

EFIGE: a conceptual model for integrating environmental education, social participation and environmental governance for sustainability

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Abstract

Environmental challenges increasingly require approaches capable of integrating education, social participation, and governance mechanisms to promote sustainability. In this context, this study aimed to examine the relationships among environmental education, environmental citizenship, social participation, and participatory environmental governance by proposing the EFIGE model (Formal, Informal Education and Environmental Governance) as an integrative conceptual framework. The research was conducted as a qualitative theoretical-conceptual study developed in four analytical stages: literature review, document analysis, conceptual systematization, and model development. The analysis encompassed theoretical contributions related to environmental education, human capabilities, communities of practice, and environmental governance, as well as national and international sustainability frameworks. The results identified four interdependent dimensions that support sustainability-oriented processes: environmental education and environmental citizenship development, human capability expansion, collaborative learning through communities of practice, and participatory environmental governance. The integration of these dimensions resulted in the development of the EFIGE model, which articulates educational processes, social participation, collective knowledge construction, and governance mechanisms within a single analytical framework. The model highlights the role of human capabilities and social learning in strengthening environmental citizenship and fostering more inclusive and collaborative decision-making processes. It is concluded that EFIGE represents an innovative conceptual contribution that may support future research, environmental education programs, community-based initiatives, and participatory governance strategies aimed at advancing sustainability.

Keywords: *environmental citizenship; participatory governance; communities of practice; collaborative learning; sustainability.*

Introduction

Contemporary socio-environmental challenges require approaches capable of integrating scientific knowledge, social participation, and governance mechanisms aimed at sustainability. Issues such as climate change, biodiversity loss, ecosystem degradation, and the unsustainable use of natural resources demonstrate that exclusively technical or regulatory solutions are insufficient to promote lasting changes in the relationship between society and the environment (McCormick, 1992; Ga-

dotti, 2009). In this context, environmental education has been recognized as a strategic instrument for building more sustainable societies capable of reconciling human development, environmental conservation, and social justice (Bursztyn, 2004; Guimarães, 2004; Loureiro, 2004). Since the Tbilisi Conference held in 1977, environmental education has been understood as a continuous process aimed at developing individuals and communities capable of critically understanding the relationships between society and nature

and actively participating in the resolution of environmental problems (UNESCO, 1978). This perspective has been further strengthened by discussions on sustainable development and the Sustainable Development Goals (SDGs), particularly those related to quality education, social participation, and the promotion of more inclusive and sustainable institutions (United Nations, 2015). In Brazil, the National Environmental Education Policy establishes that environmental education should be integrated across all educational levels and modalities in a permanent and articulated manner (Brasil, 1999). This orientation was subsequently reinforced by the National Curriculum Guidelines for Environmental Education, which advocate the transversal integration of socio-environmental issues across different fields of knowledge. According to critical environmental education should not be limited to the transmission of ecological content but should promote educational processes capable of fostering critical awareness, collective responsibility, and active citizenship (Guimarães, 2004; Loureiro, 2004). However, several studies have demonstrated that the implementation of environmental education in educational institutions still faces important challenges. Among the main obstacles are curriculum fragmentation, insufficient teacher training, difficulties in interdisciplinary integration, and the predominance of conservationist approaches focused primarily on individual behavioral change (Macedo, 1999; Bernardes and Prieto, 2013; Carvalho et al., 2018). Furthermore, research conducted in Brazilian schools indicates that many educators experience difficulties in incorporating environmental issues in a transversal and contextualized manner that reflects local realities (Ferrari et al., 2019). The literature also indicates that the effectiveness of environmental education depends on its ability to extend beyond the boundaries of formal schooling and engage broader society. Experiences developed in both formal and non-formal educational settings demonstrate that participatory educational processes promote collective knowledge construction, environmental awareness, and social empowerment (Freire, 1999; Loureiro, 2006). In this regard, extension programs and community-based initiatives have highlighted the potential of collaboration between educational institutions and different sectors of society to foster critical reflection and mobilization around socio-environmental issues (Barbado et al., 2022). Studies conducted in different educational contexts reinforce this perspective. Educational activity circuits designed for environmental educator training have demon-

