Students' Energy Sustainability Behaviors: Modeling the Role of Values and Self-Efficacy Beliefs

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Received 10 November 2025; Accepted 19 January 2026

Abstract

Individual behavior is a multifactorial system subjected to multiple influences. This study examines the effect of personal values and self-reported efficacy of secondary school students on their energy-saving behavior. Predicting behavior is an important issue in sustainability issues, especially in energy consumption, a field that has attracted increasing interest in recent years. Data collection of 6.161 middle school students in the region of Attica have been utilized in this quantitative analysis of this paper. Ordinal regression models were applied in order to assess the ability to predict students' energy behavior based on their personal values and self-reported efficacy. The results highlight the strong possibility students with altruistic values to engage themselves in energy-sustainable behaviors. On the contrary, those being more selfish are less likely to take actions such as turning off the lights when leaving a room or adjusting the thermostat of the heating system in order to reduce consumption. At the same time, the findings show the positive effect of perceived self-efficacy on the implementation of

Strategic Planning for Energy and the Environment, Vol. 45_2, 429–460.
doi: 10.13052/spee1048-5236.4526

sustainable behaviors. Thus, emphasis is placed on the key foundations of energy behavior, specially of the future to be consumers having to decide on energy issues, unaware of the possible effects of their decision. So, the need to place more importance on the educational practices is hereby arisen targeting to the strengthening of holistic energy behavior of the students.

Keywords: Personal social values, self-efficacy, students, regression.

1 Introduction

Climate change has been a topic of public debate in recent decades with increasing frequency and intensity, intensifying concerns about preserving the quality of the environment and the role of man in it [1]. The growing concern has led to skepticism about the development of environmental awareness and responsible environmental behavior of young people from a young age, as people's behavior towards nature is considered the key to sustainable development [2–4]. Energy is directly linked to sustainability, especially renewable energy sources. Sustainable management of energy resources is a necessary prerequisite for addressing climate change, energy security, energy equality and autonomy, and ecological balance [5]. Today's students, as tomorrow's consumers, should become energy literate so to be able to make sustainable choices that support their well-being while preserving the environment for future generations [6]. It is therefore necessary to be created an educational framework providing students with all the knowledge about energy consumption. Thus, education can provide to the students the intellectual means for decision making towards abundant and accessible to all energy, fulfilling the seventh goal (SDG 7) as defined for 2030 by the United Nations [7, 8]. The motivation for this study comes from the growing need for energy education that will enhance the individual's ability to shape energy-sustainable behavior, which is a requirement of the educational systems of most countries. Developments in technology and science are rapid, formatting to a complex energy market and emerging concepts such as "energy freedom" that are gaining significant momentum, illuminating the path to autonomy and sustainability [9, 10]. The mechanisms that mediate between knowledge, attitudes and behaviors seem uncertain. Self-efficacy and self-regulation seem to play an important role in activating the oriented action of young people [11]. This study aims to investigate how Schwartz's human values and self-efficacy beliefs predict students' energy-saving behaviors. Thus, the novelty of the study lies in the combination of the theoretical frameworks

of social cognitive values and efficacy-based psychology to explain energy-saving behavior among students, in contrast to pre-existing studies that are limited to measuring knowledge and attitude. Thus, the empirical analysis aims to answer the following research questions:

> RQ1: How do students' personal values affect their energy-saving behaviors?
> RQ2: How do students' self-efficacy beliefs predict their energy-saving actions?

Thus, the contribution of this study is twofold. First, it analyses the behavioral underpinnings of students' energy saving actions – as proposed by DeWaters and Powers framework – by examining the joint influence of personal values – derived from Schwartz's value theory – and energy-related self-efficacy beliefs. This study adopts a holistic approach, tracing the influence of intrinsic values and perceived self-efficacy on an individual's environmental behavior and orientation towards sustainable consumption. The modeling of the relationship between an individual's behavioral profile and sustainable attitude and behavior is achieved through two ordinal logistic regressions. The individual's value framework, as defined by Schwartz, and his self-esteem of efficacy, as outlined by Badura, are utilized in the regressions, leading to conclusions that illuminate their influence on the actions an individual take. These findings advocate the development of targeted energy education programs and behavioral interventions focused on promoting sustainability.

2 Literature Review

2.1 About Energy Education

People begin to interact with the environment, both anthropogenic and natural, from the moment of their birth, thereby creating mental representations and contexts. According to Otto et al., children under the age of seven begin to be concerned about the natural environment, to exhibit environmentally friendly attitudes and to try to adopt environmentally sustainable behaviors [12]. However, there are studies that highlight a decreasing trend in pro-environmental beliefs from elementary school to the first grades of high school, with them reaching a lower level in the high school years [2–4, 12]. The assessment of environmental beliefs and attitudes is quantitatively presented to have a curvilinear form in relation to age, as after the minnimum recorded in secondary education it begins to increase as the individual progresses towards adolescence [13]. Children's environmental

behavior presents a similar curvilinear form as it increases from elementary school to high school and then decreases until the early stages of adulthood, however, presenting fluctuations due to their experiences and external stimuli [14–17]. It is obvious that energy education is important to start earlier than high school. This helps children to internalize attitudes and behaviors that will manifest them for the rest of their lives, as in their adult lives, change in their daily practices is difficult to occur [18, 19]. According to Piaget's theory of cognitive development, elementary school covers the concrete operational stage, where children can follow rules, acquire skills to regulate their behavior, and undergo physical and psychosocial changes that lead them to use logic and develop abstract thinking to delimit their place in the natural world and explore their relationship with objects [20–23]. Middle school coincides with the beginning of the formal operational stage, where children develop abstract thinking, participate in discussions that require inductive reasoning and concern the present and the future [22]. Grade 7 and 8 primary school students, and grade 9 and 10 of secondary students are the appropriate target group to be educated about energy-related issues and to transform knowledge into environmentally friendly attitudes and behaviors, thus diversifying an energy-sustainable character that will accompany them in their adult lives [24]. The level of cognitive development of students and the abstract form of high school curriculum, allows the application of the Piagetian approach to education which entails the restructuring and continuous adaptation of knowledge mainly through experimental procedures, experiential approaches to topics and to hypothesis and inductive thinking [25]. The deviations, in relation to the theory of cognitive development, observed in students' attitudes on energy issues are mainly due to the fact that it presents ambiguities in its application as it has structural deficiencies as it overlooks the influence of cultural and social factors on the individual [26, 27].

2.2 Students' Attitudes and Perceptions on Energy Issues

Children often evaluate other people's attitudes towards energy mainly based on internal self-regulation factors. According to Pearce et al., children consider energy waste as a bad act and show negative feelings towards people who do not use energy rationally as they consider them as bad or people with bad behavior [28]. They express their disappointment with adults who do not try to save energy while they themselves are working towards it. The children who participated in the research fear that the planet will lose its energy reserves, resulting in new generations not having the amounts of

energy required for their survival. As a consequence, they consider energy waste as unethical behavior, while on the contrary, its sustainable use as the appropriate and ethical attitude [28, 29]. Young people seem to have become aware of the unstable balance that characterizes the environment as they are exposed through education, the internet, and the media to negative news about nature's ability to restore the damage caused to it by human activity, as well as the immediacy with which they should act towards the sustainable exploitation of natural resources. This leads them to awareness of environmental change and environmentally friendly attitudes and pushes them to take collective action [30, 31] but they are often disappointed as the results of their actions are not as expected, their actions have limited diffusion, they have no imitators, resulting in frustration and possibly anger [17, 32] and negatively affects their psychology by creating anxiety about environmental sustainability [33, 34]. Environmental anxiety in young people is defined by Clayton et al. as the constant fear of the consequences of an ecological disaster. It causes both individually and collectively, psychological pressure and negative emotions [35]. It is present in people's everyday lives and specially in young people's life, resulting in increased sensitivity to it [36–39]. Students' attitudes towards energy use are influenced by a series of factors such as social factors, e.g. family and school, skills they possess, environmental awareness and external sources of influence such as the internet, advertising, cinema, etc. [35, 40–42]. Research on the factors that influence children's attitudes towards climate change and environmental disasters hasn't produced a comprehensive predictive model yet [17]. The negativity of young people towards energy waste and the consequences of climate change is present in their social and moral construct but is mitigated by a series of biases which, according to Shapiro, are: a) proximity bias, according to which climate change is not occurring in the area where they live, b) recency bias, according to which recent events have not occurred that would lead to conclusions that climate change is responsible for them, and c) technology bias, according to which technology can reverse environmental change [43].

