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Energy Literacy of Economics Students in Rijeka: Knowledge, Attitudes, and Behavioral Approach

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Abstract: The research problem of this paper is related to numerous open questions in the field of energy, its understanding, its use, and the challenges of the energy future. After the introductory part, in which a brief historical overview of energy literacy is provided, the paper focuses on energy literacy, its emergence, and the different approaches to its definition and measurement. The paper analyzes the energy literacy of students at the Faculty of Economics in Rijeka based on their cognitive, affective, and behavioral skills. Their knowledge about energy, energy processes, and the energy efficiency of the objects they encounter on a daily basis is examined. Their personal attitudes and values are examined through various forms of personal initiatives and active participation in energy sustainability projects. Finally, the habits and behavioral patterns that the respondents have in their daily lives and their tendencies to save energy resources and find energy-efficient solutions are examined. Despite some positive findings, the current results are not satisfactory and point to the creation of adequate public policies with a particular focus on education and the role of the corrective mechanisms of the state, but also the need for joint negotiations between policy makers, regulators, scientists, representatives of civil society, and the business community. The particular contribution of this work is reflected in being the first research of its kind conducted among Croatian economics students, as well as among Croatian students in general; in the creation of a research instrument that is conceptually consistent with the findings from the existing literature, but with an original set of questions within each energy literacy skill adapted to the cultural and sociological background of the respondents; and in a kind of progress from previous research by taking into account the quantitative aspect (in addition to the qualitative) assessment of the respondents' energy literacy.

Keywords: energy; energy literacy; energy efficiency; economics students; energy policy

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1. Introduction

The phenomenon of literacy is part of the heritage, tradition, and culture of each country, which has its own historical, social, geopolitical, socio-demographic, and ideological characteristics.

From Mesopotamia (ca. 3500 B.C.), the ancient Sumerians and cuneiform writing to Egyptian hieroglyphics (ca. 3300 B.C.), the Indus civilization and the Harappan script (ca. 2800 B.C.), the Minoan civilization (ca. 2500 B.C.) and the linear script, China and the Chinese script (ca. 1200 B.C.), to the sign script of the Olmecs and Zapotecs (ca. 900 B.C.) in the Central American lowlands, the history of writing has undergone many changes, from signs and symbols to today's letters. It is believed that, in this prehistoric period, less than 1% of the population was literate and that this was limited to a very small ruling elite [1].

And although ancient and post-ancient literacy [2] had its good and bad days (Dark Ages), major changes did not follow until the new century, stimulated by Gutenberg's printing press (1440), which led to the information revolution and the mass spread of literacy throughout Europe [3].

During the industrial revolutions and the invention of the steam engine (18th century), the internal combustion engine (19th century), the first digital message *login* (20th century) and finally artificial intelligence, robotization, additive (3D) technology, and virtual reality (21st century), literacy continued to grow, increasing from 12% individuals being *literate* (1820s) to up to 87% (2020s), i.e., only 13% individuals were *illiterate* in just 200 years [4].

Today's information age has connected different peoples and cultures, and modern society requires new criteria, media, and interpretations of literacy [5]. It is undeniable that basic literacy is defined as the ability to read, write, and perform arithmetic, i.e., alphabetic and numeric literacy. However, in addition to basic literacy, today, there are also many aspects of functional literacy, which is the world population's response to the demands of society, a population that (in addition to the ability to read and write), to a considerable extent, also understands more complex datasets and knows how to solve certain life and work tasks. According to UNESCO [6], functional literacy is the ability to recognize, understand, interpret, create, communicate, compute, and use printed and written materials in a variety of contexts. Thus, functional literacy is a fundamental dimension of literacy concepts in all areas of human activity, including *energy*. In this sense, numerous specific forms of functional literacy can be identified, including *energy literacy*, which, from the perspective of functional theory, encompasses the knowledge and skills required to perform specific tasks related to *energy issues*.

The importance of energy literacy for coping with the energy problems and challenges of modern society is beyond question. It is already acquired in childhood and especially during the school years and manifests itself in energetic behavior patterns not only within but also outside the household, in all areas of individual activity. The aim of this study is therefore to analyze the energy literacy of the student population as the full potential of modern society and, taking into account the results, to propose appropriate measures for prevention, correction, and problem solving.

To date, several papers have been published on the topic of the energy literacy of students [7,8], mainly of students majoring in technology, engineering, energy, and environment, but there are also studies on economics students [9,10], which represent a relevant research population. Indeed, it is becoming increasingly clear that the synergy of the energy and economic professions is necessary [11] to achieve a sustainable model of energy efficiency and optimization of the costs and benefits of all resources used, from energy to money [12,13]. In this sense, the energy literacy of economics students as future managers, executives, directors, and holders of other responsible positions should contribute significantly to understanding and solving the energy and financial issues of the future.

2. The Genesis of the Phenomenon of Energy Literacy

The history of energy and the understanding of energy is linked to man's efforts to use natural forces to his advantage. Following Maslow's pyramid of the hierarchy of needs, it first served to satisfy physiological needs (preparation of food, water…), then to satisfy security needs (shelter, heating, lighting, completion of work tasks…) and to the modern needs of the 21st-century man.

Energy is vital for all life forms on this planet. Almost all organisms depend on energy to survive. Over time, humans gained a better understanding of energy and began to use it for various purposes, not just basic survival needs. The mastery of fire was the first major advance that contributed to the understanding of energy. At least 400,000 years ago, fire was used to cook food and water and to heat homes. On the one hand, over time, the burning of wood and other biomass led to the use of ovens for the production of food and the processing of metals from ores. The first evidence of the use of coal as a fuel dates back 2400 years. On the other hand, asphalt (as one of the natural forms of oil) was the first fossil fuel used by the Sumerians in the area of former Mesopotamia as early as 6000 years before Christ. Later, with the development of technology, other fossil fuels began to be extracted [14]. Not long after humans learned to use fire, they also mastered the use of energy from the sun, water, wind, and animals for heating, cooling, agriculture,

and transportation [15]. Despite the knowledge acquired, energy consumption did not change significantly from the advent of fire to the first industrial revolution (18th century) and the invention of the steam engine. The steam engine converted chemical energy (from wood and coal) into kinetic energy. This was a time when coal replaced wood as the main source of fuel, triggered by a shortage of wood and charcoal due to economic growth [16].

Coal was used intensively until the middle of the 20th century, when it was replaced by oil as the primary source of fuel. For heating purposes, coal was replaced by gas and electricity (which made it possible to transfer energy in large quantities to another location from where it could be distributed to a greater number of places throughout the region), and for transportation purposes, oil began to be used instead of coal. Initially, the citizens resisted the adoption of oil because it polluted the wells that were their source of drinking water. However, this later changed when the oil was used for lighting purposes and processed into gasoline, which was used as fuel for internal combustion engines.