strated potential to stimulate active participation and collective knowledge construction (Barbado et al., 2019). Similarly, environmental education strategies implemented in public and non-formal spaces have contributed to raising public awareness of local environmental issues and strengthening interactions between schools and communities (Oliveira et al., 2020). Such evidence suggests that environmental learning tends to be more effective when associated with participation, dialogue, and practical experience. Social participation represents a central element in this process. According to the capability approach, development should be understood as the expansion of human freedoms and individuals' capabilities to make choices and act within society (Sen, 2000). Among these capabilities, education occupies a strategic position because it expands access to knowledge, strengthens autonomy, and promotes citizenship. Consequently, better-informed and more capable individuals are more likely to participate effectively in decision-making processes related to public policies and environmental management (Sen, 2000; Nussbaum, 2011). The relationship between education and participation is also linked to the development of a sense of belonging to territories and communities. Studies conducted in rural contexts demonstrate that integrating environmental education with local realities contributes to valuing community knowledge, strengthening collective identity, and enhancing individuals' commitment to environmental conservation and sustainable development (Sen, 2000; Nussbaum, 2011). Therefore, environmental education can be understood not only as a tool for ecological awareness but also as a mechanism for strengthening citizenship and democratic governance. This perspective is closely related to contemporary debates on environmental governance, which emphasize the need for collaborative processes involving governments, educational institutions, civil society organizations, the private sector, and local communities in addressing complex environmental challenges (Fraser, 2009; Sorrentino, 2011). Shared governance requires mechanisms of dialogue, cooperation, and collective learning, enabling different forms of knowledge to contribute to the formulation and implementation of more effective and socially legitimate public policies (De Angelis, 2016, 2018). Among the approaches associated with collaborative learning, communities of practice stand out as groups of individuals who share common interests and develop knowledge collectively through continuous interaction, experience exchange, and joint

problem-solving (Wenger, 2006, 2023). These communities facilitate the integration of scientific knowledge and local knowledge, strengthen cooperation networks, and expand opportunities for social participation in sustainability-related decision-making processes. Although the literature provides important contributions regarding environmental education, citizenship, governance, and collaborative learning, these themes are frequently addressed in a fragmented manner. Studies that seek to integrate formal environmental education, non-formal awareness-raising initiatives, and participatory governance mechanisms based on collective knowledge construction within a single conceptual framework remain scarce. To address this gap, the present study aims to discuss the relationships among environmental education, citizenship, social participation, and shared governance by proposing the EFIGE model (Formal, Informal Education and Environmental Governance). Grounded in the capability approach and the concept of communities of practice, the model seeks to integrate educational processes and participatory mechanisms capable of strengthening environmental citizenship, expanding collective learning, and contributing to the development of more effective public policies for sustainability.

Materials and Methods

This study is characterized as a qualitative theoretical-conceptual investigation developed through literature review and document analysis. The research aimed to understand the relationships among environmental education, citizenship, social participation, environmental governance, and communities of practice, with the purpose of proposing a conceptual model capable of integrating these elements within a sustainability-oriented perspective. The study was conducted in four complementary stages. The first stage involved the identification and analysis of theoretical frameworks related to environmental education, sustainable development, social participation, citizenship, environmental governance, and collaborative learning. Books, scientific articles, institutional documents, and national and international regulations widely recognized in the field were consulted, including the National Environmental Education Policy (Brasil, 1999), the Tbilisi Declaration (UNESCO, 1978), the 2030 Agenda for Sustainable Development (United Nations, 2015), as well as studies on critical environmental education (Freire, 1994; Loureiro, 2004; Guimarães, 2004) the capability approach (Sen, 2000; Nussbaum, 2011), and

