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Integrating Environmental Education Into Physics Instruction: Insights From Teachers Regarding Students' Engagement

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ABSTRACT

In this research, we examine environmental education in the context of Moroccan secondary schools, focusing on the field of physics teaching. Our investigation is based on an analysis of empirical observations provided by physics teachers. To this end, a structured questionnaire was administered to 120 physics teachers from various high schools located in the academic area of Fez-Meknes in Morocco. The results clearly underline the importance of assimilating environmental education principles in the teaching of physics. This environmental education clearly favors the cultivation of students' inclination and disposition towards the subject. In addition, the questionnaire data also provide enlightening indications in favor of integrating environmental education paradigms into the didactic apparatus of physics-related knowledge in secondary education. This integration promises to develop sustainable skills in students, galvanizing their capacity to adopt environmentally friendly behaviors.

KEYWORDS

Physics; Environmental education; Students' interest; teachers' observations; Moroccan high school

INTRODUCTION

Environmental education has garnered global attention owing to its inherent significance for humanity (Alagoz & Akman, 2016). Contemporary environmental education primarily emphasizes nurturing individuals' motivation and competence to conscientiously manage natural resources (Bekhat et al., 2020; El Azzouzi, Elachqar, & Kaddari, 2023; Sukma et al., 2020). This concern manifests in multifaceted dimensions and interplays that necessitate elucidation for a comprehensive comprehension of the environmental domain. Notably, the objectives of environmental education intersect with diverse disciplinary domains, including physics education, wherein the pedagogical focus is directed toward imparting physics content while accentuating environmental dimensions (El Moussaouy et al., 2014).

Within Morocco, the educational system has, over the past two decades, adopted a pedagogical approach that underscores the incorporation of environmental education within the curriculum, particularly at the secondary education level. Environmental education wields the potential to impact students in myriad ways, changing their interests and attitudes toward the environment. It fosters the acquisition of knowledge, skills, interests, and affirmative attitudes toward the environment, nurturing responsible citizens equipped to comprehend the intricacies of natural systems and the interrelationships among environmental constituents (Singh & Rahman, 2012).

In response to the growing imperative of environmental education, teachers are compelled to integrate the ethos of environmental awareness. Conversely, scientific textbooks tend to emphasize informational and instructive styles (El Moussaouy et al., 2014; El-Batri et al., 2019), which can hinder students from actively participating in the construction of their knowledge and from developing constructive interests and attitudes toward the environment. While environmental themes can be integrated across diverse scientific disciplines, physics instructors encounter challenges in effectively incorporating environmental education within their instructional practices (Bekhat et al., 2020; Capone, 2022).

This present study seeks to discern varied perspectives of Moroccan physics teachers concerning the enhancement of environmental education within physics pedagogy. Furthermore, recognizing the limited explicit coverage of environmental concepts in physics textbooks, this study endeavours to assess the prevalence of diverse physics concepts that might facilitate the seamless integration of environmental education into physics curricula. Ultimately, the study aims to gauge the impact of environmental education on students' interests and attitudes towards secondary-level physics education, as perceived through the lens of physics teachers within their instructional contexts. The following research questions are posed to fulfil these objectives:

- How can environmental knowledge establish a sustainable and enduring interrelationship between physics and the environmental domain?
- What is the significance of environmental education in Moroccan secondary school physics instruction?
- What extent has environmental content been integrated into secondary school physics curricula?
- What is the influence of environmental education on students' enthusiasm and perspectives regarding the learning and teaching of secondary school physics within the Moroccan education framework?

The foundation of this investigation rests on several presuppositions stemming from our empirical inquiry. First, we posit that the inclusion of environmental education within physics textbooks does not inherently facilitate teachers' integration of environmental topics into their instructional practices. Second, we postulate that physics teachers exhibit the motivation to incorporate environmental education but lack precise methodologies to realize this aspiration.

The study employs a questionnaire-based approach to glean insights and viewpoints from Moroccan physics teachers concerning the incorporation of environmental education within their instructional practices.

THEORETICAL FRAMEWORK

Our theoretical framework draws upon the (KVP) model introduced by Clément, (2019). This model delineates the interplay of three pivotal facets: Scientific Knowledge (K), Values (V), and Social Practices (P). Clément, (2019) posits that these three dimensions bear significance in the pedagogical transference process and can serve as a tool for discerning scientific knowledge and values embedded within scholastic materials, including physics textbooks.