Some important historical steps related to the development of energy with a focus on renewable energy sources should be highlighted. At the end of the 19th century, the first hydroelectric power plants were built, which became an important source of energy by the middle of the 20th century. They became an important source of energy in the second half of the 20th century. In the 1890s, the first windmills were built to generate electricity, and today, wind energy supplies around 2% of the world's energy. In the 20th century, nuclear power plants began to be used, which today generate almost 15% of the world's energy, and solar cells, which generate about 1% of the world's energy [17].

However, it was the emergence of **oil** as an energy source and then its scarcity (when oil-exporting countries deliberately cut production to increase the price) that led to a shift in thinking about the importance of energy and its use, as well as a greater awareness of the finite nature of the Earth's existing natural resources and the search for sustainable alternatives. Since the first major oil crisis in the 1970s (the largest oil crisis on October 17, 1973: a 70% increase in the price of oil) and the second major oil crisis in 1979/1989, concerns about the importance of energy have increased significantly (the time of the first Gulf War between Iran and Iraq). As a result, educational programs on energy conservation became part of public policy (first) in US schools and then around the world, while (at the same time) experts from the real sector began to warn the public about the problems of limited resources and the need for more knowledge and understanding in the field of energy. This historical event marked a turning point compared to previous forms of energy understanding, which were mainly limited to energy management for household needs, as well as the state's efforts to educate the public about the importance of energy, new technologies, and their application and use, with the aim of modernizing the community and society.

The genesis of the development of the concept of energy literacy gained additional importance with the awakening of public awareness regarding the problems of global warming and the sustainability of the quality of the Earth's atmosphere, climate change, pollution, and other energy threats to humanity.

In recent years, more and more laws related to the *circular economy* (to solve the problem of limited resources and climate change) have been transformed into laws to enable the *Green Transition*. The vision of the European Union (EU) under the *Green Plan* is to reduce greenhouse gas emissions (compared to 1990 levels) by at least 55% by 2030 and by as much as 90% by 2050, increase the share of renewable energy to 38.5% and improve energy efficiency by at least 36%, and make the EU a modern, efficient, and competitive economy in terms of resources. The plan aims to ensure that the EU's economic growth is not dependent on the use of resources and that Europe becomes the first climate-neutral continent [18].

Although the topic of energy literacy has been of interest to professionals and academics for at least 50 years (since the time of the great oil crisis at the end of 1973), it has become particularly important in recent years with the increase in energy consumption and the associated need for the sustainable management of energy resources [7]. How-

ever, no consensus has yet been reached on a common, clear, and uniform definition of energy literacy.

Approach 1: Defining energy literacy according to the *principle of functionality*

- DeWaters and Powers [19]: energy literacy involves understanding the basic facts about energy and the impact of energy production and consumption on the environment and practices for using energy in everyday life, as well as adopting energy-saving behaviors.

Approach 2: Defining energy literacy from the perspective of *cost–benefit analysis*

- Brounen, Kok, Quigley [20] provide a narrower definition: energy literacy refers to the trade-off between the initial investment required to purchase efficient appliances (on the one hand) and the money and energy savings that result from this decision in the long term (on the other).
- Kalmi, Trotta, Kazukauskas [13] provide a broader definition: with the trade-off of a satisfactory cost–benefit ratio, the authors appeal to the awareness of individual energy consumption, the understanding of the process of forming the price of energy in the household, the evaluation of long-term decisions related to investments to improve energy efficiency, the willingness to take action to save energy, and consumer interest in accessing energy-related information.

Approach 3: Defining energy literacy *in synergy with financial literacy*

- Kalmi, Trotta, Kazukauskas [13]: the daily energy decisions a person makes at the household level can also be considered as part of personal financial decisions.
- Blasch et al. [12]: the concept of energy literacy defined by a financial approach includes not only energy-related knowledge (necessary to make informed decisions), but also additional skills to draw financial conclusions regarding energy-related issues.

Approach 4: *Institutional approach* to defining energy literacy *frameworks and guidelines*

- U.S. Department of Energy: energy literacy encompasses not only an understanding of the nature of energy and the role of energy in the world and in daily life, but also the ability to apply that understanding in practice. In this sense, an energy literate person [17]:
  - ✓ Can track energy flows and think in terms of energy systems.
  - ✓ Knows how much energy they consume, what they use it for, and where the energy comes from.
  - ✓ Can critically assess the credibility of energy information.
  - ✓ Can communicate about energy and energy use in a meaningful way.
  - ✓ Makes informed decisions about energy and energy use based on an understanding of cause and effect and continues to learn about energy throughout their lives.

As mentioned earlier, energy literacy begins with understanding the nature of energy and the role of energy in the world and in daily life. According to a recent resource, *Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education*, energy literacy requires an understanding of seven essential principles and a set of fundamental concepts that support each of these principles [17]: (1) Energy is a physical quantity that follows precise natural laws; (2) Physical processes on Earth are the result of the flow of energy through the Earth's system; (3) Biological processes depend on the flow of energy through the Earth's system; (4) Various sources of energy can be used to carry out human activities, and often this energy must be transferred from the source to the destination; (5) Energy decisions are influenced by economic, political, environmental, and social factors; (6) The amount of energy consumed by human society depends on many factors; and (7) The quality of life of individuals and societies is influenced by energy sources.

In summary, energy literacy, in conjunction with the previous definitions, means that consumers, companies, government institutions, etc. must make rational decisions related

to energy (production and consumption, buying, and selling), both in economic terms (considering the benefits and costs of energy choices), political terms (national security in terms of the choices made by the government, politicians, and political parties about the diversity of energy sources and energy independence), environmental terms (energy choices that affect the environment and, consequently, people and all organisms on planet Earth), and social terms (considering morality, ethics, and social norms).

3. A Conceptual Model of Energy Literacy: Cognitive, Affective, and Behavioral Skills

Civilization as we know it today, as well as its future development, has been and will be greatly influenced by energy, its historical development, its various manifestations, and its natural resources, but also by the decisions and behaviors of individuals and society as a whole. Energy is a broad concept and can be found all around us. Therefore, energy literacy is a broad and complex term without strict boundaries and frameworks, composed of a set of principles, concepts, and skills.

In terms of attitude formation, energy literacy is described by the synergy of skills of *knowledge*, *engagement*, and *behavior* of all stakeholders involved in energy decisions, energy issues, and their resolution:

- From a *knowledge* perspective, it can be an understanding of the relationship between nature and energy and the impact of energy on the world and life. Then, it can be the understanding of where the energy comes from and how it is transferred into the desired forms. But also, it can be an awareness of the amount of energy a person uses and the energy efficient nature of the light bulb or other appliances.
- From an *engagement* perspective, a person with the knowledge and information they have about energy has the need to inform other individuals and society about energy, its role and importance, and energy efficient behavior models, but also the dangers that threaten it in the case of its irresponsible use. These are additionally motivated individuals, activists who want to influence a wider circle of people with their decisions in order to create a better and happier society. These capabilities imply the involvement of individuals in processes of social change, increase civic engagement, and lead to solutions that are not driven by self-interest but aim at the well-being of all [21]. Adopting such a macro-perspective allows individuals to transcend their own position within the social structure to better understand the problems of the community and society [22].
- From a *behavioral* perspective, it is about applying knowledge and engagement in practice. This ability refers to the habits and customs of individuals and society as a whole, i.e., the implementation of their knowledge about energy as well as their efforts and positive intentions in solving energy issues and problems. It is a direct expression of energy choices and, in this context, of corresponding behavioral patterns.