2.3 The impact of personal values and self-efficacy beliefs on students' energy-sustainable behavior

The adoption of sustainable behaviors and the "translation" of knowledge and attitudes into a change in an individual's behavior is not a matter of possessing sterile knowledge or personal will but rather a process of self-regulation

[11, 44]. An important parameter in human behavior is the perceptions individuals have of their own self-efficacy. Self-efficacy refers to one's belief in their ability to accomplish a task with their behavior, as well as the degree of confidence they have in their control over their motivations, behavior and social factors that influence their performance [45, 46]. Behavioral change is closely linked to the change in the self-efficacy perceived by the individual. People can abandon their efforts and not proceed with behavioral change if they seriously doubt that they can do what is required or if, although they are confident in their abilities, they believe that their efforts will have no effect due to a lack of response or negative prejudice from their surroundings [44, 47]. Many studies examine the relationship between human behavior and human self-efficacy and the mechanism through which a person's belief in their abilities, via the psychological changes it causes – predicts changes in their behavior in different domains of social behavior [40, 47–49].

A large number of studies have been conducted, especially in the last two decades, when the term energy literacy has attracted the attention of the academic community. Their results, in the emotional and behavioural domain, do not show the high degree of agreement that they present in the cognitive domain. DeWaters & Powers, note that despite the relatively good scores that students scored in the cognitive subscale, their scores in the emotional and behavioral subscales were low. Students promote the use of renewable energy sources as part of their pro-environmental attitude, but this tendency decreases when potential cost increases are mentioned. Students are concerned about energy problems but do not have the knowledge and skills to work on their solution and therefore there is a discrepancy between their attitude and their actions [2, 3]. Children exhibit a positive attitude towards energy saving, show willingness to proceed with practices in this direction and believe that they can do it, but they report that they need guidance, rules at home or school that follow and confirm them, as well as repeated behavioural routines in order to form real, strong and solid energy saving habits [28, 50–52]. This is also consistent with research on secondary school students from Indonesia, where while they consider energy conservation to be very important and score well on the emotional and behavioural subscales, scores on the cognitive subscale are low and appear to affect the behavioral part [53]. The DeWaters & Powers study showed a differentiation in children's attitudes and behaviors related to age. The self-efficacy of middle school students proved to be slightly higher than that of high school students. Normally, high school students score lower on the behavioural subscale than those in middle school. According to DeWaters &

Powers, as children grow older and approach adulthood, they are led towards more energy-intensive tactics [2, 3]. That is, while high school students had more positive attitudes and values than those in middle school, these were not translated through the perception of their self-efficacy, into corresponding behaviors, a finding consistent with Bandura's views that individuals' behavior is influenced by the confidence they have in themselves that they can accomplish a task [54]. In the same research, gender differences were noted only in the emotional subscale, as girls in middle school and high school exhibited significantly more positive attitudes and values but also a stronger sense of self-efficacy than boys. In the cognitive and behavioural components of the research, no gender differences were found. Emotion and behavior were more closely related than knowledge and behavior, indicating the clear influence of emotion in determining sustainable energy behavior [2, 3]. Lee et al. also found differentiation between schools in their research, according to the results of which Vietnamese secondary public-school students are more effective in saving energy than their peers in private schools. They observed that students' intention and behavior on energy saving issues were relatively strong but these were influenced indirectly rather than directly by knowledge. The researchers concluded that children's values and attitudes are correlated with the integration of knowledge into their behavior [55]. Research on primary and secondary school students shows changes towards sustainable energy-related behaviors when children participate in educational programs such as case studies, decision-making exercises, action strategies, video games, experiments, etc. that focus on developing children's values, beliefs and attitudes [56–59]. Keller et al., reported that after the energy workshop they participated in, their energy literacy in the cognitive, emotional and behavioural part increased [60]. Pradana et al. showed that structured educational activities go beyond raising awareness by fostering more positive attitudes towards energy and activating students' energy economic literacy [61]. Students believe that energy education is important for adopting energy-sustainable attitudes and behaviors [62]. In contrast, research on elementary and secondary school students has shown that media and peer discussions have little impact on students' attitudes and very limited influence on energy-saving behaviors [56].

An individual's pro-environmental attitudes and intentions and their ecological orientation guide them to sustainable actions and behaviors [63, 64]. Pro-environmental behaviors influence many aspects of daily life, mainly regarding saving and rational consumption practices and product choice. Research has demonstrated the impact of ecological attitudes, intentions and

concerns on a wide variety of issues such as e.g. policies for environmental practices, agricultural work, the use of plastics, waste management, tourism, the "green living" and sustainable consumption more broadly [65–74]. Energy is a concept that has been inextricably linked to issues such as carbon emissions, global warming, pollution and other important environmental issues that cause concern in modern societies [75–78]. This often leads people to energy-sustainable behaviors and choices [79]. Consequently, ecological attitudes and intentions influence energy-related behavior. Personal values influence an individual's environmental behavior as they can promote or hinder it, although there is considerable disagreement among researchers about the impact they have on an individual's behavior directly or indirectly [80, 81]. Values can have predictive power for attitudes and choices, which is consistent with value theory, while other studies agree that values indirectly influence behaviors [66, 78]. According to Schwartz's value model, traditionalism and openness to change are conflicting and competing values [82]. Environmental concern and the basis of environmental behavior are associated with egoistic (self-enhancement), altruistic, and biospheric values (self-transcendence) as well as with the impacts of environmental change [83]. Biospheric values are the importance that individuals attach to the well-being of the natural environment and ecosystems. Altruistic values and biospheric values are positively associated to sustainable behaviours in contrast to egoistic and hedonism [81, 83–85]. People whose values are self-transcendence oriented recognize their position in nature and feel the responsibility to undertake eco-friendly actions alone or in groups. On the contrary, people with egoistic tendencies, are more interested in their self-improvement. They can ignore the common good and environmental balance in order to serve their personal pursuits. They will probably exhibit behaviors, such as energy conservation, only when their personal interests e.g. economic benefit, are served or when they perceive environmental risks [86, 87]. However, it is not clear whether biospheric values are related to altruistic values or whether biospheric, altruistic and egoistic values create a coherent single framework that is able to explain environmental beliefs, intentions and behaviors [84, 88]. De Groot & Steg report that research participants who had an egoistic orientation had low self-determination regarding their ecological behavior [88]. Their ecological intentions are explained mostly by less self-determined motives such as lack of motivation and external regulating factors. Participants who self-identified as individuals with pro-environmental intentions and actions had both an altruistic orientation and biospheric values. Simultaneously, they noted that tradition and openness to

change seem to have little or no effect on the individual's behavior. Karp considers environmental protection as a social dilemma between exploitation and protection. He believes that personal values have a greater effect on pro-environmental behavior than coercive measures such as monetary fines [89]. The results of his survey showed that the values self-transcendent/openness to change and universalism/biospheric had a positive effect on environmental behavior. On the contrary, self-enhancement/conservation have a strong negative effect on pro-environmental behaviour. The researcher does not consider the results to be absolute. In Asian countries such as Japan, the environment is a significant part of their tradition, so traditionalism has a positive effect on the environmental behaviour while in Western societies it has a negative effect. Schultz & Zelezny argue that regarding eco-centric behaviours, tradition and power have a negative correlation while universalism presents a strong positive correlation [90]. In a different approach, Tolppanen & Kang consider that a value alone does not have a significant impact on the environmental behaviour of the individual. However, a combination of values can lead to this objective [91]. They showed that altruistic values must be combined with biospheric values to lead to an eco-friendly lifestyle. They emphasize that hedonism does not necessarily imply anthropocentric behaviour, as if combined with biospheric values, it becomes of secondary importance and the individual may exhibit eco-centrism. People who are distinguished by extroversion and whose personality has a high identification with values such as openness to change, are willing to use "green" products, adopt energy-saving practices and overcome the limitations that they consider that sustainable behaviors cause in well-being [86, 92, 93]. Personal values are not the only predictive factor of energy-sustainable behaviours. The individual's experiences, education, social norms and external influences play active roles and structure a multifactorial system in which personal occupy a significant position.

