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Strategies for Environmental Education on Renewable Energy through the Study of Social Representations

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Abstract

This article explains a psycho-pedagogical approach that aims to develop students' social skills in the field of renewable energies. This approach moves beyond the acquisition of knowledge and technical skills to focus on interpersonal skills. It does so by articulating cognitive and emotional dimensions through the study of students' social representations of renewable energies.This study is based on the structural approach, specifically the central core theory. It made it possible to identify the importance of key elements, namely solar energy and oxygen. These elements can therefore be mobilized in the design of an educational project aimed at developing social competence related to sustainable development issues and renewable energies.

Keywords: *Renewable Energy Education, Social Skills Development, Psycho-Pedagogical Approach, Social Representations Theory, Sustainable Development Competence.*

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Introduction

In order to address environmental challenges and the depletion of fossil fuel resources, and to provide global and sustainable solutions, Algeria has been committed since 2011 to the development of renewable energies. This commitment has taken the form of a national program based on a new model of economic growth (CDER, 2015).

Any societal or economic project cannot be achieved without the socialization of young people. Education and teaching programs at different levels must therefore take into account the major economic projects adopted by society.

Environmental education is an educational process that aims to develop ecological awareness among learners, as well as the skills needed to understand, evaluate, and solve environmental problems (Moser,2009).

Environmental education methods do not only enable the transmission of knowledge. They also contribute to the development of responsible attitudes and practical skills that support action in favor of sustainable development.

For this reason, pedagogical approaches and teaching methods related to Education for Sustainable Development (ESD) must be designed according to social and individual contexts. They must also be continuously renewed to respond to social and individual changes and transformations.

Within the Algerian education system, the concept of energy and its transformations is introduced at the middle school level. It is addressed in the second and third years through natural sciences courses, focusing on the organism level. This includes teaching about chlorophyll, respiratory gas exchanges, and food chains as mechanisms for synthesizing organic matter, which represents stored energy and its dynamics.

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These concepts are revisited in the first year of secondary education in the field of natural and life sciences. At this stage, they are addressed at the cellular level through explicit teaching on the origin of energy used for the development of living beings, including respiration, fermentation, and photosynthesis.

In the third year of secondary education, the same themes are taught again, but this time at the molecular level. This occurs within a unit entitled "energetic transformations at the level of the cellular ultra structure. The objective of this unit is to develop a fundamental skill, namely enabling students to propose an interpretative model of cellular energy dynamics based on knowledge related to energetic transformations within cellular structures (Curriculum SNV, 3rd year of secondary school, 2008).

At the end of secondary education, students are expected to know the concept of energy and its transformations within the context of biological organization. However, the competence defined in the teaching programs remains limited to the level of capacity. It therefore corresponds to know-how rather than to know-how-to-be.

Since competence cannot be reduced to the mere acquisition of information, all educational practices must progress from knowledge to know-how and then to know-how-to-be. Only through the integration and mobilization of these three components can individuals act appropriately in real social situations (Félonneau, 2008).

To select active and participatory pedagogical methods that allow students to experience sustainable development challenges concretely, it is essential to understand students' social representations of Education for Sustainable Development. Identifying the elements that structure these representations makes it possible to determine the skill foundations upon which an educational strategy can be built.

The study of social representations of ESD thus allows a better understanding of how sustainable development is socially perceived and how these perceptions evolve within society. It also provides a basis for reflecting on the most appropriate pedagogical approaches, particularly those that influence emotions, attitudes, and behaviors.

By taking pre-existing social representations into account, educational strategies can be designed more effectively. These strategies aim to facilitate the transformation of preconceived knowledge into social skills that encourage student engagement. Such engagement is essential for enabling future citizens to better appropriate and act upon issues related to sustainable development.To explore this issue further, we ask the following question:

How do students represent renewable energy?

The theory of social representations offers a specific analytical framework that enhances understanding of the relationships between individuals, social groups, and the environment. It allows for a deeper comprehension of the social dynamics involved in environmental issues.

Methodology

The structural approach used in the study of social representations combines two complementary dimensions: quantitative and qualitative. The central core theory developed by Abric (2003) constitutes the main theoretical and methodological foundation of this study. This theory focuses on the structure and organization of social representations, which are considered hierarchical cognitive systems composed of two interrelated subsystems.