In this sense, the fundamental energy literacy skills that are examined and analyzed when assessing the respondents' energy literacy are cognitive, affective, and behavioral skills [19]:

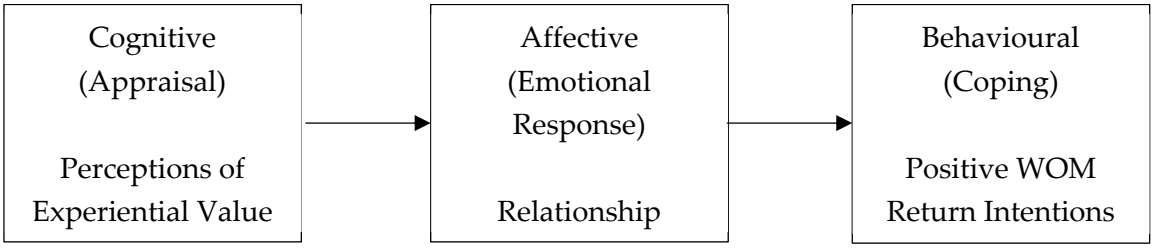
- Cognitive skills are intellectual abilities and processes that a person possesses when gathering certain information [9]. Some of these abilities are the ability to think, pay attention, remember, reason, language, abstract thinking, and the like. Cognitive abilities are directly related to intelligence, personal development, and learning.
- Affective skills can be defined as an individual's personal attitudes, values, and commitments [23]. A person who possesses affective skills is informed and aware of opportunities and threats. They are ready to respond, know what to do, and react accordingly. They are prepared to be leaders, to advocate and organize certain activities for the common good, and to propose changes in daily behavior and lifestyle to reduce or eliminate a particular problem in the immediate or wider environment. It is assumed that these abilities are determined by the personality (temperament and character) and socio-demographic characteristics of the respondent: education, income, marital status, gender, and age [7,9,24–26].

- Behavioral skills are the performance and actions of people that are conditioned by their knowledge and efforts, but also by their personality, life experience, and the behavioral patterns adopted at home or at school [27,28]. This ability is closely related to the individual's ability to behave appropriately and rationally in a given situation [29]. Some of the behavioral skills that a person may possess are communication, decision making, problem solving, and more.

In the context of the topic, cognitive skills refer to information about the extent to which respondents (in general) have an understanding and knowledge of energy and related concepts and phenomena. Affective skills refer to the respondents' personal attitudes and values towards environmental protection, as well as additional efforts, endeavors, and steps in this direction. Finally, behavioral skills provide information about the respondents' habits and behavioral patterns, as well as their willingness to contribute to rationalizing consumption, sustainability, and energy conservation through their decisions and choices.

The development and integration of this concept evolved gradually. And while in the past, the importance of the cognitive dimension dominated, in the 1950s, the emphasis was placed on the affective dimension, while at the beginning of the 1960s, this multidimensional concept was supplemented by the behavioral aspect. The concept of the cognitive–affective–behavioral framework emerged in the 1960s [30,31], and the research model of this paper is based on it.

The model implies a high correlation between the three literacy skills and the uniqueness of each skill. The model's conceptual links point to the interdependence and conditioning (sequencing) of the three literacy skills: knowledge without intention is *dead* knowledge; intention without knowledge is *false* intention; and only knowledge in synergy with intention is a sufficient stimulus to action (Scheme 1).



Scheme 1. Cognitive–affective–behavioral relationship framework. Source: [32]. Remark: WOM: word of mouth, WTP: willingness to pay.

In contrast to cognitive skills (knowledge), affective skills (effort/engagement) and behavioral skills (behavior) cannot be uniformly determined and therefore cannot be uniformly measured. And while *knowledge* is indisputable, *effort* is the ability to change one's perspective from one's own interest to that of another and is an expression of the individual's responsibility to (more or less) change society; *behavior* is the final manifestation of previous abilities, i.e., the translation of knowledge and values into actions (in accordance with one's own abilities, desires, and drives).

Given the objective limitations in measuring the *elementary literacy* of the population (reading, writing, and arithmetic), which result primarily from the methods used to measure literacy (historically: 1. self-assessment according to the statement of the head of household, 2. self-assessment according to the statement of the individual directly, 3. indirect assessment or extrapolation, and 4. assessment by testing) [4], it is undeniable that measuring specific forms of functional literacy (in addition to existing ones) faces additional challenges, especially in setting up appropriate specific instruments to measure such specific knowledge. In addition, each of these measurement tools needs to be adapted to a specific area of literacy; so, there is no unique, uniform, or universal solution [33].

4. Research Methodology

Summarizing the findings stated in previous sections, energy literacy means an understanding of energy and energy processes as well as efficient and responsible behavior in dealing with energy with the aim of protecting and preserving the environment. As this responsibility is assumed from an early age and especially during the school years, the research focus of this paper is on the student population, which represents not only the current bearers of consumption but also the future bearers of production, i.e., the main actors in the development of society in the broadest sense of the word. Knowledge of the level of education of the young and educated part of the population, the future agents of social development, is the basis for adopting appropriate policies to promote energy literacy, efficiency in the consumption of energy resources, and the preservation of planet Earth. In this sense, the research subject of this paper was a student population, with the target group being undergraduate students of the Faculty of Economics in Rijeka (1st year of study, all majors), thus expanding the research sample beyond the field of energy and related professions and placing this topic in a broader social context.

4.1. Measuring Instrument and Object of Research

The empirical part of the work was based on the collection of primary data using the survey method. For this purpose, a measurement instrument (questionnaire) was developed based on the relevant literature and the results of previous studies [23,34–36] in accordance with the *National Energy Literacy Survey Assessment Questionnaire* [37] developed by the *National Energy Foundation* (*NEF*) [38]. Respecting the standard format of the questionnaire as well as a set of closed questions of different forms (multiple choice questions, dichotomous questions, checkbox questions, and questions on an odd Likert scale), the survey questionnaire was completed with an original set of questions within each energy literacy skill, with questions adapted to the cultural and sociological background of the respondents. The questionnaire created in this way is considered a high-quality measurement tool for analyzing the research problem and a relevant indicator of the respondents' energy literacy.