3 Methodology

3.1 Data and Sampling

The data collection was carried out in Greece and specifically in the Attica region. This is the region with the largest secondary education student population in the country. The Attica region is divided into seven education directorates. Four of them concern the metropolitan area and the surrounding municipalities, one directorate concerns the city of Piraeus and the islands

Table 1 Sampling

	Number	Acceptance Rate
Distributed Questionnaires	9,950	61.92%
Questionnaires Answered	6,161	

Table 2 Students' characteristics (n = 6,161)

Variable	Categories	%	Min	Max	Mean	Std. Dev.
Gender	Male	50.92	0	1	0.50917	0.499965
	Female	49.08				
Grade	7th	34.12	1	3	1.98036	0.8139035
	8th	33.73				
	9th	32.15				

of the Argosaronic Gulf and two concern areas of extension of Athens with an urban and semi-rural character. The sampling was carried out in 50 mainstream junior high schools of all seven education directorates, proportional to the number of students. The sampling procedure took place into the classroom in person, by the researcher, in the presence of the class's science teacher, during a class time designated by the school principal. Questionnaire sampling is presented in Table 1.

The research questionnaire consists of four parts concerning: (a) demographics, (b) energy saving behaviours and (c) self-efficacy as proposed by DeWaters and Powers framework [2, 94] and personal values as derived from Schwartz's value theory [82, 95]. The questionnaire was pilot tested on one hundred students from all three grades in order to record observations on any ambiguities and difficult-to-understand points. The basic characteristics of the student sample are presented in Table 2, whereas Table 3 presents the descriptive statistics of the variables used in the statistical and econometric analysis.

3.2 Modeling Regression Analysis

To answer the research questions of our study, econometric analysis is employed. In particular, ordered regression logistic models are estimated to predict the level of students' agreement on each of the eight sustainable energy related behaviors (as described in Table 3) on relation to their personal values Equation (1) and self-efficacy beliefs Equation (2). The general specification of the proposed ordinal regression model regarding the RQ1 is

Table 3 Descriptive statistics of variables used in statistical and econometric analysis (n = 6,161)

Variable	Mean	Std. Dev.	Min	Max	Description
lightsoff	4.186983	1.051792	1	5	When I leave a room, I turn off the lights.
compoff	3.845967	1.223341	1	5	I turn off the computer when it is not being used.
thinkenrg	2.915111	1.0604	1	5	Many of my everyday decisions are affected by my thoughts on energy use.
lowtemp	4.131472	1.065509	1	5	My family turns the heat down at night or the air condition temperature up when we are not home to save energy.
encoufam	3.772115	1.193057	1	5	I am willing to encourage my family to turn the heat down at night or the air conditioner temperature up when we're not home to save energy.
efflamp	2.8062	1.239803	1	5	My family buys energy efficient compact fluorescent light bulbs.
enceff	3.239085	1.252324	1	5	I am willing to encourage my family to buy energy efficient compact fluorescent light bulbs.
buyless	3.185846	1.149125	1	5	I am willing to buy fewer things in order to save energy.
persusen	2.823081	1.020978	1	5	The way I personally use energy does not really make a difference to the energy problems that face our nation.
schpay	2.017367	1.211896	1	5	I don't need to worry about turning the lights or computers off in the classroom, because the school pays for the electricity.
probsolv	3.733485	0.8890004	1	5	I believe that I can contribute to solving the energy problems by making appropriate energy related choices and actions.
solvecoo	3.794676	0.9195977	1	5	I believe that I can contribute to solving energy problems by working with others.
opennes	3.191636	0.4843893	1	5	Openness to Change
selfenh	2.484175	0.582548	1	5	Self-Enhancement
conserv	3.510685	0.583927	1	5	Conservation
selftran	4.185955	0.6370094	1	5	Self-Transcendence

the following:

$$y_i^* = b_o + b_1 \text{opennes}_i + b_2 \text{selfenh}_i + b_3 \text{conserv}_i + b_4 \text{selftran}_i + \varepsilon_i \quad (1)$$

where yi* is the latent variable measuring the level of students' adoption of eight energy related behaviors; openness; selfenh; conserve; and selftran are the independent variables expressing students' scores towards personal values (as described in Table 3) and proposed by Schwartz and Davidov; and e is an error term [95, 96].

Next, in order to provide evidence regarding RQ2 of our study, the following specification of the ordinal regression model is proposed:

$$y_i^* = b_o + b_1 \text{persusen}_i + b_2 \text{schpay}_i + b_3 \text{probsolv}_i + b_4 \text{solvecoo}_i + \varepsilon_i \quad (2)$$

where yi* is the latent variable measuring the level of students' adoption of eight energy related behaviors; persusen; schpay; probsolv and solvecoo are the independent variables expressing students' self-efficacy beliefs (as described in Table 3) and proposed by DeWaters & Powers; and e is an error term [94].

The empirical results from the estimation of Equations (1) and (2) are presented in the next section of this study.

4 Results

This section presents the statistical and econometric results to answer the research questions of the study regarding the impact of personal values and efficacy beliefs on students' energy related behaviors.

4.1 Descriptive Statistics

Figure 1 presents students' responses to self-efficacy items. Analysis revealed a moderate belief in their personal and collective ability to contribute to solving energy problems. A majority (66%) agreed that their choices and actions can help address energy issues (probsolv), and 69% believed in collaborative efforts (solvecoo). However, self-efficacy was not uniformly high. Students 23% believe that the way they use energy is irrelevant to the energy problem faced by the nation (persusen). Only 14% of the students agreed that since the government pays school's energy bill is unnecessary to switch off the lights (schpay). It is evident that there is a differentiation in the responses regarding the individual behavior of students in relation to the positive environmental

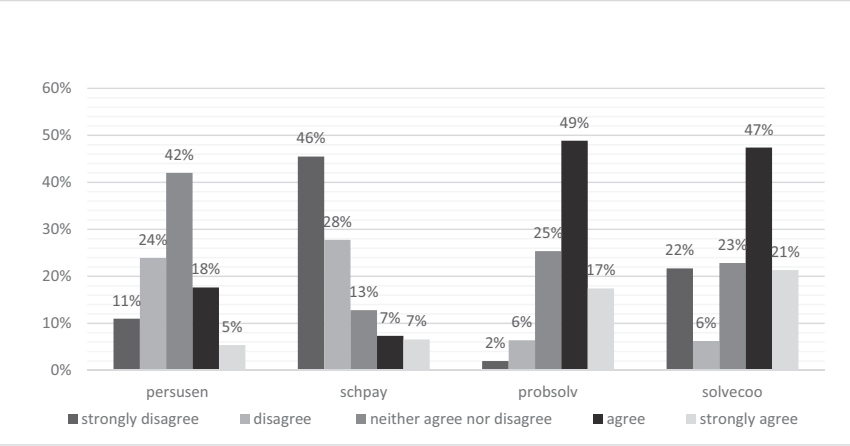


Figure 1 Students' responses to self-efficacy items.

attitudes they present. This indicates that necessary educational approaches are required in order to the responses of the two categories be aligned.

The students' answers to the questions examining their personal values show high levels of creative thinking and independence in their actions (self-direction). They score high in understanding and tolerance but mainly in sustainability and environmental protection (universalism). At the same time, they are distinguished by the tendency to focus on the well-being of others, to offer their help and to remain loyal to their friends (benevolence).

In these three values, the average score of the students exceeds 80% of the maximum score they could obtain. This is followed by values such as security, i.e. individual security and social stability with an average score of approximately 77% of the maximum value, excitement, i.e. excitement and the search for adventure with the same percentage and tradition, i.e. respect for customs and traditions as well as cultural heritage, with a corresponding percentage of 71%. Smaller percentages note values such as hedonism, i.e. pleasure and satisfaction of the senses (68%), achievement, i.e. the need for personal success and achieving goals (63%), compliance, i.e. obedience to laws and self-restraint (62%), while the smallest percentage, 52%, is concentrated on the value of power, i.e. the possession of social status and the acquisition of material goods.

The social focus of the respondents is clear, as the higher order value of self-transcendence (selftran) is marked by scores approaching 83.7% of the maximum score, while the value of conservation (conserv) collects 70.2% of

the maximum score. On the contrary, the personal focus presents moderate levels. Scores approaching 63.8% of the maximum value are noted for the higher order value of oppeness to change (opennes) and only 49.7% for self-enhancement (selfenh).

When it comes to self-reported sustainable energy behavior items showed strong and consistent patterns of environmentally responsible actions. As shown in Figure 2, the most common behavior was turning off lights when leaving a room, reported by 77% (lightsoff). Similarly, 65% turn off their computer rather than leaving it on standby (compoff), and 76% reduce heating or AC use at night (lowtemp). These are practical, everyday actions, indicating that students are incorporating energy-saving habits into their routines.