First, the central core represents a fundamental system made up of a limited number of elements. These elements generate meaning and provide coherence to the other components of the representation.

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Second, the peripheral system is described as a "conditional" system (Flament, 1994). The elements that constitute this system are more flexible and adaptive. They function as sense receptors, allowing the representation to adjust to contextual variations.

Third, the silent area refers to elements that are not explicitly expressed by individuals. In research contexts, this area is examined indirectly through surrogate methodological procedures.

The main research instrument was a questionnaire developed according to the principles of the hierarchical evocation method. It was based on two inducing words: "renewable energy." The questionnaire was administered to a sample of 100 students aged between 17 and 18 years.

The analysis of the hierarchical evocations was complemented by semi-directed interviews. These interviews made it possible to deepen and clarify certain aspects of the data, particularly with regard to the following elements:

1. The degree of students' involvement in Education for Sustainable Development (ESD) learning

2. Students' interest in ESD

3. Students' scientific knowledge related to ESD

Data analysis was conducted using the "IRAMUTEQ" software, an "R interface" designed for multidimensional statistical analysis of textual data and questionnaires (Ratinaud, 2013).

Analysis of Results

Similarity Analysis

The similarity analysis highlights the importance of several key elements, namely: solar energy, wind, water, electricity, future, oxygen, sustainable, and environmental_protection. Due to their high frequency in students' responses, these elements can be considered generative of meaning within the social representation. They therefore belong to the central core.

As central elements, they act as carriers of meaning for the social representation of renewable energies. They also contribute to organizing and giving meaning to all other constituent elements within this population group.

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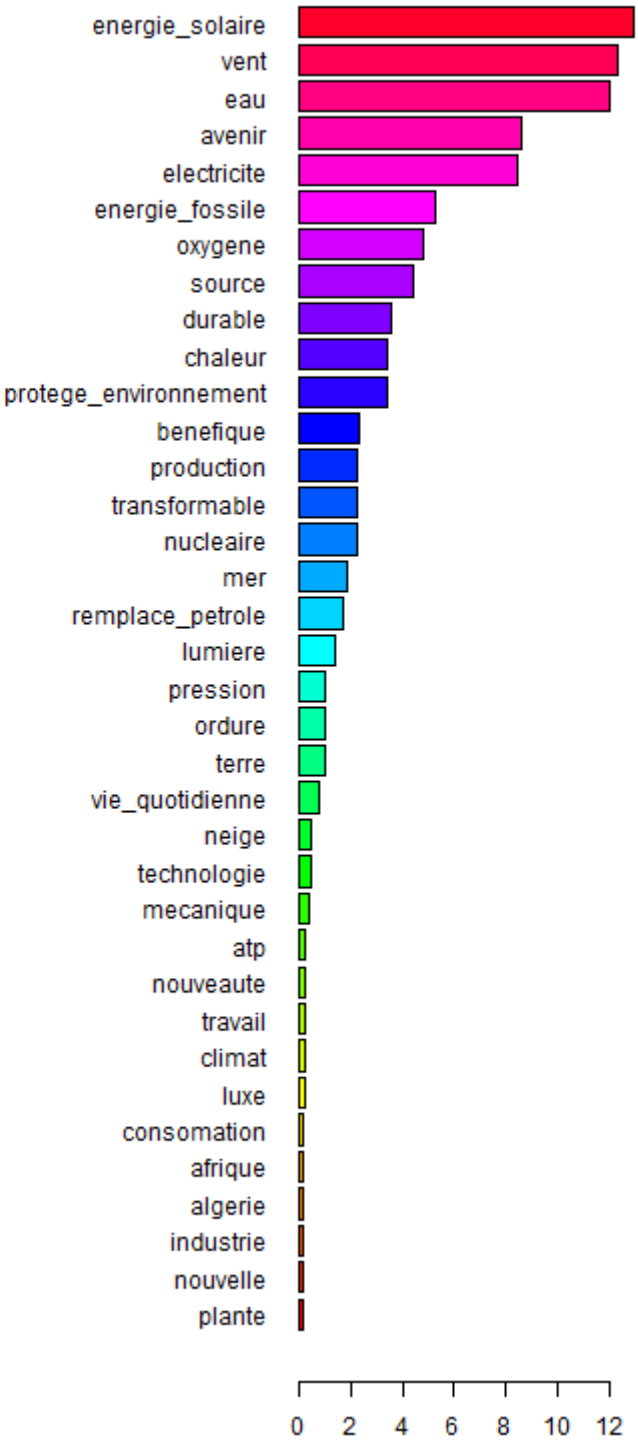