In the context of Moroccan research, El-Batri et al., (2019) embraced an environmentally focused learning approach to instill environmental education within the national educational framework. Notably, the Moroccan education system has adopted a competency-based methodology as an instructional innovation. Some Moroccan scholars have demonstrated the meaningful incorporation of environmental education directives

aimed at nurturing the environmental competencies of secondary school students (El Azzouzi, Elachqar, & Kaddari, 2023; El Moussaouy et al., 2014; El-Batri et al., 2019). These proficiencies equip students to react constructively, fostering environmental responsibility through active and participatory pedagogical methodologies (El Azzouzi, Elachqar, & Kaddar, 2023). Furthermore, El Moussaouy et al., (2014) conducted an empirical inquiry to gauge secondary school teachers' beliefs concerning the environment and environmental education.

The implementation of environmental education poses a fundamental challenge to the prevailing conception and construction of knowledge. This often engenders conflict with teachers' notions of instructional processes. Despite its integration into the Moroccan curriculum, environmental teacher's effective execution to achieve its intended environmental amelioration objectives, particularly within subjects such as physics, remains elusive. El Moussaouy et al., (2014) emphasize that the assimilation of environmental education constitutes an educational innovation necessitating meticulously designed teacher training programs and conceptual paradigm shifts (Rauch & Steiner, 2013).

To bolster the infusion of environmental education in schools, teachers must exhibit confidence and willingness to seamlessly integrate environmental education into their pedagogical contexts. A constructivist approach is suggested as conducive to this endeavor. Such an approach underscores reflection, stimulates problem exploration, and fosters the development of environmental education skills, thereby empowering students to cultivate pertinent behaviors. This approach should be underpinned by suitable teaching methodologies that facilitate knowledge co-creation and nurture positive environmental attitudes (Boukerche & Abrougui, 2007; El Azzouzi, Elachqar, & Kaddari, 2023; Lavigne et al., 2008; Palumbo et al., 2008).

RESEARCH METHODS

Description of the Research Questionnaire

To address our research inquiries, we devised a traditional pen-and-paper questionnaire encompassing two principal axes:

AXIS 1: Teachers' Perceptions of Environmental Education in Physics

This axis encompasses three multiple-choice questions (*Q1*, *Q2*, and *Q3*) aimed at eliciting the viewpoints of participating teachers regarding the interrelation between physics and environmental education.

AXIS 2: Teachers' Insights into Student Interests and Attitudes Towards Environmental Education during Physics Instruction

This axis consists of two questions (*Q4* and *Q5*) intended to elucidate the influence of environmental education on students' proclivity and attitudes within the context of physics education.

The following table summarizes all the questions of the present study, distributing them according to the research axes:

Table 1. Research axes and questions.

AXES	QUESTIONS
AXIS 1	**Q1**: To study a physics phenomenon one always resorts to environmental education.

	Q2: Environmental education and physics are sustainable and continuous noncollaboration.
	Q3: Contextualization of the environment is a real challenge for the teaching and learning of physics.
AXIS 2	**Q4**: Students' interest is developed by changing the teaching methodology of physics based on environmental education.
	Q5: Successful environmental education in physics requires innovation in the physics curriculum.

In our questionnaire, we adopted a Likert scale with four choices:

- Strongly Disagree: **SD**;
- Disagree: **D**;
- Agree: **A**;
- Strongly Agree; **SA**.

Questionnaire Validation

The validation process of the measurement instruments entails an initial assessment to ascertain the questionnaire's reliability. To gauge internal consistency and reliability, Cronbach's Alpha coefficients were computed. The obtained Cronbach's Alpha for our questionnaire stands at 0.88, surpassing the recommended threshold (Bagozzi & Yi, 1988). Our Cronbach's Alpha falls within the range of 0.73 to 0.94, consistent with the spectrum of Cronbach's Alpha values reported in prior investigations (Manis & Choi, 2019; Peterson, 1994; Schweizer, 2011). This alignment signifies the discriminant validity of our questionnaire.

Participant

The validation process of the measurement instruments entails an initial assessment to ascertain the questionnaire's reliability. To gauge internal consistency and reliability, Cronbach's Alpha coefficients were computed. The obtained Cronbach's Alpha for our questionnaire

Data Processing Tools

The validation process of the measurement instruments entails an initial assessment to ascertain the questionnaire's reliability. To gauge internal consistency and reliability, Cronbach's Alpha coefficients were computed. The obtained Cronbach's Alpha for our questionnaire

RESULTS AND DISCUSSION

As mentioned above, the questionnaire aims to collect information from secondary school physics teachers. The data collected concerns environmental education, and its importance in teaching and learning the subject, they look for the importance of implementing environmental education in classroom practices, addressing difficulties and constraints, and different suggestions from teachers.