communities of practices (Wenger, 1998, 2006). The selected literature was chosen based on its scientific relevance, theoretical contribution, and recognition within the fields of environmental education, environmental governance, human capabilities, and collaborative learning. Classical references were combined with contemporary studies and official Brazilian and international policy documents to ensure theoretical consistency, conceptual comprehensiveness, and alignment with the objectives of the proposed conceptual model. In the second stage, a document analysis of legal frameworks and guiding documents related to environmental education and social participation was carried out. The purpose of this analysis was to identify principles, guidelines, and institutional mechanisms associated with citizenship development, the transversal integration of environmental education, and participatory governance. The third stage consisted of the systematization of concepts identified in the literature. The selected references were organized into four analytical categories: (i) environmental education and environmental citizenship development; (ii) human development and capability expansion; (iii) collaborative learning and communities of practice; and (iv) participatory environmental governance. This categorization enabled the identification of theoretical convergences and complementary relationships among the different fields of knowledge addressed in the study. In the fourth stage, an integrative analysis of the theoretical frameworks and evidence identified in the literature was conducted, resulting in the development of the EFIGE model (Formal, Informal Education and Environmental Governance). The model was built on the premise that sustainability depends on the articulation among educational processes, the development of human capabilities, social participation, and collaborative mechanisms for knowledge production and sharing. In addition to classical theoretical references, studies reporting environmental education experiences in formal and non-formal contexts were also considered. These included extension activities, educational workshops, hands-on learning experiences, community projects, and initiatives aimed at strengthening social participation and fostering a sense of belonging (Barbado et al., 2019, 2022; Oliveira et al., 2020; Mora et al., 2020, 2021). Such experiences contributed to the identification of operational elements capable of connecting the conceptual proposition to educational and socio-environmental realities. Finally, the propo-

sed model was organized as an integrative framework intended to support theoretical reflections and future practical applications related to environmental education, citizenship, and participatory governance for sustainability.

Results

The analysis of theoretical and documentary references allowed the identification of four central dimensions underlying the construction of the EFIGE model (Formal, Informal Education and Environmental Governance): (i) environmental education and environmental citizenship development; (ii) human development and capability expansion; (iii) collaborative learning through communities of practice; and (iv) participatory environmental governance. Although widely discussed in the literature, these dimensions are often addressed separately. The findings indicate that their integration provides a broader perspective for understanding environmental citizenship development and the promotion of sustainability.

Environmental education and environmental citizenship development

The analyzed studies converge in recognizing that environmental education extends beyond the simple transmission of ecological knowledge and constitutes a formative process aimed at developing values, attitudes, and competencies related to citizenship and sustainability (Freire, 1994; Guimarães, 2004; Loureiro, 2004). This understanding is consistent with international environmental education guidelines and with the principles established by the Brazilian National Environmental Education Policy (UNESCO, 1978; Brasil, 1999). The literature demonstrates that approaches focused exclusively on individual behavioral change present limitations in addressing complex socio-environmental problems, as they tend to overlook the social, economic, cultural, and political factors involved in environmental degradation (Macedo, 1999; Loureiro, 2006). In contrast, critical and participatory approaches promote a systemic understanding of environmental issues and expand opportunities for active citizenship. Experiences developed in both formal and non-formal educational settings reinforce this perspective. Educational activity circuits, thematic workshops, and extension initiatives have demonstrated potential to stimulate active participation, promote collective knowledge construction, and strengthen environmental awareness (Barbado et al., 2019; Oliveira et al., 2020; Melo et al., 2023). These findings indicate that the effectiveness of

environmental education depends not only on knowledge acquisition but also on the active engagement of participants in educational processes.