Moderate levels of engagement were found in influencing others. More precisely, 45% of students encouraged their family to use energy-saving bulbs (enceff), and 38% reported that their family had already purchased such bulbs (efflamp). About one third of the students declares that is thinking about energy in their daily decisions (thinkenrg), suggesting a growing internalization of energy awareness. However, more demanding or abstract behaviors, such as buying fewer products to save energy, received lower endorsement, with only 41% agreeing (buyless). These findings suggest that while convenient, habitual actions are widespread, more transformative behaviors – those involving consumption reduction or lifestyle change – remain less common.

4.2 Ordinal Logistic Regression Analysis

In this section, the empirical results of the Equations (1) and (2) are presented. Tables 4 and 5 summarize the results of the ordinal logistic regression model regarding the effects of personal values and self-efficacy beliefs on students' energy related behaviors, respectively.

Empirical results presented in Table 4 imply that students' value orientations were found to significantly predict their engagement in a range of pro-environmental behaviors. Among the four Schwartz value dimensions, self-transcendence emerged as a strong and consistent positive predictor across nearly all behavioral outcomes. Students who endorse self-transcendence values – such as caring for others, the environment, and promoting the welfare of all – were consistently and strongly more likely to engage in energy-saving behaviors across all models. These students were significantly more likely to turn off lights when leaving a room ($\beta = 0.52$, $p < 0.01$) and to switch off unused computers ($\beta = 0.39$, $p < 0.01$). Their values also

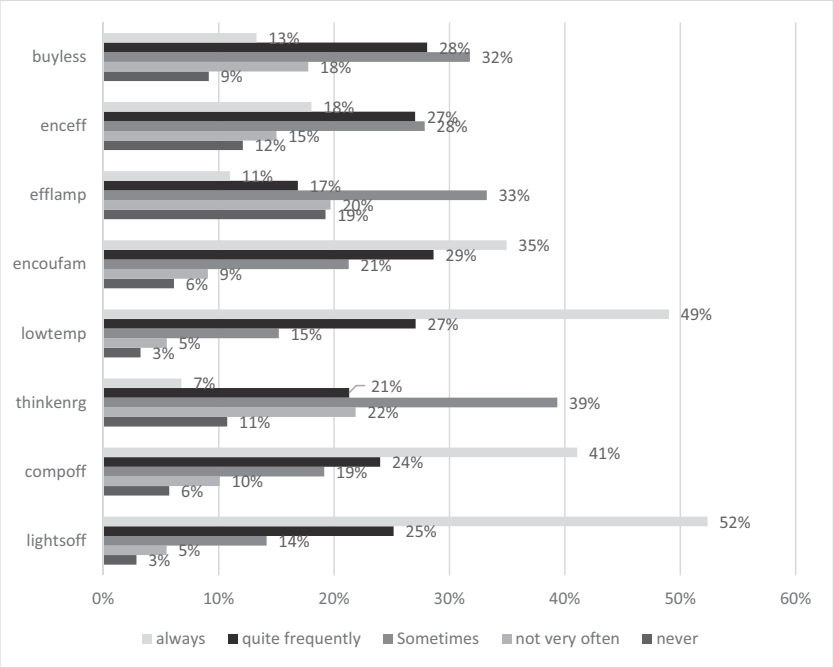


Figure 2 Students' sustainable energy behaviors.

predicted strong internal engagement, such as thinking about energy use in daily decision-making ($\beta = 0.13$, $p < 0.01$). In the household domain, they were more likely to report that their families lower the temperature when not at home ($\beta = 0.53$, $p < 0.01$) and that they personally encourage such behavior ($\beta = 0.59$, $p < 0.01$). Self-Transcendence also significantly predicted encouraging others to adopt energy-efficient technologies such as energy-efficient light bulbs ($\beta = 0.44$, $p < 0.01$) and reducing consumption by purchasing fewer products ($\beta = 0.30$, $p < 0.001$).

Conservation also emerged as a strong and consistent positive predictor across all behavioral outcomes. Students who endorse conservation values, such as security, conformity and tradition, were significantly more likely to turn off lights when leaving a room ($\beta = 0.31$, $p < 0.01$), to switch off unused computers ($\beta = 0.35$, $p < 0.01$), to think about energy use in daily actions ($\beta = 0.40$, $p < 0.01$). In the household domain, they were more likely to state that their families lower the temperature when not at home ($\beta = 0.32$, $p < 0.01$) and that they personally encourage such behavior ($\beta = 0.32$, $p < 0.01$). Conservation significantly predicted the buying

Table 4 Estimated ordinal regression results predicting the role of personal values on energy-related behaviors (n = 6,161)

Dependent Variables	Independent Variables				McFadden R^2
	opennes	selfenh	conserv	selftran	
lightsoff	0.2287***	−0.4159***	0.3131***	0.5245***	0.2328
	(0.000)	(0.000)	(0.000)	(0.000)	
compoff	0.0381	−0.2547***	0.3507***	0.3898***	0.2185
	(0.511)	(0.000)	(0.000)	(0.000)	
thinkenrg	0.0517	−0.1025***	0.3985***	0.1337***	0.2008
	(0.374)	(0.020)	(0.000)	(0.004)	
lowtemp	0.3803***	−0.2953***	0.3192***	0.5349***	0.2342
	(0.000)	(0.000)	(0.000)	(0.000)	
encoufam	0.2443***	−0.3127***	0.3223***	0.5881***	0.2032
	(0.000)	(0.000)	(0.000)	(0.000)	
efflamp	0.0430	−0.1673***	0.1699***	0.0567	0.2021
	(0.959)	(0.000)	(0.003)	(0.206)	
enceff	0.0019	−0.1094**	0.1351***	0.4433***	0.2112
	(0.448)	(0.012)	(0.002)	(0.000)	
buyless	−0.2094***	−0.5177***	0.4585***	0.2972***	0.2248
	(0.000)	(0.000)	(0.000)	(0.000)	

p-values are presented in the parentheses; ***,** denotes statistical significance at 1% and 5% level, respectively.

of energy-efficient lamps ($\beta = 0.17$, $p < 0.01$), others encouragement to adopt such energy-efficient practices ($\beta = 0.14$, $p < 0.01$) and reducing consumption by purchasing fewer products ($\beta = 0.46$, $p < 0.01$).

In contrast, students who endorse self-enhancement values like power, success, and status, were significantly less likely to present pro-environmental attitudes and behaviors. This negative relationship appeared across most behaviors: students with these values were less likely to turn off lights ($\beta = -0.42$, $p < 0.01$) and computers ($\beta = -0.25$, $p < 0.01$), and they were less likely to think about energy use in their daily actions ($\beta = -0.10$, $p < 0.01$). In the household sector, the respondents were less likely to lower the temperature when are not at home ($\beta = -0.30$, $p < 0.01$), to encourage their families to such actions ($\beta = -0.31$, $p < 0.01$), and presented low engagement in behaviors such as purchasing efficient bulbs ($\beta = -0.17$, $p < 0.01$) and recommending this to others ($\beta = -0.11$, $p < 0.05$). Additionally, these students were significantly less willing to reduce their consumption by buying fewer items ($\beta = -0.52$, $p < 0.01$).

Students who endorse openness to change values showed selective but positive associations with sustainable behavior. These students were

Table 5 Estimated ordinal regression results predicting the role of self-efficacy on energy-related behaviors (n = 6,161)

Dependent Variables	Independent Variables				McFadden R^2
	opennes	selfenh	conserv	selftran	
lightsoff	0.0244	−0.2062***	0.2119***	0.1184***	0.2182
	(0.318)	(0.000)	(0.000)	(0.000)	
compoff	0.0559	−0.1549***	0.1441***	0.1523***	0.2112
	(0.016)	(0.000)	(0.000)	(0.000)	
thinkenrg	0.0484	−0.0630***	0.1358***	0.2453***	0.2103
	(0.037)	(0.002)	(0.000)	(0.000)	
lowtemp	0.0091	−0.1862***	0.2197***	0.1739***	0.2198
	(0.705)	(0.000)	(0.000)	(0.000)	
encoufam	0.0177	−0.2291***	0.2613***	0.2935***	0.2316
	(0.449)	(0.000)	(0.000)	(0.000)	
efflamp	0.0196	−0.0249***	0.0870***	0.1092***	0.2027
	(0.392)	(0.213)	(0.003)	(0.000)	
enceff	0.0019	−0.1324***	0.2239***	0.2917***	0.2203
	(0.082)	(0.000)	(0.000)	(0.000)	
buyless	0.0141	−0.1555***	0.2215***	0.2081***	0.2167
	(0.545)	(0.000)	(0.000)	(0.000)	

p-values are presented in the parentheses; *** denotes statistical significance at 1% level.

consistently and strongly more likely to turn off lights when leaving a room ($\beta = 0.23$, $p < 0.01$), to lower the temperature when not at home ($\beta = 0.38$, $p < 0.01$) and personally encourage such behavior ($\beta = 0.24$, $p < 0.01$). On the contrary, the respontents were significantly less willing to reduce their consumption by buying fewer items ($\beta = -0.21$, $p < 0.01$). These results highlight that personal oriented and egoistic values are mostly predicting negative energy-sustainable behaviors and environmentally responsible attitudes. Openness to change is the value that also has positive associations with patterns of sustainable energy behavior. However, we can estimate from the results that individuals who possess egoistic values are not receptive to adopting behaviors that promote energy saving, especially if these behaviors could change their lifestyle.