Before the teachers respond to what they perceive as environmental education, we asked them, through the question *(Q1)*, to mention that *'To study a physics phenomenon one*

always resorts to environmental education' (Q1). The analysis of the collected data shows that 85% of the interviewed teachers disagree (24% strongly disagree and 61% disagree *(Fig. 1)*). This verifies the hypothesis of the difficulty of environmental education in the teaching and learning of physics in secondary schools. In this sense, El Moussaouy et al., (2014) showed that physics teachers were less motivated to integrate environmental situations into their classroom lessons.

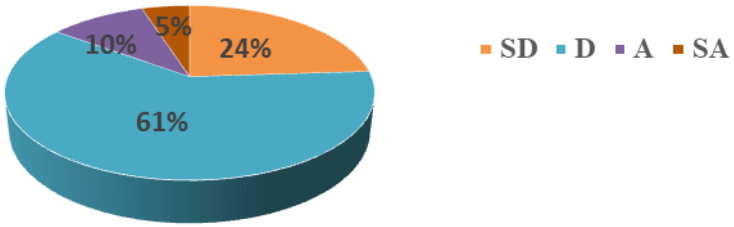

Figure 1. Percentages of teachers' responses regarding the use of physics in environmental education.

To confirm the conclusion of question 1 *(Q1)* we asked question 2 *(Q2)*: *'Environmental education and physics are a sustainable and continuous collaboration'*. This last question aims to affirm the relationship between environmental education and physics content. The results show that 49% of the teachers disagreed and 28% strongly disagreed while 25% agreed (9% strongly agreed and 16% agreed *(Fig. 2)*).

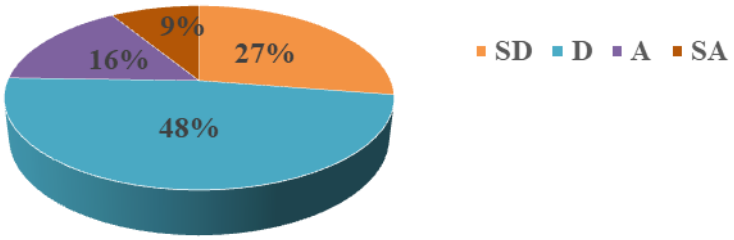

Figure 2. Percentages of teachers' responses regarding the complementarity of physics and environmental education.

From these results, it appears that teachers have a clear idea of what environmental education means, but the majority of them do not use it in their classroom practices. However, it seems that the majority of their answers included the difficulty of contextualizing physics content with the environment.

In this context, question 3 is defined as *'Contextualization to the environment is a real difficulty for the teaching and learning of physics'(Q3)*. The analysis of the data collected for question 3 reveals that 92% of the teachers questioned agree (25% strongly agree and 67% agree *(Fig. 3)*), while 8% disagree (3% strongly disagree and 5% disagree *(Fig. 3)*).

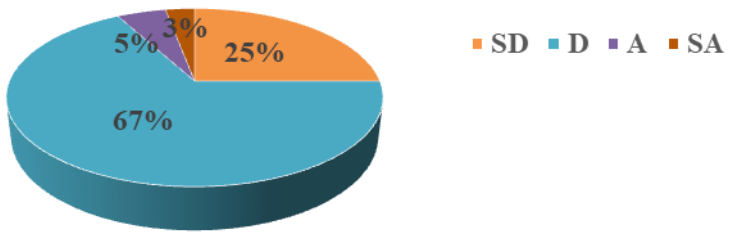

Figure 3. Percentages of teachers' responses regarding the difficulty of contextualization to the environment in teaching and learning physics.

Our results from the first axis stated that teachers are faced with the problem of implementing environmental education in their classroom practices due to the insufficient possibilities of physics content related to the environment, which is an obstacle to the introduction of environmental education in classroom practices. Indeed, contextualization skills in physics related to environmental education are remarkably absent. Furthermore, interdisciplinary education (Bicalho & Oliveira, 2011; Reverdy, 2016; Trouche, 2019), which allows for interaction between different scientific disciplines and the professional collaboration of teachers, is insufficient. Unaware of all the educational possibilities of environmental education, teachers think that the importance of environmental education is limited to practices outside the classroom, such as school clubs and associations.