Human development and capability expansion

The second dimension identified concerns the relation-ship between education, human development, and so-cial participation. The literature review revealed that education constitutes one of the main mechanisms for expanding human capabilities, increasing individuals' opportunities for choice, autonomy, and participation in social and political life (Sen., 2000; Nussbaum, 2011). From this perspective, sustainability depends not only on the availability of natural resources or regulatory instruments but also on citizens' ability to understand the challenges affecting their territories and actively contribute to the development of collective solutions. The expansion of human capabilities strengthens environmental citizenship and supports ore democratic and inclusive decision-making processes. Studies conducted in rural contexts reinforce this understanding by demonstrating that valuing local knowledge and strengthening the sense of territorial belonging contribute to collective identity formation and encourage engagement in environmental conservation and sustainable development initiatives (Mora et al., 2020, 2021). Consequently, environmental education assumes a strategic role in promoting autonomy, citizenship, and social participation.

Collaborative learning and communities of practice

The third dimension identified relates to collaborative learning and communities of practice. The studies reviewed indicate that sustainability-related knowledge is more effectively constructed through collective processes involving interaction, experience sharing, and collaborative problem-solving (Wenger, 1998, 2006)). Communities of practice facilitate the the integration of different forms of knowledge, including scientific knowledge, local knowledge, and practical experience. This characteristic promotes social learning and enhances the capacity of groups to address complex sustainability challenges collaboratively. Socio-environmental mobilization experiences also demonstrate the relevance of these collaborative structures. The international Cielo Siete campaign highlighted the capacity of educational institutions, students, and local communities to engage in critical reflection on global and local socio-environmental issues while strengthening cooperation networks and social participation (Barbado et al., 2022). These initiatives share characteri-

ristics of communities of practice by encouraging continuous learning, collective knowledge construction, and collaborative engagement.

Participatory environmental governance

The fourth dimension identified concerns participatory environmental governance. The literature demonstrates that contemporary socio-environmental challenges require decision-making processes capable of integrating multiple stakeholders and different forms of knowledge (Fraser, 2009; Sorrentino, 2011). The findings indicate that social participation strengthens the legitimacy of public policies, enhances social accountability. Transparency and social accountability, and promotes solutions that are better adapted to local realities. Furthermore, participatory governance creates opportunities for knowledge generated in educational settings to be incorporated into environmental planning and management processes (De Angelis, 2016, 2018). The articulation among education, participation, and governance also contributes to the developing citizens who are more aware of their socio-environmental rights and responsibilities, thereby strengthening democratic go-vernance and increasing society's capacity to respond to contemporary environmental challenges.

Integration of dimensions and development of the EFIGE model

The integrated analysis of the theoretical frameworks revealed that the four identified dimensions do not constitute independent processes but rather complementary components of the same sustainability-oriented dynamic. As illustrated in Figure 1, formal and informal education function as input elements capable of promoting the development of human capabilities and environmental citizenship. These capabilities foster social participation and the formation of communities of practice, strengthening collaborative learning processes and collective knowledge production. The model proposes that formal and informal education function as input elements that promote the development of human capabilities and environmental citizenship. These capacities foster social participation and the formation of communities of practice, strengthening collaborative learning and collective knowledge construction. The resulting inter-actions contribute to participatory governance and support sustainability in its environmental, social, economic, and institutional dimensions. The interaction among these elements contributes to strengthening participatory governance, understood as a process based on dia-

logue, cooperation, and shared responsibility among different social actors. As a result, the integration of education, participation, and governance creates favorable conditions for achieving sustainability in its environmental, social, economic, and institutional dimensions. Based on this articulation, the EFIGE model (Fig. 1) was developed as an integrative conceptual framework designed to connect educational processes, human development, social learning, and participatory governance. The theoretical foundations of the model components are presented in Table 1, while its conceptual implications and po-tential applications are discussed in the following sec-tion.