Students' beliefs in their personal ability to contribute to solving energy problems (probsolv) emerged as the strongest and most consistent predictor of energy-related behaviors (Table 5). Those who endorsed this self-efficacy belief were significantly more likely to report turning off lights when not needed ($\beta = 0.21$, $p < 0.01$) and switching off unused computers ($\beta = 0.14$, $p < 0.01$). They also demonstrated a greater tendency to engage in energy-conscious thinking ($\beta = 0.14$, $p < 0.01$), to report that their families adjusted

room temperatures to save energy ($\beta = 0.22$, $p < 0.01$), and to encourage their families to do so ($\beta = 0.26$, $p < 0.01$). Furthermore, this belief positively predicted behaviors such as buying energy-efficient light bulbs ($\beta = 0.09$, $p < 0.01$), encouraging others to make such purchases ($\beta = 0.22$, $p < 0.01$), and reducing consumption by buying fewer things to conserve energy ($\beta = 0.22$, $p < 0.01$). These findings suggest that students who feel individually empowered are significantly more engaged in a wide range of both personal and family-level energy-saving actions.

Belief in collective efficacy, or the idea that one can help solve energy issues by working with others (solvecoo), was also a strong and consistent positive predictor across all examined behaviors. Students who shared this belief were more likely to turn off lights ($\beta = 0.12$, $p < 0.01$) and computers ($\beta = 0.15$, $p < 0.01$) when not in use. They also exhibited more frequent energy-conscious thinking ($\beta = 0.25$, $p < 0.01$), were more likely to have families that adjusted their home temperature settings ($\beta = 0.17$, $p < 0.01$), and were more inclined to encourage their families to adopt such practices ($\beta = 0.29$, $p < 0.01$). Moreover, students who believed in the power of collaboration were more likely to buy energy-efficient bulbs ($\beta = 0.11$, $p < 0.01$), encourage others to do the same ($\beta = 0.29$, $p < 0.01$), and purchase fewer things as a means of saving energy ($\beta = 0.20$, $p < 0.01$). The results present that both individual and collective action are positively associated with the adoption of energy-sustainable behaviors. This reinforce the common belief that pro-environmental behaviors involve action. In contrast, respondents who support the idea that saving energy at school or in environments where the cost of energy consumption is the responsibility of others (schpay) were consistently and significantly associated with a lower likelihood of engaging in energy-related behaviors. Students who held this belief were less likely to turn off lights ($\beta = -0.21$, $p < 0.001$) or computers ($\beta = -0.15$, $p < 0.01$), and they demonstrated less frequent energy-conscious thinking ($\beta = -0.06$, $p < 0.01$). Although this statement directly references the school context, it also negatively predicted behaviors beyond the school environment, including family-related actions such as lowering home temperature ($\beta = -0.18$, $p < 0.01$) and encouraging families to reduce energy use ($\beta = -0.23$, $p < 0.01$). Moreover, students with this belief were less likely to report buying efficient light bulbs ($\beta = -0.03$, $p < 0.01$), less likely to encourage others to buy such lamps ($\beta = -0.13$, $p < 0.01$), and less likely to reduce personal consumption ($\beta = -0.16$, $p < 0.01$). This suggests a broader sense of disengagement and externalization of responsibility that undermines both school- and home-based energy-saving behaviors.

Finally, the belief that individual energy use does not make a meaningful difference to national energy problems (persusen) was not significantly related to any of the observed behaviors. Across all eight dependent variables – turning off lights, turning off computers, energy-conscious thinking, lowering home temperature, encouraging family, buying efficient bulbs, encouraging others, and buying fewer items were non-significant. This suggests that although some students may intellectually distance themselves from the broader energy problem, this belief alone does not reliably predict whether they will or will not engage in energy-saving behavior. It may reflect a passive stance that does not translate into clear behavioral patterns, in contrast to the more active dimensions captured by personal and collective efficacy.

5 Discussion

The results support the significance of self-efficacy in developing energy saving behavior (RQ1). In most models such as those which involve taking personal responsibility and initiative, the greater the beliefs in personal and collective efficacy, the more likely respondents were to perform the behaviors. Specifically, those who perceived that their personal actions contribute to positive environmental change and that they can solve energy problems by cooperating with others showed higher intention of adopting environmentally friendly behaviors in agreement with Bandura's theory (Bandura et al., 1980). In contrast, agreement with more passive or detached belief were negatively associated with energy saving action, providing evidence that when responsibility is shifted outside it reduces sustainable engagement. These results are consistent with social cognitive theory, emphasizing students' sense of being effective agents in their own lives.

As regards Schwartz's value orientations (RQ2), self-transcendence was most strongly and consistently related to energy-saving behavior. Participants who identified themselves as valuing universalism, benevolence, and environmental concern, reported more frequent sustainable behaviors – from shutting off lights and devices to minimizing consumption activities. This indicates that altruistic and biospheric concerns strongly influence sustainable orientations, also among the young which is in line with previous studies [91].

At the other end, self-enhancement factors were negatively related to several behaviors, in particular, those requiring sacrifice or deferred rewards. This suggests that egoistic orientations can be a hindrance to sustainability, as long as it is not compatible with status-driven needs and desires.

It is worth noting that openness to experience played a less important but still positive role, particularly in behaviors that require personal pondering and taking the initiative. This conclusion agrees with previous studies that argue that the individuals who are distinguished by openness will probably act pro-environmentally, trying even to overcome the difficulties that this behavior will bring in terms of their well-being [86, 92, 93]. This implies that autonomy and creativity could help to facilitate engagement in light of energy behaviors being represented as self-expression and decision-making.

Conservative did not itself significantly predict energy behaviors. This could be indicative of a discrepancy between conservative values and the presentation of sustainability in the context of a contemporary, activist-oriented or especially youthful initiative. That or students don't see acts of energy conservation to be as normative and mandatory that they should be solidified by habit or custom.

6 Conclusions and Policy Implications

This research investigated how students' personal values and self-efficacy beliefs are related to their engagement in saving energy. Results from ordinal logistic regression analyses indicated that the values related to security and self-transcendence were strong positive predictors of environmentally responsible behavior. On the other hand, self-enhancement values related negatively to sustainability-related behavior. Students who had higher confidence in their own personal and collective efficacy were more likely to engage behaviors of turning off equipment that remains unused, reminding family members to save energy, and making intentional energy-smart choices.

These results add to the expanding literature on the social underpinnings of sustainable behavior and emphasize the significance of value-based and efficacy-enhancing educational interventions. Energy-use interventions that are rich in empathy, responsibility and have clear implications for the individual's own action may be more successful in encouraging youth to adopt energy-conscious behaviors.

The results of the study have implications for environmental educators as well as for policy-makers: Sustainability education should not only emphasize knowledge, but also empower beliefs – making it possible for students to regard their actions as relevant and to feel that they can have an impact. Curricula should cultivate the value of empathy. It should promote care and responsibility and positively strengthen self-transcendence and social concern. Programs can work to reframe energy behaviors as not sacrifices,

but instead as statements of personal creativity or autonomy in order to link them with openness to change. Lastly, interventions targeting and re-framing egoistic resistance (e.g., linking sustainability with leadership or forward thinking) might also facilitate the engagement of high self-enhancement students.

However, there are some limitations to this study. The data are cross-sectional and based on self-report so responses may be influenced by social desirability bias. In addition, the sample is limited to students, so results cannot be generalized to wider populations with different sociodemographic characteristics.

These developments can be reasonably assumed to be observed by analysts with longer durations of the intervention in order to measure longitudinal effects of value development and efficacy enhancement on behavior change. In addition, causal efficacy of integrated value- and efficacy-based programs could be tested in controlled experimental "real-life" educational studies and interventions. Moreover, broadening the sample to different age groups and cultural settings would improve the external validity of the results.

