer-related driver-pressure-impact (DPI) aspects, as well as state-impact descriptions and beliefs, urge for student-centered driver-pressure-state-impact-response (DPIR) analyses in ES teaching.

Teaching of ecosystem services has seen a significant and widespread boom in recent years in the mother discipline - environmental science and ecology, as well as in related fields. The recognition and understanding of ES have become increasingly pivotal in public policy, curricula, and education systems across the globe. Hence, all academic institutions, educators, and policymakers are intensely pressured to embrace and harness the demands and intriguing opportunities presented by this recent trend, ensuring that the teaching, research, and practical applications related to ES are effectively integrated into their respective domains. Such a collective effort will undoubtedly contribute to promoting environmental awareness, sustainability, and the safeguarding of essential natural resources for future generations. (Huge et al., 2020; Gasparatos, 2020; Kissling & Bell, 2020; Lin & Egerer, 2020)

3.1. Benefits of Using DPSIR in Education

A systemic approach is used to analyse the interactions between driving forces, pressures, the state of the environment, and the impacts these changes might have. The DPSIR framework also can help to arrange materials and guide students for interviews, discussion points, and business plan projects. The interview technique helps the students to understand complex problems and provides a broad picture of issues. The structure of representation establishment is to aid each of the four basic relationships of driving pressure, state impact, response to political teachers, and understanding that different classes are involved in the development of the relationship. Students and teachers can analyse problems deeply through DPSIR levels. The DPSIR framework allows the students to realize what each class can do in a developmental relationship; it should provide a more desirable representation of the relationship. (de et al., 2020; Loizia et al., 2021)

The DPSIR framework promotes a methodical and organized approach to teaching environmental management. It covers distinct yet interrelated ideas, illustrating different activities and sources that impact the environment. It equips students with knowledge of how the environmental state can change through various activities. The framework allows for analysis of the interactions between environmental pressures, state, impacts, and responses. It considers the long-term consequences of human actions and emphasizes the need for sustainable practices. It also serves as a valuable tool for policymakers and decision-makers in evaluating the environmental impacts of different policy options. Finally, the DPSIR framework enhances environmental education by offering a structured and multi-dimensional approach to understanding environmental issues and promoting sustainable development. (Mosaffaie et al., 2021; Kyere-Boateng & Marek, 2021; Swangjang and Kornpiphat, 2021)

4. Case Studies and Examples

This section provides several quick examples of how the DPSIR framework has been utilized in educational settings. The University of Michigan Business School is using the DPSIR framework in a project that examines the role of nonmarket forces in shaping corporate environmental strategy. The DPSIR model underpins the research framework used in the project, which is aimed directly at the graduate business studies audience. (Andries et al., 2022; Grigg, 2021) The Moore School of Business at the University of South Carolina designed its Greening of Business program using a framework partially based on the DPSIR characteristics. The green criteria the students used to evaluate a series of companies were classified in terms of inputs, such as toxic chemicals; releases, such as wastes and emissions; and responses, such as corporate environmental policies. Based in part on their analyses of company data, the students formulated green priorities for each company. (Cousins & Hill, 2021; Labianca et al., 2020; den Heijer & Coppens, 2023; Miah et al.2023)

4.1. Real-world Applications of DPSIR in Environmental Management

Similarly, various organizations use their variants of DPSIR, incorporating indicators and assessment criteria to track environmental issues in specific ways. Ecological production research, modelling changes in natural resources, focusing on the development process and ecological impacts consider several groups of indicators (pressures, load, effects, state, impact), called DPSIR, linkages with this study, and identify 59 core indicators to summarize the whole issue. Each of these different applications slightly modifies the DPSIR layout, but still shows

the sequential and cascade nature of environmental management needs. (Ikram et al., 2021; Vadén et al., 2020; Visentin et al., 2020; De et al., 2021)

For instance, the comprehensive DPSIR framework was effectively utilized across various European nations as a vital component of the meticulous procedure involved in the establishment of a collaborative and harmonized Environmental Information and Reporting System, widely known as INSPIRE. Remarkably, the renowned European Environment Agency (EEA) consistently adopts the highly efficient DPSIR methodology in their state-of-the-environment reporting endeavors, thereby ensuring accurate and holistic assessment of environmental conditions. Moreover, the esteemed EEA diligently incorporates the DPSIR framework within their robust evaluations of the Marine Strategy Framework Directive, further accentuating its indispensability and undeniable efficacy.