Figure 1. Conceptual structure of the EFIGE model. Source: Prepared by the authors based on Freire (1994), Sen (2000), Wenger (1998,2006), Loureiro (2004), Nussbaum (2011), and Sorrentino (2011)

Table 1. *Theoretical foundations and contributions of the EFIGE model components. Source: Prepared by the authors (2026)*

Component	Main References	Contribution to the EFIGE Model
Formal environmental education	Freire (1994); Loureiro (2004); Guimarães (2004)	Development of environmental knowledge, critical awareness, and citizenship
Informal environmental education	UNESCO (1978); Gadotti (2009)	Social engagement and community-based learning
Human capabilities and environmental citizenship	Sen (2000); Nussbaum (2011)	Expansion of autonomy, participation, and decision-making capacity
Communities of practice	Wenger (1998; 2006)	Collaborative learning and collective knowledge construction
Participatory environmental governance	Fraser (2009); Sorrentino (2011)	Shared decision-making and stakeholder engagement
Territorial belonging and social participation	Mora et al. (2020; 2021)	Strengthening local identity, commitment, and environmental responsibility

Discussion

The EFIGE model as an integrative framework for environmental education and participatory governance

The results revealed that environmental education, human capability development, collaborative learning, and participatory governance are interdependent dimensions that, although extensively discussed in the literature, are often addressed separately. The primary contribution of the EFIGE model lies in the integration of these elements into a single conceptual framework capable of connecting educational processes, social participation, and governance mechanisms aimed at sustainability. Traditionally, environmental education initiatives have focused on ecological awareness and individual behavioral change. Although such approaches remain relevant, several authors have argued that they present limited effectiveness when disconnected from the social, political, and institutional contexts that shape environmental problems (Freire, 1994; Guimarães, 2004; Loureiro, 2004). In this regard, the EFIGE model expands conventional perspectives by incorporating environmental citizenship, collaborative learning, and participatory governance as central components of environmental education. The conceptual structure of the model is grounded in the understanding that sustainability depends not only on environmental knowledge acquisition but also on individuals’ capacity to participate actively in decision-making processes affecting their communities and territories. This perspective is closely aligned with the capability approach, which conceptualizes development as the expansion of

substantive freedoms and opportunities for individuals to act, choose, and influence societal outcomes (Sen, 2000).

From education to collective action

One of the distinguishing features of the EFIGE model is the articulation between formal and informal educational processes. The literature demonstrates that learning related to environmental issues occurs across multiple social spaces and is not restricted to educational institutions (UNESCO, 1978; Loureiro, 2006). Consequently, schools, universities, community organizations, social movements, governmental agencies, and local communities play complementary roles in the development of environmental citizenship. The educational experiences analyzed in this study reinforce this understanding. Participatory methodologies implemented in formal and non-formal contexts have demonstrated the capacity to strengthen environmental learning, stimulate critical reflection, and encourage active engagement among participants (Barbado et al., 2019; Sen, 2000; Oliveira et al., 2020). Likewise, collective mobilization initiatives aimed at sustainability have highlighted the importance of interaction among different social actors in generating shared responses to socio-environmental challenges (Barbado et al., 2022). Within this perspective, environmental education is no longer viewed solely as a process of knowledge transmission but as a mechanism for social mobilization and collective empowerment. The transformation of knowledge into collective action represents a fundamental condition for strengthening environmental citizenship and enhancing the effectiveness of sustainabi-

lity-oriented public policies.

Communities of practice as an innovative component of the model

Another innovative aspect of the EFIGE model is the incorporation of communities of practice as a structural mechanism for collaborative learning. Although widely applied in studies related to knowledge management and organizational learning, communities of practice remain relatively underexplored within environmental education research. Communities of practice are social learning structures through which individuals develop competencies, exchange experiences, and collectively construct knowledge (Wenger, 1998, 2006). By incorporating this concept, the EFIGE model expands opportunities for interaction among different sectors of society, facilitating knowledge exchange and strengthening connections between scientific knowledge and local experience. This characteristic is particularly relevant given the complexity of contemporary environmental challenges, whose solutions require interdisciplinary approaches and the active involvement of multiple stakeholders. Issues such as biodiversity conservation, water resource management, climate change adaptation, and territorial planning cannot be effectively addressed by isolated actors. Communities of practice therefore play a strategic role in promoting continuous dialogue, collaborative learning, and the co-creation of innovative solutions.