Figure 1: Frequency Analysis

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The Similarity Tree

The similarity tree clearly shows that the element solar_energy is the most salient. It occupies a central position and organizes the meaning of the social representation by connecting with two major elements, namely water and wind. This pattern of connectivity also reveals a strong relationship between the elements water and wind through the mediating role of solar_energy.

The strong connectivity of the solar_energy element with water, wind, electricity, oxygen, future, sustainable_source, fossil_energy, and environmental_protection, which are also significant elements due to their high frequency, allows the formulation of the following interpretative hypotheses:

- Solar energy is represented as a sustainable form of energy derived from nature and closely related to natural sources such as water, wind, and fossil_energy. This natural character explains both its durability and its protective role with regard to the environment.

- Solar energy is also represented by students within a temporal dimension oriented toward the future.

- The strong links between solar_energy and the elements electricity and oxygen indicate the central importance of this energy source. Because these elements are indispensable in daily life, solar_energy appears to be particularly meaningful for students, as it is associated with basic human needs.

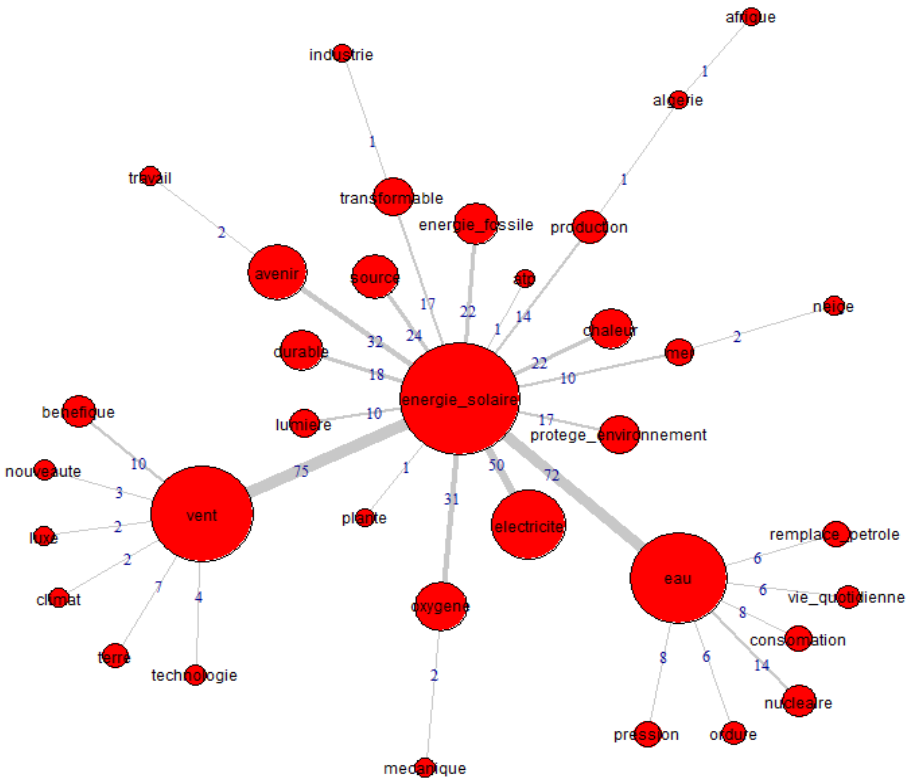

Figure 2: The Similarity Tree

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The Mute Zone

The most significant elements that are not openly expressed by students constitute what is referred to as the mute zone. These elements are, in order of importance: future, solar_energy, wind, water, electricity, protects_environment, and fossil_energy. This hierarchy of elements confirms that students perceive renewable energies as a future-oriented project. Renewable energy is therefore represented within a temporal perspective that is clearly directed toward the future.