A multitude of instances exist in which the DPSIR framework was employed for practical examination of intricate environmental matters, and frequently in a manner analogous to the one elucidated in this course. These mainly comprise comprehensive evaluations for entire nations or localities, frequently utilized in the context of environmental reporting or comparable undertakings. (Cao & Bian, 2021; Carnohan et al., 2023)

5. Challenges and Limitations

Far from addressing issues of context, learning processes, power and control, knowledge society, or epistemology, the DPSIR's emphasis on environmental management education calls for expanded approaches. This is to avoid entrenching Western environmental culture as universal and to enable a broader appreciation of cultural diversity that considers the diversity of societal issues in different regions of the world in their responses to the critical environmental challenges all societies face. As a global web of international environmental education organizations, networks, and institutions, that aim to provide leadership, networking services, and other programs, the education currently contributes to these issues. It does so by the responsibility of promoting a sustainable future for the planet. The true potential of environmental education can be harnessed through building platforms for discussion, knowledge-sharing, and policy development and implementation between Indian and international environmental education professionals. (Henri et al., 2021; White, 2020; Mucioki et al., 2021)

The policy, case study, and management response contributions offer more than just the application of DPSIR elements in the environmental management education and learning environment. These elements also provide the basis for identifying challenges and limitations in doing so. Illustrative of these challenges and limitations is the problem of being Eurocentric. Both Western environmental management and education appear to be considering the learning aspects of DPSIR as addressing both generic and universal challenges and processes. Such processes are the product of a Western worldview that lacks the dynamic, context-specific, and pluralist variability inherent within local knowledge systems.

5.1. Obstacles to Implementing DPSIR in Education

The application of the DPSIR within organizations is also complex. An example of practical application has been found regarding the management of a region's sustainable development. However, our review has shown that the application of the DPSIR framework in policy and management methods is not yet systematized. Furthermore, the consensus within the community about what DPSIR exactly is and what it represents is far from uniform. The exact constructs of DPSIR are generally either not discussed, not operationalized, or are used in a general and superficial way. Furthermore, the relation between the constructs within the DPSIR framework is not yet understood. Although there has been an increase in research, our study thus far has not yet been able to find research that has theoretically grounded the constructs of the DPSIR. Most of the literature that discusses the relation between the constructs of the DPSIR does so in a casual way, not relating DPSIR on an organizational level, or not at all. Only a few research studies make a direct link between cause-and-effect chains and the DPSIR constructs, especially on an operational level. (Quevedo et al., 2023; Akbari et al., 2021; Mandić, 2020; Quevedo et al., 2021)

The Belgian chemical agency has developed a practical advisory guideline on how to select and use indicators, with a special focus on regional authority as the target. A few authors have emphasized the learning dimension of the relationship between policymakers and scientists. The DPSIR framework has thus attracted interest and has been

greeted by both scholars and politicians as a promising policy-support tool. However, it has been noted that in practice, the application has been mainly theoretical. In an evaluation of European environmental reporting, scholars found the quality of reporting far from consistent. (EFSA et al.2021; Knight et al.2021; Health Organization, 2020; Ougier et al., 2021; Marx-Stoelting et al., 2023)

6. Conclusion

Graduates from environmental courses who are entering the workforce are equipped with a robust theoretical and contextual framework that links the scientific and social science disciplines. Using the DPSIR framework and the linked teaching methodologies, skills such as problem-solving, strategic thinking, and critical evaluation are developed by learners. These unique skills, coupled with a consideration of organizational and sectoral pressures, enable students to fully assess different organizations' strategic policies and operational needs. This creates a wealth of attributes that are vital for environmental graduates entering the workforce, allowing organizations to take a positive and forward-thinking approach to environmental pressures. By reinvigorating the DPSIR framework and the connected teaching and learning support systems, more of the employment skills required within the industry may be directly addressed during the undergraduate stage.

As demonstrated in the paper, a structured approach to teaching environmental management can bring clarity and coherence to the teaching process while developing potential environmental managers' skills. The DPSIR framework has been proven to be suitable for organizing and structuring the varied range of skills and conceptual ideas required by undergraduates studying environmental management-related degrees. The coherence it provides makes it easier for students to see the relationships between different elements of the wider picture and how they might facilitate decisions. Importantly, this approach can also provide undergraduate students with an understanding of how their learning can be practically applied in a meaningful way. If students understand the relevance of their learning, they can become more motivated to develop and master both practical and theoretical skills.

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