References

[1] Dijoo, Z. K., and Khurshid, R. 2022. Environmental degradation as a multifaceted consequence of human development. In *Environmental Biotechnology* (pp. 39–56). Apple Academic Press. https://doi.org/10.1201/9781003277279.

[2] DeWaters, J. E., and Powers, S. E. 2011. Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. *J. Energy policy, 39*(3), 1699–1710. https://doi.org/10.1016/j.enpol.2010.12.049.

[3] DeWaters, J., and Powers, S. 2013. Establishing measurement criteria for an energy literacy questionnaire. *J. The Journal of Environmental Education, 44*(1), 38–55. https://doi.org/10.1080/00958964.2012.711378.

[4] Sanginova, G. B. 2024. Improving organization in the first environmental education of preschool children. *J. Multidisciplinary Journal of Science and Technology*, *4*(4), 440–447.

[5] Elkhatat, A., and Al-Muhtaseb, S. 2024. Climate change and energy security: a comparative analysis of the role of energy policies in advancing environmental sustainability. *J. Energies*, *17*(13), 3179. https://doi.org/10.3390/en17133179.

[6] Casmana, A. R., Dewantara, J. A., Timoera, D. A., Kusmawati, A. P., and Syafrudin, I. 2023. Global citizenship: preparing the younger generation to possess pro-environment behavior, mutual assistance and tolerance awareness through school engagement. *J. Globalisation, Societies and Education*, *21*(1), 15–32. https://doi.org/10.1080/14767724.2021.2013167.

[7] Küfeoðlu, S. 2022. SDG-7 affordable and clean energy. In *Emerging technologies: Value creation for sustainable development* (pp. 305–330). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-07127-0_9.

[8] Lup, A. N. K., Soni, V., Keenan, B., Son, J., Taghartapeh, M. R., Morato, M. M., ... and Montañés, R. M. 2023. Sustainable energy technologies for the Global South: challenges and solutions toward achieving SDG 7. *J. Environmental Science: Advances*, *2*(4), 570–585. https://doi.org/10.1039/D2VA00247G.

[9] Adewumi, A., Olu-lawal, K. A., Okoli, C. E., Usman, F. O., and Usiagu, G. S. 2024. Sustainable energy solutions and climate change: A policy review of emerging trends and global responses. *J. World Journal of Advanced Research and Reviews*, *21*(2), 408–420. https://doi.org/10.30574/wjarr.2024.21.2.0474.

[10] Laimon, M., and Yusaf, T. 2024. Towards energy freedom: Exploring sustainable solutions for energy independence and self-sufficiency using integrated renewable energy-driven hydrogen system. *J. Renewable Energy*, *222*, 119948. https://doi.org/10.1016/j.renene.2024.119948.

[11] Bandura, A., and Schunk, D. H. 1981. Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *J. Journal of personality and social psychology, 41*(3), 586. https://doi.org/10.1037/0022-3514.41.3.586.

[12] Otto, S., Evans, G. W., Moon, M. J., and Kaiser, F. G. 2019. The development of children's environmental attitude and behavior. *J. Global Environmental Change, 58*, 101947. https://doi.org/10.1016/j.gloenvcha.2019.101947.

[13] Bogner, F. X., Johnson, B., Buxner, S., and Felix, L. 2015. The 2-MEV model: Constancy of adolescent environmental values within an 8-year time frame. *J. International Journal of Science Education, 37*(12), 1938–1952. https://doi.org/10.1080/09500693.2015.1058988.

[14] Bergman, B. G. 2016. Assessing impacts of locally designed environmental education projects on students' environmental attitudes,

awareness, and intention to act. *J. Environmental Education Research, 22*(4), 480–503. https://doi.org/10.1080/13504622.2014.999225.

[15] Bogner, F. X., and Wilhelm, M. G. 1996. Environmental perspectives of pupils: The development of an attitude and behaviour scale. *J. Environmentalist, 16*(2), 95–110. https://doi.org/10.1007/BF01325101.

[16] Collado, S., Corraliza, J. A., Staats, H., and Ruiz, M. 2015. Effect of frequency and mode of contact with nature on children's self-reported ecological behaviors. *J. Journal of Environmental Psychology, 41*, 65–73. https://doi.org/10.1016/j.jenvp.2014.11.001.

[17] Demetriou, K., Rana, S. S., and Williams, J. 2024. Measures of Children's concerns and attitudes in relation to environmental crises: A systematic review. *J. Journal of Environmental Psychology*, 102433. https://doi.org/10.1016/j.jenvp.2024.102433.

[18] Evans, G. W., Otto, S., and Kaiser, F. G. 2018. Childhood origins of young adult environmental behavior. *J. Psychological science, 29*(5), 679–687. https://doi.org/10.1177/0956797617741894.

[19] Kopnina, H. 2011. Kids and cars: Environmental attitudes in children. *J. Transport Policy, 18*(4), 573–578. https://doi.org/10.1016/j.tranpol.2011.01.013.

[20] Eccles, J. S. 1999. The development of children ages 6 to 14. *J. The future of children*, 30–44. https://doi.org/10.2307/1602703.

[21] Piaget, J. 2003. Part I: Cognitive Development in Children–Piaget Development and Learning. *J. Journal of research in science teaching*, 40. https://doi.org/10.1002/tea.3660020306.

[22] Piaget, J. 2000. Piaget's theory of cognitive development. Childhood cognitive development: *J. The essential readings, 2*(7), 33–47.

[23] Schwenck, C., Göhle, B., Hauf, J., Warnke, A., Freitag, C. M., and Schneider, W. 2014. Cognitive and emotional empathy in typically developing children: The influence of age, gender, and intelligence. *J. European Journal of Developmental Psychology, 11*(1), 63–76. https://doi.org/10.1080/17405629.2013.808994.

[24] Isabelle, G. M. 2011. Energy-related logics of action throughout the ages in France: historical milestones, stages of life and intergenerational transmissions. *J. Energy Efficiency, 4*(4), 493–509. https://doi.org/10.1007/s12053-011-9124-8.

[25] Sanghvi, P. 2020. Piaget's theory of cognitive development: a review. *J. Indian Journal of Mental Health, 7*(2), 90–96.

[26] Kuhn, D. 1979. The application of Piaget's theory of cognitive development to education. *J. Harvard educational review, 49*(3), 340–360. https://doi.org/10.17763/haer.49.3.h70173113k7r618r.

[27] Pakpahan, F. H., and Saragih, M. 2022. Theory of cognitive development by Jean Piaget. *J. Journal of Applied Linguistics, 2*(1), 55–60. DOI: https://doi.org/10.52622/joal.v2i2.79.

[28] Pearce, H., Hudders, L., and Van de Sompel, D. 2020. Young energy savers: Exploring the role of parents, peers, media and schools in saving energy among children in Belgium. *J. Energy Research & Social Science, 63*, 101392. https://doi.org/10.1016/j.erss.2019.101392.

[29] Strife, S. J. 2012. Children's environmental concerns: Expressing ecophobia. *J. The Journal of Environmental Education*, *43*(1), 37–54. https://doi.org/10.1080/00958964.2011.602131.

[30] Kuthe, A., Keller, L., Körfgen, A., Stötter, H., Oberrauch, A., and Höferl, K. M. 2019. How many young generations are there? – A typology of teenagers' climate change awareness in Germany and Austria. *J. The Journal of Environmental Education*, *50*(3), 172–182. https://doi.org/10.1080/00958964.2019.1598927.

[31] Neas, S., Ward, A., and Bowman, B. 2022. Young people's climate activism: A review of the literature. *J. Frontiers in Political Science, 4*, 940876. https://doi.org/10.3389/fpos.2022.940876.

[32] Jouhki, E. 2021. 'Then we were ready to be radicals!': school student activism in Finnish upper secondary schools in 1960–1967. *J. Scandinavian Journal of History, 46*(3), 383–407. https://doi.org/10.1080/03468755.2021.1875871.

[33] Marks, E., Hickman, C., Pihkala, P., Clayton, S., Lewandowski, E. R., Mayall, E. E., … and Van Susteren, L. 2021. Young people's voices on climate anxiety, government betrayal and moral injury: A global phenomenon. Government betrayal and moral injury: A global phenomenon. https://doi.org/10.1016/S2542-5196(21)00278-3.

[34] Wankmüller, F., Loy, L. S., and Siegmund, A. 2025. Perspectives on climate change adaptation – A cluster analysis of young Germans to develop tailored educational approaches. *J. Journal of Environmental Psychology*, 102560. https://doi.org/10.1016/j.jenvp.2025.102560.