In relation to electricity, renewable energies derived from natural sources are associated with elements of nature, such as wind, water, and solar energy. These energies are perceived as playing an essential and beneficial role in everyday life. They are also attributed a protective function, particularly with regard to environmental preservation (protect_environment).

Fossil fuels, including gas and oil, are represented by students as renewable energy sources. This representation appears to be influenced by the specific economic context of the students' country of origin.

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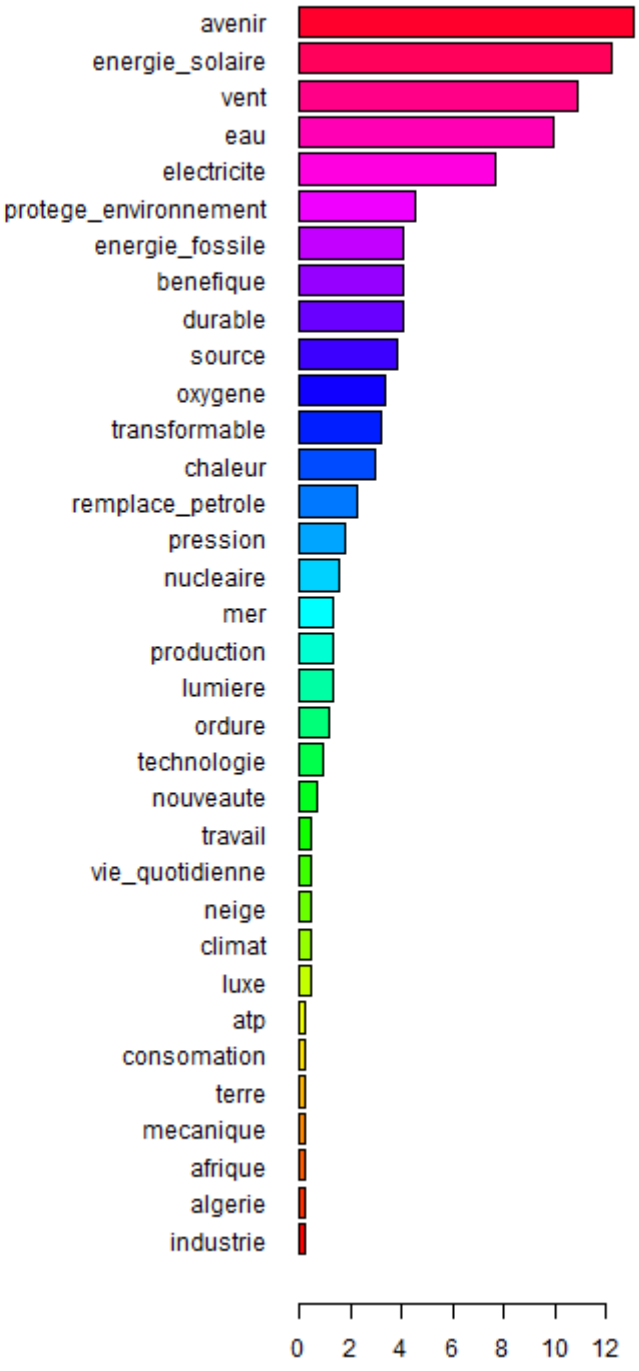

Figure 3: The Silent Area

The Structure of Social Representation

The structure of the social representation is illustrated through the different zones that compose it, in accordance with the model proposed by Abric (2003). As shown in Figure 4, the social representation is organized around a central core composed of elements that are significant due to their frequency and rank:

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- Solar_energy: frequency 91, rank 2.15
- Wind: frequency 68, rank 2.62
- Fossil_energy: frequency 33, rank 2.76
- Oxygen: frequency 24, rank 2.83

These elements are organized around the central importance of solar_energy, fossil_energy, and oxygen. Their classification as elements of Education for Sustainable Development (ESD) and their presence in the core zone indicate that they generate the meaning of the social representation (Abric, 2003).

This meaning is complemented and reinforced by the elements of the first peripheral zone, namely water and electricity. These elements clarify that the importance of solar_energy, fossil fuels, wind, and oxygen lies in their connection to nature and to basic needs such as electricity and water. The elements of this first peripheral zone play a key role in influencing and transforming behaviors.