The second axis of the questionnaire as mentioned above is divided into two kinds of questions. Some of them provide direct information about teachers' observations of learners' interest in and attitudes toward environmental education during physics learning. Others gave intrinsic information about the pedagogy of environmental education and its impact on the interests and attitudes of Moroccan secondary school students.

Question 4 *(Q4) 'Students' interests and attitudes are developed by changing the teaching methodology of physics-based on environmental education, states the impact of environmental education on students' interests*'. 54% of the teachers agree and 33% strongly agree while 13% disagree (4% strongly disagree and 9% disagree *(Fig. 4)*).

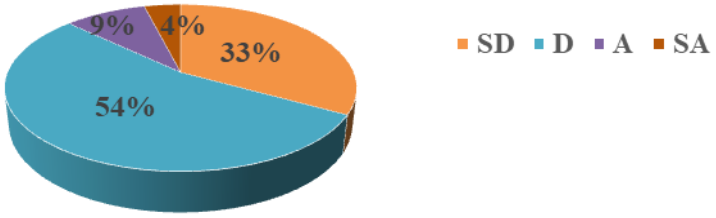

Figure 4. Percentages of teachers' responses regarding students' interest in environmental education.

The results of question 4 *(Q4)* state that the interviewed teachers are aware that environmental education influences the interest of their students. According to these teachers, there are at least two possible and distinct reasons for this conclusion: on the one hand, students do not have the necessary environmental skills to deal with an environment-based situation. On the other hand, students do not know how to apply their available environmental skills to particular problem situations in physics.

In the same context, we asked Question 5 *(Q5)* to confirm that *'Successful environmental education in physics education requires innovation in the physics curriculum'(Q5)*. The result of the question *(Q5)* showed us that 84% of the interviewed teachers agreed (45% agreed and 25% strongly agreed *(Fig.5)*) that the integration of environmental education can play a crucial role in the memorization of most concepts, laws, and theories of physics, and subsequently the participation of students in different physics' activities.

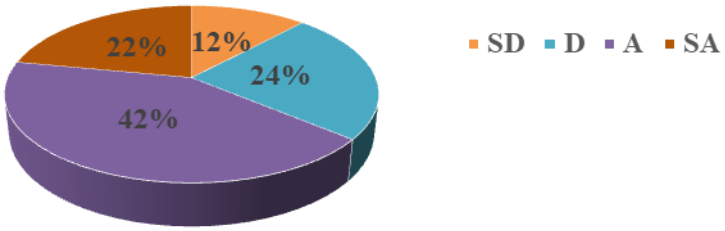

Figure 5. Percentages of teachers' responses regarding the success of environmental education in the teaching and learning of physics.

The results of this question affirm the conclusion of El Moussaouy et al., (2014) that the secondary school textbooks in the Moroccan educational system do not have a sufficient amount of good classroom practice of environmental education in physics. As well as the informative style of the textbooks such as documents, pictures, and data are not successfully exploited. Indeed, two chapters are devoted to radioactivity. They briefly present the influences of radioactivity on the human body without considering the dangers to the environment in case of a nuclear leak.

So environmental education in physics encounters several obstacles that hinder the implementation of environmental education in classroom practices and on the various suggestions of teachers. On the one hand, the nature of the curriculum and textbooks does not allow teachers to effectively implement environmental education in the classroom, the time devoted to environmental education is not sufficient, and the lack of training and the lack of teaching materials. About the respondents' suggestions, the following were selected: Teachers should think about curriculum reform, and teachers should have a bank of environmental education problem-solving activities.

CONCLUSION

The lack of initial and further training opportunities in the field of environmental education is an obstacle to the introduction of environmental education into classroom practice. In addition, contextual skills in physics in the problem situation or problem-solving related to environmental education are remarkably absent. Furthermore, the professional collaboration of physics teachers is insufficient. Unaware of all the educational possibilities of environmental education, teachers think that the importance of environmental education is limited to practices outside the classroom, such as school clubs and related associations.

The integration of environmental education in physics remains marginal in physics teaching. The complexity of this integration is largely underestimated in the training arrangements. The conclusion of this research is fully affirmed by the teachers questioned, as initial and/or in-service training on the application of environmental education, especially in physics, is still lacking for Moroccan secondary school physics teachers. Therefore, an initiative on environmental education can promote high interest and positive attitudes of Moroccan students.

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