The survey questionnaire was divided into two parts segmented into two parts, the first of an identification nature and the second of an essential nature, in which the cognitive, affective, and behavioral aspects of the students' energy literacy were assessed (Appendix A). In order to systematize the questions and facilitate the conclusions about the students' energy literacy, the first part of the questionnaire collected basic socio-demographic data about the respondents (gender, high school education, type of study, place of residence, etc.), while the crucial (second) part of the survey consisted of *three sections* that examined the respondents' knowledge, commitment, and behavior in relation to issues of energy, energy efficiency, and their sustainable future. In this sense, the questionnaire examines the students' factual knowledge about energy, their attitudes and values about energy, and their willingness to actively participate in society's energy problems and challenges, as well as their lifestyle habits and behavioral patterns in the area of energy decisions and choices.

A total of 109 respondents participated in the survey, of which 80 (73.39%) were women and 29 (26.61%) were men. In addition, 61.5% of respondents completed Vocational secondary school and 38.5% Grammar *secondary* school (Gymnasium). Of the respondents who voluntarily took part in the survey, 96.3% were studying full-time and only 3.7% part-time. All respondents were studying at undergraduate level, but in different majors. Thus, most respondents (in the survey) were finance students (26.6%), followed by management students (18.3%), international business students (17.4%), marketing students (15.6%), and entrepreneurship students (14.7%), and the least respondents were from the field of general economics (only 7.4%). Of the 109 respondents, 48.7% lived in places with the characteristics of a city, 28.4% in places with the characteristics of a municipality, and 22.9% in places with the characteristics of a village. Of these, 74.3% lived in a private house and 25.7% in an apartment. The last piece of information is somewhat surprising,

even worrying. There are studies that state that buildings and overbuildings are responsible for up to 50% of climate change [39]. In addition to climate change, excessive construction also has a negative impact on water and air pollution, landfills, noise, and more.

The survey was conducted in the period from June to July 2023, and the model of conducting the survey was mixed, mostly in physical (paper) form, but also online using a Google form. Given the extensive research design, the results of the analysis are mainly described by descriptive statistics, without their repetition in graphical or other form, except for more complex question types, such as tabular questions.

4.2. Research Results

The interesting part of the analysis is the comparison between the subjective view of the students and the objective results of the research findings in relation to the cognitive abilities of the students' energy literacy.

Regarding the subjective perception of the respondents, To the question "To what extent do you agree with the statement: *I am energy literate*", 10.1% of the respondents answered that they fully agree with this statement and 48.6% that they partially agree with this statement (on a Likert scale with 5 possible answers). This indicates that more than half of respondents (58.7%) feel that they have a satisfactory level of energy literacy, which is encouraging but not enough. Indeed, for humanity to overcome the challenges, problems, and crises in the energy sector, it is necessary that the vast majority or almost all have a high level of energy literacy. On the other hand, 26.6% of respondents do not know whether they are energy literate or not, 11% even consider themselves partially illiterate, and 3.7% completely illiterate in energy matters.

The objective results of the survey, based on the answers to 11 questions on the respondents' cognitive skills (Section 4.2.1), indicate that 33.04% of respondents fully meet the literacy criterion (32.1 + 37.6 + 11.9 + 12.9 + 58.7 + 33.0 + 51.4 + 34.9 + 9.2 + 53.2 + 28.5 = 363.4/11 = 33.04%). This result deviates significantly from the subjective (pessimistic) perception of the respondents and only 10.1% of them are considered to be completely energy conscious (*assuming that only the answer "I completely agree" is rated as an energetically desirable answer).*

Although they are objectively slightly better than their subjective perception, these (generally poor) results are not surprising given the respondents' answers in the identification section of the questionnaire:

- *When asked if respondents had taken a course in energy, environmental protection, or similar during their education*, 66.1% of the respondents answered no. This result suggests that subjects or even majors should be included in the curriculum to familiarize students with energy and its importance, energy efficiency, energy problems, as well as the energy challenges of modern society.
- *When asked which of the sources offered contributed the most to their knowledge of energy and energy literacy*, only 19.3% answered that it was school and college. As many as 56.9% of them named the Internet as the main source of this information, 11.9% television and radio, 11% word of mouth (family, friends, and acquaintances), and 0.9% (as the main source of this information) books, magazines, and newspapers. On the one hand, such responses are encouraging as they confirm a willingness to seek independent information and an interest in energy issues and problems. On the other hand, such results are worrying because they indicate that the school system, which has the highest qualifications in the field of education, does not provide the young population with sufficient information on these issues.

Similar studies confirm that students' energy literacy should start in primary or secondary school and that it is too late if it only starts at college. It is assumed that it is then more difficult to change habits and behavior patterns than if they are simply and quickly adopted at an earlier age. Education is a component of great importance for the formation and promotion of proper attitudes and behaviors in the field of energy sustainability [40], and the lack of such knowledge requires the improvement in the curricula [9,26].

Considering that the literature emphasizes the lack of knowledge and information, the lack of interest and motivation, and the long-term process of changing attitudes and habits as the main obstacles to a positive expression of energy literacy in practice [41], an analytical insight into the questions, answers, and results of the various energy literacy skills follows in the course of the paper.

4.2.1. Cognitive Skills

The cognitive skills that an energy literate person should possess include knowledge and the understanding of basic energy concepts and processes, different types and sources of energy, and the energy efficiency of different objects and appliances that they encounter on a daily basis [42]. The following survey questions (11 questions) were used to test the respondents' cognitive skills, i.e., their knowledge, understanding, and reasoning on issues related to energy and energy efficiency, and to determine their level of the cognitive dimension.

1: In response to the question "What is the basic unit of measurement for energy", kilowatt, volt, joule, and newton were named. Only **32.1%** of respondents answered joule (correct answer). Most of them, namely 48.6%, answered kilowatts, 16.5% volts, and 2.8% newtons.

Although all units of measurement can be related to energy in one way or another, the joule (J, after the English physicist James Prescott Joule) is still the basic unit of measurement for energy. It can be defined as the energy expended by the application of a force of 1 Newton over a distance of 1 m.

2: In response to the question "What proportion of the total energy generated by burning coal reaches the end consumer in the form of electricity?", **37.6%** of respondents answered 1/3 (correct answer). Of the remaining 62.4% of the respondents, 30.3% answered 2/3, 25.7% answered 2/4, and 6.4% answered 3/4.

Coal is not only the oldest fossil fuel, but also the fuel that currently emits the most CO_2 into the atmosphere. The energy produced by burning coal is very harmful to the environment, as a large proportion of this energy is lost to nature on its way to the end user.

3: In response to the question "Which type of energy currently produces the most greenhouse gases worldwide?", almost half, 47.7%, answered oil, 30.3% nuclear energy, and 10.1% natural gas. Only **11.9%** of the respondents answered coal (correct answer).

It can be concluded from this that the respondents have a completely wrong attitude towards the dangers of certain types of energy (with the exception of oil). They also have a completely wrong understanding of nuclear energy and its associated radiation with CO_2, when in fact they are two different phenomena.

4: In order to investigate whether the respondents were aware of how long and complex the production of oil in nature actually is, they were asked the question "How many years does it take nature to produce oil". As many as 41.3% of the respondents answered 2 million years and 28.4% 20 million years. In addition, 17.4% of them answered 2000 years and only **12.9%** of the respondents answered that nature needs 200 million years to produce oil (correct answer).