The components of the second peripheral zone show a strong relationship with the first peripheral zone. Its elements—source, future, heat, production, and environmental_protection—refer to the functional dimensions of ESD. They confirm the importance and the concrete role of solar energy in terms of sustainability and environmental protection.

The future-oriented temporal dimension associated with this representation is thus reinforced. It reflects the lived experience and expectations of these young individuals.

The contrasting elements sustainable, transformable, and consumption enable interaction between the central system and the peripheral system. They link the abstract meaning of the central core to concrete aspects of reality. Wind and water are represented as sources of ESD. As natural energy sources, they undergo transformation processes that lead to consumption. The sustainability of this consumption is directly related to the natural origin of the energy elements subjected to transformation.

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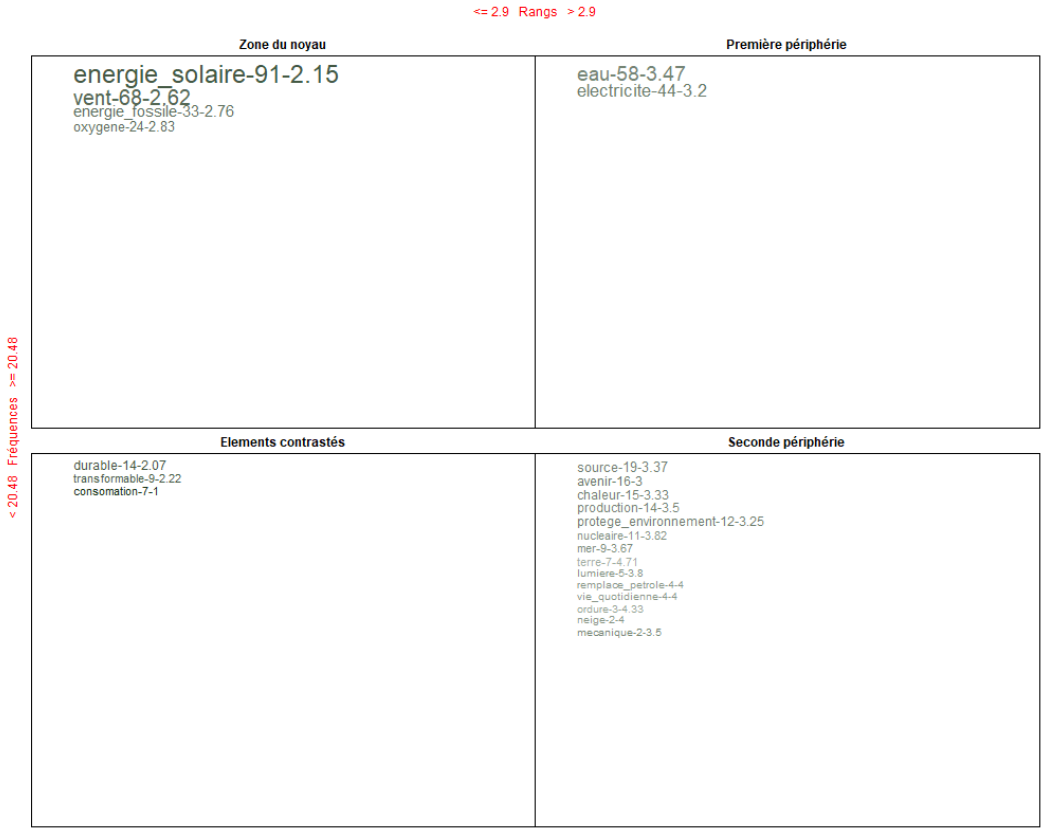

Figure 4: The Structure of Social Representation

Students' Interest in Renewable Energy

Although students are aware of the importance of renewable energies in protecting the environment, they do not appear to engage with this issue at a personal level. The most frequent responses regarding their individual interest in renewable energies are limited to the desire to obtain information about the topic.

The frequent occurrence of the word future in students' responses, used to describe the nature of their interest in Education for Sustainable Development (ESD), confirms that their representation of renewable energies is strongly associated with a future-oriented perspective. This issue is therefore not perceived as a present concern.