Contributions to participatory environmental governance

Environmental governance has been recognized as one of the principal challenges for implementing sustainability-oriented public policies. The literature indicates that participatory decision-making processes tend to generate greater legitimacy, transparency, accountability, and long-term social commitment (Fraser, 2009; Sorrentino, 2011). In this context, the EFIGE model presents significant potential for strengthening governance mechanisms by establishing connections among education, knowledge production, and social participation. Through the development of human capabilities and environmental citizenship, environmental education contributes to improving the quality of public participation and supports more inclusive decision-making processes (Sen, 2000). Furthermore, the sense of territorial belonging identified in environmental education studies (Mora et al., 2020, 2021) suggests that participation becomes more effective when individuals recognize their connection to the communities and ter-

ritories in which they live. Consequently, the EFIGE model goes beyond environmental awareness by promoting social bonds and collective identities capable of supporting long-term participatory governance processes.

Strengths and limitations of the EFIGE model

Among its main strengths, the EFIGE model integrates theoretical contributions from environmental education, the capability approach, communities of practice, and participatory governance into a coherent analytical framework. This integrative perspective enables the model to be applied across a wide range of contexts, including formal educational institutions, community-based initiatives, university extension programs, watershed committees, environmental councils, and other participatory governance arenas. Additionally, the model contributes to bridging the gap between educational processes and governance mechanisms by highlighting the role of social learning and collaborative knowledge production in sustainability transitions. This integration represents an advance over fragmented approaches commonly found in the literature and provides a broader understanding of how environmental citizenship can contribute to sustainability outcomes. However, some limitations should be acknowledged. As a theoretical-conceptual proposition, the EFIGE model has not yet been empirically validated in specific contexts. Therefore, future studies should test and refine the model through case studies, participatory action research, and evaluations of environmental education programs. Such investigations may contribute to assessing its applicability, effectiveness, and adaptability across different social, environmental, and institutional settings. Overall, the EFIGE model offers a theoretical contribution by proposing an integrated approach to environmental education that articulates human development, collaborative learning, environmental citizenship, and participatory governance within a single analytical framework. By connecting educational processes with collective action and governance mechanisms, the model provides new perspectives for research and practice aimed at advancing sustainability.

Conclusions

This study examined the relationships among environmental education, environmental citizenship, social participation, and participatory governance by proposing the EFIGE model (Formal, Informal Edu-

cation and Environmental Governance) as an integrative conceptual framework for sustainability. The analysis demonstrated that environmental education, human capability development, collaborative learning, and participatory governance constitute complementary and interdependent dimensions that support the construction of more sustainable and democratic societies. The findings indicate that environmental education achieves greater transformative potential when associated with social participation, a sense of territorial belonging, and collective knowledge construction. Within this perspective, the development of human capabilities, together with collaborative learning environments, strengthens environmental citizenship and enhances society's capacity to participate in sustainability-oriented decision-making processes. The principal contribution of this study lies in the development of the EFIGE model, which integrates environmental education, human development, collaborative learning, and participatory governance into a coherent analytical framework. By articulating these dimensions, the model offers a broader understanding of how educational processes can contribute to collective action, democratic governance, and sustainability. From a practical perspective, the EFIGE model may support the planning and implementation of environmental education programs, university extension initiatives, community-based projects, watershed committees, environmental councils, and other participatory governance arenas. Its conceptual structure also provides a useful framework for strengthening environmental citizenship and fostering collaborative responses to contemporary socio-environmental challenges. This study is subject to the limitations inherent to theoretical-conceptual research, since the proposed model has not yet been empirically validated. Future investigations should evaluate its applicability in different educational, community, and institutional contexts through case studies, participatory action research, and comparative analyses. Overall, the EFIGE model broadens the theoretical dialogue among environmental education, human development, collaborative learning, and participatory governance by integrating these dimensions into a single conceptual framework. It offers both an original contribution to environmental education research and a robust analytical foundation for future studies and practical initiatives aimed at promoting more resilient, inclusive, and sustainable societies.

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