Nature needs millions and millions of years to produce oil. Of the oil deposits known today, 70% were formed between 253 and 66 million years ago, i.e., in the Mesozoic era. In addition, it is assumed that 20% of oil deposits were formed 65 million years ago, in the Cenozoic era, and 10% in the Palaeozoic era, between 541 and 254 million years ago. On the other hand, it is assumed that fossil fuels have a limited production potential before all sources are exhausted. Natural oil reserves are estimated to last 47 years, natural gas reserves 52 years, and coal reserves 133 years [43].

5: In order to investigate the respondents' knowledge about energy in their daily lives, the next questions related to energy consumption in the household. One of the basic questions in this context was "Which type of light bulb is the most energy efficient". The majority of respondents, namely **58.7%**, answered LED light bulb (correct answer). Nevertheless, 33.9% of respondents believed that energy-saving light bulbs are the most efficient, while

an equal proportion of the respondents, 3.7%, believed that incandescent bulbs and halogen bulbs are the most efficient.

To produce the same amount of light, an LED bulb consumes 10 times less energy than an incandescent bulb and 8 times less than a halogen bulb. An energy-saving bulb also uses less electricity than an incandescent bulb for the same amount of light, lasts longer, but is more expensive and more dangerous for the environment and health (contains mercury) than an incandescent bulb. Finally, LED lamps are safer and more energy-efficient than energy-saving lamps.

6: The energy (in)efficiency of the incandescent light bulb was also questioned in the question "What percentage of the electricity consumed is lost in the form of heat when using an incandescent light bulb". A total of **33%** of respondents believed that 85% of the electricity consumed is lost in the form of heat (correct answer). A total of 37.6% believed that this loss is 50%, 24.8% believed that 35% is lost, and 4.6% believed that 95% is lost.

The percentage of electricity lost in the form of heat when using an incandescent light bulb is 85%. This is a considerable difference to an LED bulb, where this loss is only 20%.

7: In response to the question "What is the optimum refrigerator temperature", **51.4%** of the respondents answered 4 °C (correct answer). A total of 23.8% answered 6 °C, 16.5% answered 8 °C, while 8.3% of the respondents believe that the optimum refrigerator temperature is 2 °C.

The refrigerator should be set to the optimum temperature so that food does not spoil. It should also not be opened unnecessarily.

8: The respondents were also asked the question "What is the optimum temperature in the freezer?". A total of **34.9%** of respondents answered −18 °C (correct answer). A total of 33% of respondents answered −16 °C, followed by 27.5% of the respondents answering −14 °C, while 4.6% believed that the optimum freezer temperature is −20 °C.

9: When selecting refrigerators, freezers, and general white goods and other electrical appliances, you should pay attention to the energy efficiency class of these appliances. When asked "What is the range of energy efficiency classes?", 51.4% of the respondents believed that the classes are A–F, 27.5% opted for classes A–E, 11.9% for classes A–D, and only **9.2%** of the respondents believed that the energy efficiency classes are in the A–G range (correct answer).

The scale of energy classes was recently changed so that the new scale no longer includes the extension to class A+. From 1 March 2021, the class of appliances that previously belonged to energy class A has been changed to make room for future appliances that are considered more efficient than existing ones. In this sense, from 1 March 2021, the best classes to which the existing appliances belong will be classes B or C, while class A can only be met by new appliances that have not yet been manufactured by then.

10: In the Republic of Croatia, an agency with the acronym HERA is active in the field of energy. When asked "Which of these acronyms stands for the agency that operates in the field of energy in the Republic of Croatia?", **53.2%** of the respondents answered correctly. However, 18.3% of the respondents believed that the acronym of the agency is ENEHA, 14.7% that it is the acronym HIRENA, and 13.8% that it is the acronym of the agency REGEHA.

The acronym HERA stands for the Croatian Energy Regulatory Agency (founded by the Republic of Croatia). Its responsibilities include issuing permits for the implementation of energy activities, monitoring the implementation of energy activities by energy companies, and many more. The Agency ensures that its work is carried out objectively, transparently, and impartially.

11: For the purpose of further sustainable energy development, the Republic of Croatia adopted a Strategy for the Energy Development of the Republic of Croatia. In response to the question "For what period does the *Energy Development Strategy of the Republic of Croatia* apply?", 47.7% of the respondents chose the period up to 2035, only **28.5%** chose the period up to 2030 (correct answer), 17.4% the period up to 2040, and 6.4% the period up to 2045.

The Energy Development Strategy of the Republic of Croatia until 2030 defines the pace of transition in the energy sector, i.e., the dynamics of changes and the introduction of new technologies and devices, transportation solutions, energy consumption, etc. As a result of the strategy, which would bring about changes in production and transport as well as distribution, trade and other areas, high-quality digitalized, low-carbon, and decentralized systems and a reduction in CO_2 and greenhouse gas emissions are expected.

As already mentioned, the results show that only 33.04% of respondents fulfil the criterion of the cognitive dimension. A look at the structure of the questions shows that they are divided into three subgroups: Questions on theoretical knowledge (1–4), practical knowledge (5–9), and information (10–11).

The first group of cognitive questions (1–4): 32.1 + 37.6 + 11.9 + 12.9 = 94.5/4 = 23.625%.
The second group of cognitive questions (5–9): 58.7 + 33.0 + 51.4 + 34.9 + 9.2 = 187.2/5 = 37.44%.
The third group of cognitive questions (10–11): 53.2 + 28.5 = 363.4/11 = 81.7/2 = 40.85%.

Although limited by the small number of questions, it is still possible to gain some rough insights into the causes of the respondents' relatively weak cognitive abilities. They lie primarily in the respondents' theoretical knowledge base, which is acquired during their school years and growing up. The result (23.625%) is worrying and implies the urgent need to include subjects of this type in formal education programs at all levels of education and to promote other models of education, non-formal and informal, as well as all other forms of lifelong learning. The group of questions on practical knowledge yielded a slightly better result (37.44%), which is not surprising as this knowledge is directly reflected in household expenditure and the respondents are likely to be confronted with these issues more frequently in their daily lives. Finally, the best result (40.85%) was achieved for the third group of questions, which relates to the respondents' knowledge of energy issues in the broadest sense of the word. These results are encouraging, but also leave plenty of room for improvement. The results obtained clearly show that the state must intervene in the field of education policy and take a whole series of well-defined measures to promote energy literacy.

4.2.2. Affective Skills

In terms of affective skills, an energetically educated person will recognize problems and have a positive and proactive attitude towards solving them. They will use energy responsibly and efficiently and their actions will lead to positive change. The following survey questions (seven questions) were used to examine the respondents' personal attitudes, commitment, and efforts, as well as their values related to concerns for energy conservation and to assess the respondents' level of affective skills.

1: As many as 59.6% of the respondents answered positively and 40.4% of the respondents answered negatively to the question "I am trying to get additional information about how I can contribute to conserving energy on planet Earth".