The results of the follow-up interviews further reveal a low level of personal involvement and limited interest in renewable energies. Students tend to view renewable energies as a societal project that primarily concerns the future. This perception highlights a clear psychological and temporal distance between students and Education for Sustainable Development (ESD).

Table 1. Distribution of Students' Responses According to Mode, Frequency, and Percentage

Mode	Frequency	Percentage of Total (%)
Information	22	25.58
Future	21	24.42
Environmental protection	16	18.60
Electricity	5	5.81
Pointless	3	3.49
Economic	3	3.49
Sustainable	2	2.33

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Day-to-day life	2	2.33
Solar energy	2	2.33
Production	2	2.33
Personal evolution	2	2.33
Work	1	1.16
Wind	1	1.16
Very beneficial	1	1.16
Water	1	1.16
Daily use	1	1.16
Crude oil production/consumption	1	1.16

Note. Percentages are calculated based on the total number of responses.

Summary of Results Analyses

The analysis of the data collected through the questionnaire developed according to the principles of the hierarchical evocation method, combined with the complementary interviews, made it possible to identify solar_energy as the most central element of the social representation. This energy, derived from natural sources, is mainly associated with electricity production. Its importance for students is linked to the essential role electricity plays in their daily lives, as it satisfies fundamental needs.

Oxygen also appears as a key element for students and belongs to the central core of the representation. This importance can be explained by its relationship with the human energy system, as oxygen is involved in the aerobic sector. It enables long-term energy production (Assadi & Lepers, 2012). Oxygen is therefore perceived by students as a vector of energy. The centrality of both solar_energy and oxygen suggests that these elements could serve as the basis for an educational project aimed at developing social competence.

Fossil fuels are also part of the core area of the representation and are considered renewable energies by a significant number of students. This indicates that students tend to classify all natural resources as renewable energies. They thus confuse the concept of renewal related to usage with that of regeneration or reformation.

Although pro-environmental attitudes and behaviors appear to be socially valued, they are not fully internalized at the social and psychological levels by young people. For students, interest in renewable energies mainly remains within the scope of information, general knowledge, and the economic development of society. Education for Sustainable Development (ESD) is therefore weakly invested at a personal level. The results of this study highlight a lack of personal engagement with renewable energy issues, which are perceived as part of a future societal project. This representation does not involve personal future projection but rather reflects a form of psychological distance from ESD.

This psychological distance is closely associated with a temporal distance that influences behavior. According to Trope (2000), young people tend to categorize their interest in renewable energies in broad and abstract terms when they situate their goals in a distant future.

By considering the importance and strong connectivity of the central core elements responsible for the meaning of the social representation of ESD, namely solar_energy and oxygen, and by taking into account curricular content focused on energy transformations at the level of cellular ultrastructure, these elements can be viewed as repositories of competence. They may serve as a foundation for the development of an educational project aligned with curricular content and aimed at fostering social competencies related to ESD.

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Conclusion

Environmental education oriented toward sustainable development is closely linked to a broader societal project that can be defined as a cultural transformation. This transformation must begin with educational initiatives capable of developing social skills related to renewable energies and environmental protection.

Education in renewable energies is not limited to the transmission of environmental knowledge. It also involves the development of responsible attitudes and practical skills that enable individuals to act in favor of sustainable development.

Within the natural and life sciences curriculum, energy transformations occupy a central place throughout the three years of secondary education. These programs, which focus on energy at the cellular level, should extend this perspective to a broader, planetary level. By placing students in learning situations where oxygen serves as a guiding element, educators can orient students' interests toward the challenges of sustainable development and renewable energies.

The progression from know-how to interpersonal skills, through the articulation of cognitive and emotional dimensions, leads to the development of social competence. This process is achieved through the establishment of a transversal learning pathway in which students engage in a multidisciplinary curriculum involving several subjects (Crahay & Dutrévis, 2010).

Such teaching can be implemented through multidisciplinary projects that enable young people to acquire the skills necessary to contribute to the energy transition and to engage personally with renewable energies. These projects allow students to experience the concept of energy through their bodies, emotions, personal goals, and interests. In doing so, they support the development of new beliefs aligned with the reference frameworks of social competence (CASEL, 2013).

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