[35] Clayton, S. D., Pihkala, P., Wray, B., and Marks, E. 2023. Psychological and emotional responses to climate change among young people worldwide: Differences associated with gender, age, and country. *J. Sustainability, 15*(4), 3540. https://doi.org/10.3390/su15043540.

[36] Brophy, H., Olson, J., and Paul, P. 2023. Eco-anxiety in youth: An integrative literature review. International Journal of Mental Health Nursing, 32(3), 633–661. https://doi.org/10.1111/inm.13099.

[37] Kankawale, S. M., and Niedzwiedz, C. L. 2023. Eco-anxiety among children and young people: systematic review of social, political, and geographical determinants. *J. MedRxiv*, 2023–12. https://doi.org/10.1101/2023.12.19.23300198.

[38] Léger-Goodes, T., Malboeuf-Hurtubise, C., Mastine, T., Généreux, M., Paradis, P. O., and Camden, C. 2022. Eco-anxiety in children: A scoping review of the mental health impacts of the awareness of climate change. *J. Frontiers in psychology, 13*, 872544. https://doi.org/10.3389/fpsyg.2022.872544.

[39] Niedzwiedz, C. L., Olsen, J. R., Rizeq, J., Afework, T., Hill-Harding, C. K., Shaw, R. J., ... and Papies, E. K. 2025. Coming to terms with climate change: a glossary for climate change impacts on mental health and well-being. *J. Epidemiol Community Health, 79*(4), 295–301. https://doi.org/10.1136/jech-2024-222716.

[40] Collado, S., and Evans, G. W. 2019. Outcome expectancy: A key factor to understanding childhood exposure to nature and children's pro-environmental behavior. *J. Journal of Environmental Psychology, 61*, 30–36. https://doi.org/10.1016/j.jenvp.2018.12.001.

[41] Denault, A. S., Bouchard, M., Proulx, J., Poulin, F., Dupéré, V., Archambault, I., and Lavoie, M. D. 2024. Predictors of Pro-Environmental Behaviors in Adolescence: A Scoping Review. *J. Sustainability, 16*(13), 5383. https://doi.org/10.3390/su16135383.

[42] Kubrak, T. 2020. Impact of films: Changes in young people's attitudes after watching a movie. *J. Behavioral sciences, 10*(5), 86. https://doi.org/10.3390/bs10050086.

[43] Shapiro, S. 2013. Poor people, poor planet: The psychology of how we harm and heal humanity and earth. In Toward a Socially Responsible Psychology for a Global Era (pp. 231–254). New York, NY: Springer New York. https://doi.org/10.1007/978-1-4614-7391-6_10.

[44] Bandura, A. 1982. Self-efficacy mechanism in human agency. *J. American psychologist, 37*(2), 122. https://doi.org/10.1037/0003-066X.37.2.122.

[45] Bandura, A. 2006. Guide for constructing self-efficacy scales. *Self-efficacy beliefs of adolescents, 5*(1), 307–337. https://doi.org/10.1017/CBO9781107415324.004.

[46] Maddux, J. E. 2009. Self-efficacy: The power of believing you can. in Shane J. Lopez, and C. R. Snyder (eds), The Oxford Handbook of Positive Psychology, online edn, Oxford Academic 2012, pp. 335–344. https://doi.org/10.1093/oxfordhb/9780195187243.013.0031.

[47] Constantino, S. M., Sparkman, G., Kraft-Todd, G. T., Bicchieri, C., Centola, D., Shell-Duncan, B., ... and Weber, E. U. 2022. Scaling up change: A critical review and practical guide to harnessing social norms for climate action. *J. Psychological science in the public interest, 23*(2), 50–97. https://doi.org/10.1177/15291006221105279.

[48] Kazdin, A. E. 1979. Imagery elaboration and self-efficacy in the covert modeling treatment of unassertive behavior. *J. Journal of Consulting and Clinical Psychology, 47*(4), 725. https://doi.org/10.1037/0022-006X.47.4.725.

[49] Schunk, D. H. 1989. Self-efficacy and achievement behaviors. *Educational psychology review, 1*, 173–208. https://doi.org/10.1007/BF01320134.

[50] Aguirre-Bielschowsky, I., Lawson, R., Stephenson, J., and Todd, S. 2017. Energy literacy and agency of New Zealand children. *J. Environmental Education Research, 23*(6), 832–854. https://doi.org/10.1080/13504622.2015.1054267.

[51] Boudet, H., Ardoin, N. M., Flora, J., Armel, K. C., Desai, M., and Robinson, T. N. 2016. Effects of a behaviour change intervention for Girl Scouts on child and parent energy-saving behaviours. *J. Nature Energy, 1*(8), 1–10. https://doi.org/10.1038/nenergy.2016.91.

[52] Fell, M. J., and Chiu, L. F. 2014. Children, parents and home energy use: Exploring motivations and limits to energy demand reduction. *J. Energy Policy, 65*, 351–358. https://doi.org/10.1016/j.enpol.2013.10.003.

[53] Suryana, T. G. S., Setyadin, A. H., Samsudin, A., and Kaniawati, I. 2020. Assessing multidimensional energy literacy of high school students: an analysis of rasch model. In *Journal of Physics: Conference Series* (Vol. 1467, No. 1, p. 012034). IOP Publishing. https://doi.org/10.1088/1742-6596/1467/1/012034.

[54] Bandura, A., Adams, N. E., Hardy, A. B., and Howells, G. N. 1980. Tests of the generality of self-efficacy theory. *J. Cognitive therapy and research, 4*, 39–66. https://doi.org/10.1007/BF01173354.

[55] Lee, Y. F., Nguyen, H. B. N., and Sung, H. T. 2022. Energy literacy of high school students in Vietnam and determinants of their energy-saving behavior. *J. Environmental Education Research, 28*(6), 907–924. https://doi.org/10.1080/13504622.2022.2034752.

[56] Polikovsky, M., Sharon, A., and Golberg, A. 2018. Enhancing energy literacy in children using zn/cu/potato batteries. F1000. *J. Research, 7*, 24. doi: 10.12688/f1000research.13228.1.

[57] Radtke, R., Santillan-Jimenez, E., and Mohr-Schroeder, M. 2020. Collaboration by design: Development of a video game for energy literacy. *J. International Journal of Designs for Learning, 11*(2), 46–54. https://doi.org/10.14434/ijdl.v11i2.24109.

[58] Volk, T. L., and Cheak, M. J. 2003. The effects of an environmental education program on students, parents, and community. *J. The Journal of Environmental Education, 34*(4), 12–25. https://doi.org/10.1080/00958960309603483.

[59] Zografakis, N., Menegaki, A. N., and Tsagarakis, K. P. 2008. Effective education for energy efficiency. *J. Energy Policy, 36*(8), 3226–3232. https://doi.org/10.1016/j.enpol.2008.04.021.

[60] Keller, L., Riede, M., Link, S., Hüfner, K., and Stötter, J. 2022. Can education save money, energy, and the climate? – assessing the potential impacts of climate change education on energy literacy and energy consumption in the light of the EU energy efficiency directive and the Austrian energy efficiency act. *J. Energies, 15*(3), 1118. https://doi.org/10.3390/en15031118.

[61] Pradana, N. L., Kesmawan, A. P., and Maharani, S. 2019. Energy literacy-based learning activities on female students. *J. International Journal of Scientific & Technology Research, 8*, 1711–15.

[62] Boz, V., and Gorgulu Ari, A. 2020. Student Views About Energy Resources. *J. International Online Journal of Educational Sciences, 12*(2). https://doi.org/10.15345/iojes.2020.02.001.

[63] Karimi, S., Liobikienë, G., Saadi, H., and Sepahvand, F. 2021. The influence of media usage on iranian students' pro-environmental behaviors: An application of the extended theory of planned behavior. *J. Sustainability*, *13*(15), 8299. https://doi.org/10.3390/su13158299.

[64] Tamar, M., Wirawan, H., Arfah, T., and Putri, R. P. S. 2021. Predicting pro-environmental behaviours: the role of environmental values, attitudes and knowledge. *Management of Environmental Quality: An International Journal*, *32*(2), 328–343. https://doi.org/10.1108/MEQ-12-2019-0264.

[65] Kluskens, N. T., Höffken, J. I., and Alkemade, F. 2025. Exploring opportunities and limits of energy citizenship in Dutch heat transitions. *Energy Research & Social Science*, *127*, 104184.