2: A total of 64.2% of respondents answered positively and 35.8% negatively to the question "I advise friends and family about energy efficient behaviours". It is often friends and family who can easily change a person's perspective on an issue. After all, knowledge is there to be used and passed on.

3: To the question "I take part in various energy projects (professional or scientific) organized by school, college or university", only 10.1% of the 109 respondents answered positively; all others answered negatively. Projects can help to learn something new and share old and newly acquired knowledge with others. Schools, colleges, and universities often carry out various projects, and the fact that they also carry out projects in the field of energy is encouraging.

4: Only 16.5% of respondents answered positively to the question "I take part in reforestation, underwater cleaning, etc."; all others answered negatively. Reforestation actions are not only carried out to take care of the forest and nature, but also to educate citizens about the importance and role of forests. They absorb 1/3 of anthropogenic CO_2 emissions

and are crucial for the health of all living beings as well as planet Earth itself. They are rich in biodiversity and play an important role in the global climate system. Therefore, the EU is introducing new rules for healthy forests in the member states [44]. The new EU Forest Strategy for 2030 is one of the leading initiatives of the European Green Plan and builds on the EU Biodiversity Strategy for 2030 [18].

5: An environmental activist is a person who has the desire and intention to fight for the protection of plants, animals and their habitats, the environment (air and water), and people. To the question "I consider myself an environmental activist", 15.6% of the respondents answered positively and as many as 84.4% answered negatively. Basically, all people (each in their own way) should be environmental activists, because it is not just a fight for plants, animals, the environment, or some other people, but it is a fight for the survival of planet Earth and all its species.

6: The next question asks respondents about their behavior in relation to choosing and buying products. They refer to the external characteristics of the product that are important for the preservation of the ecosystem (Figure 1).

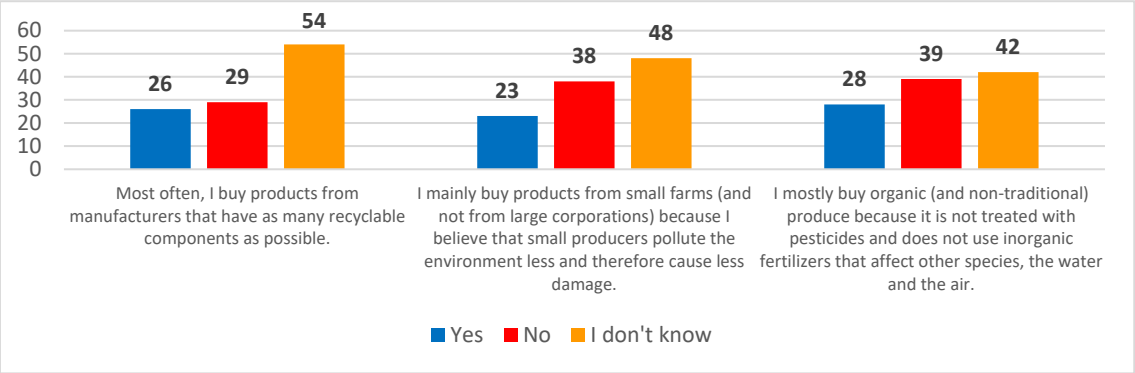


Figure 1. Answers to the question: do you adhere to the following behavioral patterns. Source: Authors' survey data.

As it can be seen from Figure 1, an average of 26 (24%) of the 109 respondents pay attention to the external characteristics of the product, which are important for the preservation of the entire ecosystem (26 + 23 + 28/3). On the other hand, an average of 35 (32%) of them do not pay attention to such features (29 + 38 + 39/3), and as many as 48 (44%) do not know whether they do or not (54 + 48 + 42/3).

Although it could be concluded that the proportion of those who do not care about the consequences of their choices is 76% (32% + 44%), it should be borne in mind that, despite their concern for the environment and their desire to contribute to its protection, consumers (unfortunately) more often choose products that are affordable for them than those that are environmentally friendly, because such products are generally more expensive [45–47].

According to the literature [48], consumers' environmental choices depend primarily on *socio-demographic factors* and only then on consumers' attitudes towards environmental protection, namely:

- *Social status*: consumers belonging to the middle or higher social class are more inclined to buy them, i.e., consumers with higher incomes for whom price is not the main criterion of choice.
- *The level of life satisfaction*: consumers who are dissatisfied with their lives generally do not focus on environmental issues but on personal problems.

Considering that consumers' environmental choices are predominantly influenced by personal factors and only then motivated by concern for the environment [49,50], it is sometimes necessary to resort to corrective state mechanisms (binding legal measures, regulations, or even sanctions) to achieve changes in society [48].

7: The following is a set of questions that assess the understanding of the phenomenon of climate change, environmental protection, energy saving, etc., as well as the respondents' intentions to contribute to the preservation of the planet's ecosystems through future activities (Figure 2).

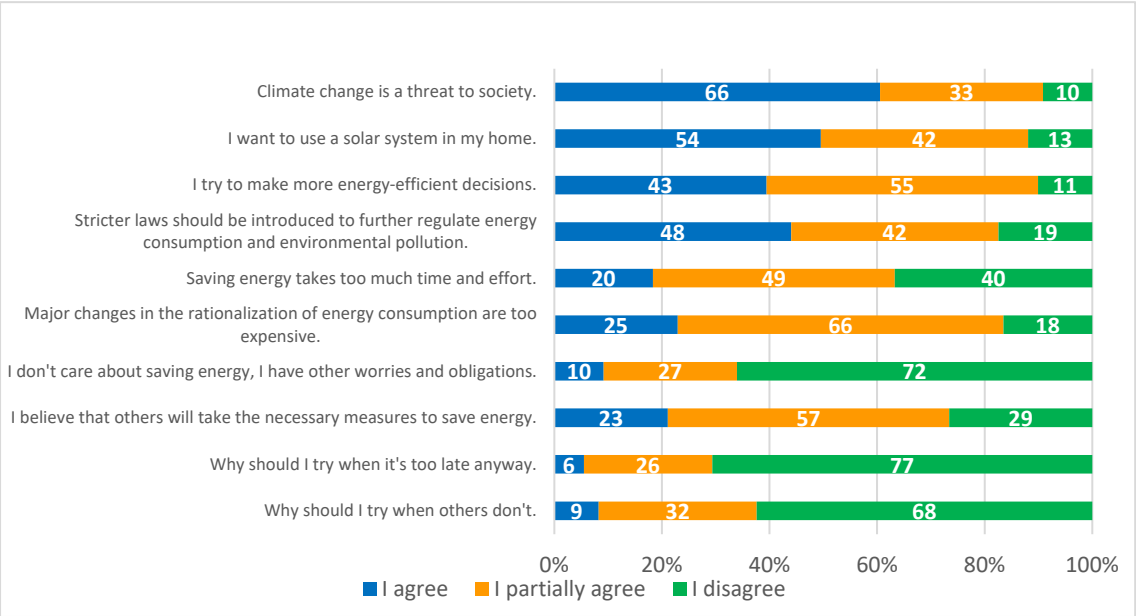


Figure 2. Answers to the question: to what extent do you agree with the following statements. Source: Authors' survey data.

From Figure 2, it can be concluded that respondents are more or less aware of the threats that climate change poses to society, the ecosystem, and planet Earth (66 of them); that they are relatively ready for change (54, 43, and 48 of them) and for some involvement in these changes (72, 77, and 68 of them); but that they do not have a clearly defined attitude towards the time, effort, and cost of these changes (49 and 66 of them). The problem of *free riders* can also be seen, as some of the respondents (23 of them) expected someone else to take the necessary measures in their place to preserve energy, the environment, and planet Earth.

Assuming that the answer to the first four questions should have been "I agree" and to the remaining six questions "I disagree", energy literacy was met by 66 (60.6%), 54 (49.5%), 43 (39.5%), 48 (44.0%), 40 (36.7%), 18 (16.5%), 72 (66.1%), 29 (26.6%), 77 (70.6%), and 68 (62.4%), or an average of 47.3% of the students.

And in this group of questions assessing the students' affective energy skills, there is an interesting comparison between the subjective view and the objective results of the research results.

Regarding the subjective perception of the respondents, to the 5th question "I consider myself an environmental activist", only 15.6% of the respondents answered positively, and as many as 84.4% of the respondents answered negatively.

The objective results of the research, based on the answers to the remaining six questions, show that 36.95% of the respondents fulfil the criterion of literacy in the area of affective skills (59.6% + 64.2% + 10.1% + 16.5% + 24.0% + 47.3% = 221.7/6 = 36.95%), a result that again differs significantly from the subjective (pessimistic) perception of the respondents. And while the subjective results indicate only 15.6% of activists, the objective results of the survey indicate more than twice as many (36.95%).

4.2.3. Behavioral Skills

In terms of behavioral skills, an energy-literate person pays attention to how they use energy, behaves in an energy-efficient manner, is rational, and is aware of their decisions.

The next set of survey questions (12 questions) examined the respondents' habits and behavioral patterns as well as their energy consumption behavior and assesses their level of behavioral skills.

1: One of the useful habits for saving energy is to unplug appliances that are not in use. To the question "Which appliance do you often leave plugged in even when you are not using it?", 79% of the respondents answered the television and 58% a floor lamp (work, night, and energy). This was followed by a microwave, a landline telephone, and a computer/laptop (47–41%), followed by a kettle and a coffee machine (34–31%). Other appliances from the sample surveyed (cell phone, room freshener, and music system) are connected to the power supply significantly less when they are not in use (17–11%) (Figure 3).

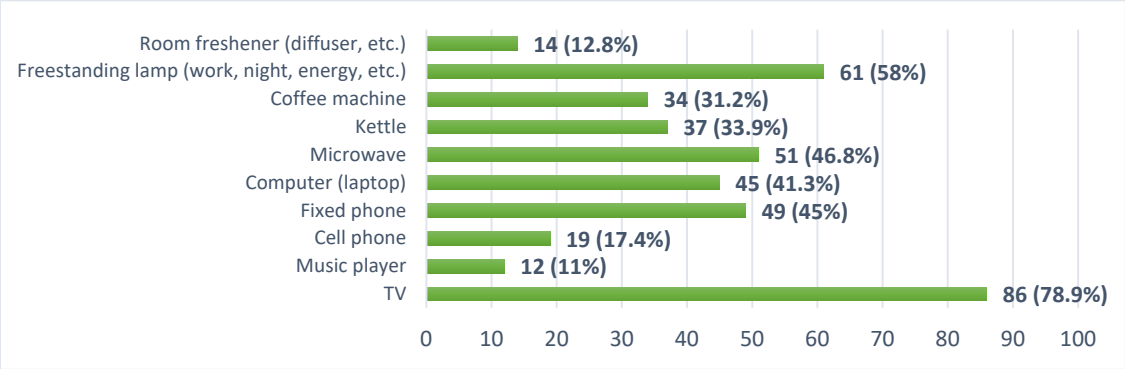


Figure 3. Answers to the question: which device do you often have plugged in, even when you are not using it? Source: Authors' survey data.

Literacy assessment: 87.2 + 42 + 68.8 + 66.1 + 53.2 + 58.7 + 55 + 82.6 + 89 + 21.1 = 623.7/10 = 62.4% (*assuming that any device plugged into electricity without being used is illiteracy*).

2: The daily habits of the respondents in their household not only have an impact on their financial well-being, but also on the consumption of renewable and non-renewable energy sources and the preservation of the ecosystem and the planet Earth (Figure 4).

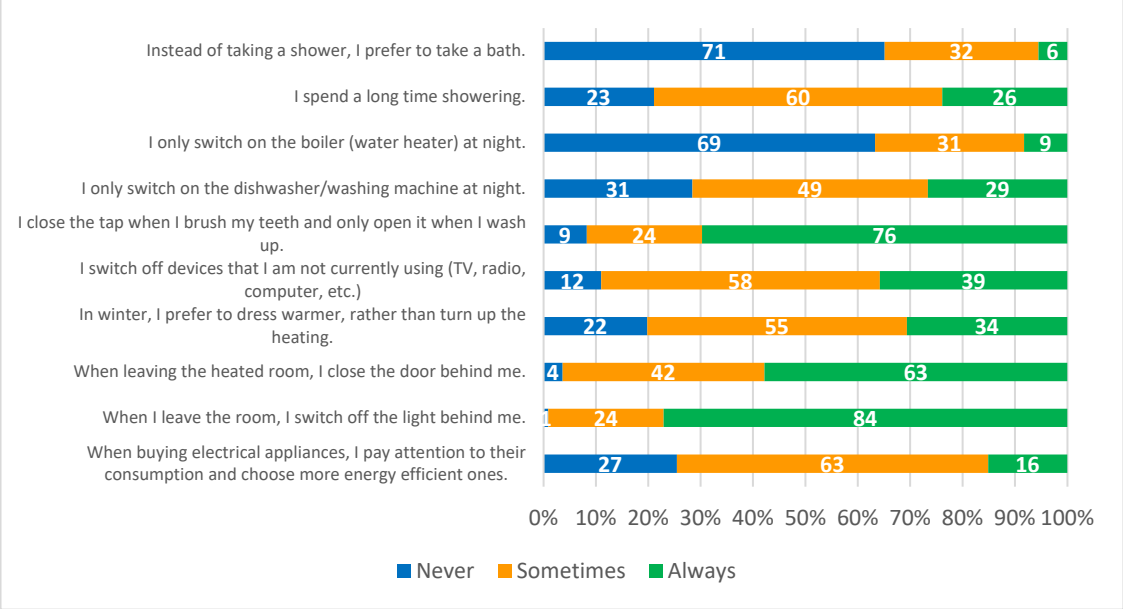


Figure 4. Answers to the question: to what extent do you adhere to the following behaviors in your household. Source: Authors' survey data.