[66] Nilsson, A., von Borgstede, C., and Biel, A. 2004. Willingness to accept climate change strategies: The effect of values and norms. *J. Journal of environmental psychology*, *24*(3), 267–277. https://doi.org/10.1016/j.jenvp.2004.06.002.

[67] Raza, S. A., Khan, K. A., and Qamar, B. 2024. Understanding the influence of environmental triggers on tourists' pro-environmental behaviors in the Pakistan's tourism industry. *J. Journal of Tourism Futures*, *10*(1), 38–67. https://doi.org/10.1108/JTF-12-2021-0269.

[68] Savari, M., Damaneh, H. E., Damaneh, H. E., and Cotton, M. 2023. Integrating the norm activation model and theory of planned behaviour to investigate farmer pro-environmental behavioural intention. *J. Scientific Reports*, *13*(1), 5584. https://doi.org/10.1038/s41598-023-32831-x.

[69] Tran, K., Nguyen, T., Tran, Y., Nguyen, A., Luu, K., and Nguyen, Y. 2022. Eco-friendly fashion among generation Z: Mixed-methods study on price value image, customer fulfillment, and pro-environmental behavior. *J. Plos one*, *17*(8), e0272789. https://doi.org/10.1371/journal.pone.0272789.

[70] Wang, H., Li, J., Mangmeechai, A., and Su, J. 2021. Linking perceived policy effectiveness and proenvironmental behavior: The influence of attitude, implementation intention, and knowledge. *J. International Journal of Environmental Research and Public Health*, *18*(6), 2910. https://doi.org/10.3390/ijerph18062910.

[71] Whitmarsh, L., and O'Neill, S. 2010. Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *J. Journal of environmental psychology*, *30*(3), 305–314. https://doi.org/10.1016/j.jenvp.2010.01.003.

[72] Widayat, W., Praharjo, A., Putri, V. P., Andharini, S. N., and Masudin, I. 2021. Responsible consumer behavior: Driving factors of pro-environmental behavior toward post-consumption plastic packaging. *J. Sustainability*, *14*(1), 425. https://doi.org/10.3390/su14010425.

[73] Wu, J. S., Font, X., and Liu, J. 2021. The elusive impact of pro-environmental intention on holiday on pro-environmental behaviour at home. *J. Tourism Management*, *85*, 104283. https://doi.org/10.1016/j.tourman.2021.104283.

[74] Zeng, Z., Zhong, W., and Naz, S. 2023. Can environmental knowledge and risk perception make a difference? The role of environmental concern and pro-environmental behavior in fostering sustainable

consumption behavior. *J. Sustainability*, *15*(6), 4791. https://doi.org/10.3390/su15064791.

[75] Chien, F., Sadiq, M., Nawaz, M. A., Hussain, M. S., Tran, T. D., and Le Thanh, T. 2021. A step toward reducing air pollution in top Asian economies: The role of green energy, eco-innovation, and environmental taxes. *J. Journal of environmental management*, *297*, 113420. https://doi.org/10.1016/j.jenvman.2021.113420.

[76] Rehman, A., Ma, H., Ozturk, I., and Ulucak, R. 2022. Sustainable development and pollution: the effects of CO_2 emission on population growth, food production, economic development, and energy consumption in Pakistan. *J. Environmental Science and Pollution Research*, *29*(12), 17319–17330. https://doi.org/10.1007/s11356-022-19600-5.

[77] Sharma, R., Shahbaz, M., Kautish, P., and Vo, X. V. 2021. Does energy consumption reinforce environmental pollution? Evidence from emerging Asian economies. *J. Journal of Environmental Management*, *297*, 113272. https://doi.org/10.1016/j.jenvman.2021.113272.

[78] Yi, S., Abbasi, K. R., Hussain, K., Albaker, A., and Alvarado, R. 2023. Environmental concerns in the United States: can renewable energy, fossil fuel energy, and natural resources depletion help?. *J. Gondwana Research*, *117*, 41–55. https://doi.org/10.1016/j.gr.2022.12.021.

[79] Pothitou, M., Hanna, R. F., and Chalvatzis, K. J. 2016. Environmental knowledge, pro-environmental behaviour and energy savings in households: An empirical study. *J. Applied Energy*, *184*, 1217–1229. https://doi.org/10.1016/j.apenergy.2016.06.017.

[80] Stern, P. C. 1992. Psychological dimensions of global environmental change. *J. Annual Review of Psychology*, *43*, 269–302. https://doi.org/10.1146/annurev.ps.43.020192.001413.

[81] Stern, P. C., and Dietz, T. 1994. The value basis of environmental concern. *J. Journal of social issues*, *50*(3), 65–84. https://doi.org/10.1111/j.1540-4560.1994.tb02420.x.

[82] Schwartz, S. H. 1992. Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In Advances in experimental social psychology, Academic Press 25, pp. 1–65. https://doi.org/10.1016/S0065-2601(08)60281-6.

[83] Martin, C., and Czellar, S. 2017. Where do biospheric values come from? A connectedness to nature perspective. *J. Journal of Environmental Psychology*, *52*, 56–68. https://doi.org/10.1016/j.jenvp.2017.04.009.

[84] De Groot, J. I., and Steg, L. 2008. Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *J. Environment and behavior*, *40*(3), 330–354. https://doi.org/10.1177/0013916506297831.

[85] Steg, L., Perlaviciute, G., Van der Werff, E., and Lurvink, J. 2014. The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *J. Environment and behavior*, *46*(2), 163–192. https://doi.org/10.1177/0013916512454730.

[86] Kim, S., and Kim, S. 2024. Does social value matter in energy saving behaviors?: Specifying the role of eleven human values on energy saving behaviors and the implications for energy demand policy. *J. Energy Strategy Reviews*, *52*, 101327. https://doi.org/10.1016/j.esr.2024.101327.

[87] Schultz, P. W., and Zelezny, L. 2003. Reframing environmental messages to be congruent with American values. *J. Human ecology review*, 126–136. https://www.jstor.org/stable/24706963.

[88] De Groot, J. I., and Steg, L. 2010. Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *J. Journal of Environmental Psychology*, *30*(4), 368–378. https://doi.org/10.1016/j.jenvp.2010.04.002.

[89] Karp, D. G. 1996. Values and their effect on pro-environmental behavior. *J. Environment and behavior*, *28*(1), 111–133. https://doi.org/10.1177/00139165962810.

[90] Schultz, P. W., and Zelezny, L. 1999. Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *J. Journal of environmental psychology*, *19*(3), 255–265. https://doi.org/10.1006/jevp.1999.0129.

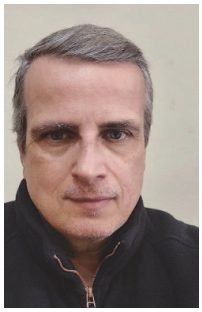
[91] Tolppanen, S., and Kang, J. 2021. The effect of values on carbon footprint and attitudes towards pro-environmental behavior. *J. Journal of Cleaner Production*, 282, 124524. https://doi.org/10.1016/j.jclepro.2020.124524.

[92] Li, Y. B., Wang, T. Y., Lin, R. X., Yu, S. N., Liu, X., Wang, Q. C., and Xu, Q. 2022. Behaviour-driven energy-saving in hotels: The roles of extraversion and past behaviours on guests' energy-conservation intention. *J. Buildings*, *12*(7), 941. https://doi.org/10.3390/buildings12070941.

[93] Busic-Sontic, A., Czap, N. V., and Fuerst, F. 2017. The role of personality traits in green decision-making. *J. Journal of Economic Psychology*, *62*, 313–328. https://doi.org/10.1016/j.joep.2017.06.012.

[94] DeWaters, J., and Powers, S. Energy literacy among middle and high school youth. In 2008 38th Annual Frontiers in Education Conference (pp. T2F-6). IEEE. October 2008. doi: 10.1109/FIE.2008.4720280.
[95] Schwartz, S. H. 2003. A proposal for measuring value orientations across nations. Questionnaire package of the european social survey, 259(290), 2003, pp. 259–315.
[96] Davidov, E. 2008). A cross-country and cross-time comparison of the human values measurements with the second round of the European Social Survey. In Survey research methods, European Survey Research Association 2008, (Vol. 2, No. 1, pp. 33–46). https://doi.org/10.5167/uzh-95236

Biographies



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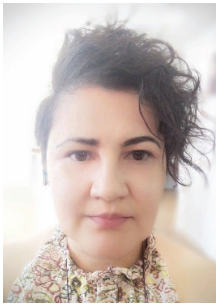

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