Although, for the function of energy saving and rationalization, the predominant answer should be "never" for the first two questions and "always" for the other questions, as it can be seen in Figure 4, the answers to most questions do not fall in these categories. However, there are also positive exceptions, such as the answers to question 1 (choosing between a shower and bath: 71/109), question 5 (turning off the tap when brushing teeth: 76/109), and question 9 (turning off the light after leaving the room: 84/109), and possibly also question 8 (closing the door after leaving the room: 63/109). Some answers are worrying, such as the answer to question 3 (referring to the time when the water heater is turned on), while the answers to the other questions (2: duration of showering, 4: time of switching on the dishwasher, 6: switching off appliances that are not in use, 7: choice of heating method, and 10: choice of energy-efficient electrical appliances) are mostly vague (type: sometimes).

Literacy assessment: 71 + 23 + 9 + 29 + 76 + 39 + 34 + 63 + 84 + 16 = 444/10 = 44.4/109 = 40.7% (assuming that only desirable answers evaluated as energy-efficient solutions are never and always).

3: To the question "What type of light bulbs do you use most often in your household?", 46.8% of the respondents answered LED bulbs, 19.3% compact fluorescent bulbs (energy saving bulbs), and the remaining 33.9% used incandescent bulbs, halogen bulbs, or did not even know which bulbs they use. Although almost half (46.8%) of the respondents use the most energy-efficient LED bulbs and a further 19.3% use energy-saving bulbs (the next most efficient), this is still not a satisfactory result considering that even 1/3 of respondents do not use these.

Literacy assessment: 46.8% (assuming that only one LED bulb is used as an energy-efficient light bulb).

4: When asked "What is the main source of heating in your household?", 52.3% answered with wood or pellets. The prices of wood are generally lower than the price of gas, electricity, oil, and even pellets, which is also the main reason for such a high prevalence of this heating source. In addition, 25.7% of the respondents heat using electricity, which, although considered expensive, can prove to be a cost-effective heating method when heating small rooms and in areas with mild and short winters. Other heating sources (gas: 15.6% and heating oil: 5.5%) are less common, and only 0.9% of the respondents heat using a solar system. Although expensive, solar heating is the most energy-efficient type of heating and has numerous advantages (solar energy is absorbed by the solar system all year round, it only takes 3 to 7 years to recoup the investment, the solar system is used for many household needs and not just for heating, etc.).

Literacy assessment: 0.9% (assuming that the solar system is only used as an energy-efficient heating source).

5: When asked "What is the primary source of cooling in your household?", the largest number of respondents, almost half (49.5%) answered air conditioning. It is estimated that, by 2050, around 2/3 of the world's households will have air conditioning [51]. As many consumers do not choose the most energy-efficient models when purchasing air conditioning systems, there is a risk that the energy required to cool the room will triple by 2050. On the other hand, with an efficient energy policy, the average efficiency of air conditioning systems could be doubled by 2050, while the energy required for cooling and the CO_2 emissions caused by room cooling could be halved. This would have numerous positive effects on people and the environment.

In addition, 9.2% of respondents use cooling fans. Fans consume only 1% of the energy that air conditioners need to operate and are therefore more energy efficient than air conditioners.

A cold shower is used by 6.4% of respondents as a source of cooling, while the preferred source of cooling from an energy perspective (balcony blinds and awnings, blinds and curtains, as well as room ventilation) is used by as many as 34.9%.

Literacy assessment: 34.9% (assuming that only balcony blinds and awnings, blinds and curtains, as well as room ventilation are used as an energy-efficient form of cooling).

6: When asked "Do you cook with gas or electricity in your household?", 59.6% of respondents answered with gas, while 40.4% cooked with electricity. There are different types of electric hobs, with the induction hob (which requires special cookware) being the most energy efficient. Up to 90% of its heat is transferred to the container, 70% of which is transferred to the top of the container. Gas burners, on the other hand, transfer between 35% and 40% of the heat to the top of the pot. Gas burners emit gases during cooking and sometimes even when idle, which have a negative impact on human health and (by and large) on climate change. Energy savings can be achieved not only by choosing the energy efficient hob, but also by using an efficient cooking method (putting a lid on the pan and choosing the optimal pan size taking into account the amount of food to be prepared and the size of the plate).

Literacy assessment: 40.4% (assuming that electricity or induction is used as an energy-efficient cooking source).

7: In response to the question "How do you wash dishes in your household?", 71.6% of the respondents used a dishwasher, while 28.4% of respondents washed dishes by hand. Washing dishes with a dishwasher is more efficient than washing dishes by hand, as it uses significantly less water. According to a study by the University of Bonn [52], a full dishwasher uses 8 to 20 liters (13 liters on average) of water to wash 144 dishes. Washing the same amount of dishes by hand would use an average of 100 liters of water. The study shows that households with a dishwasher use on average 50% less water and 28% less energy per item washed compared to households without a dishwasher. Washing by hand can only be an alternative if only a few dishes need to be washed and if water consumption and use are rationalized (closing the tap during rinsing, using the water several times before the last rinse, etc.).

Literacy assessment: 71.6% (assuming that a dishwasher is used as an energy-efficient source for washing).

8: In response to the question "How do you dry the washed laundry in your household?", 21.1% of the respondents answered with a tumble dryer, while 78.9% of the respondents air-dry their laundry, i.e., on a clothes rack. Considering the energy consumption (electricity), a tumble dryer is undeniably a more expensive form of drying goods, and it is certainly more expensive than a clothes rack, but it dries clothes faster and can also (with the help of heat) remove creases from clothes, which then reduces the need for ironing (and energy consumption). The tumble dryer is not only more expensive to buy, but also more expensive to maintain and generally more harmful to the environment. On the other hand, it is not advisable to dry items on a rack in poorly ventilated rooms, as this can contribute to the formation of moisture in the air, which promotes the growth of mold and can be harmful to health.

Literacy assessment: 78.9% (assuming that a drying rack is used as an energy-efficient drying source).

9: When asked "Which bags do you use when shopping?", the majority of respondents, 37.6%, answered with cloth bags. Cloth bags are reusable bags, but when compared to plastic bags, taking into account their production, use, and disposal, it turns out that cloth bags are actually less sustainable because their production requires more material and energy. A cloth bag would have to be used 173 times to be considered as environmentally friendly as a plastic bag [53]. In addition, cotton cultivation requires the use of large amounts of herbicides that leach into the soil, polluting groundwaters and the ecosystem.

Plastic bags were invented in 1967, and 29.4% of the respondents use them when shopping. The advantage of plastic bags compared to other types of bags is that their production is the least harmful to the environment. They can also be used several times due to their strength. It is also possible to recycle them, although this is still not a common practice. Without recycling, they become litter, which over time breaks down into microplastics that have a negative impact on the environment in many ways.

Paper bags are used by 14.7% of the respondents. Unlike plastic bags, paper bags are biodegradable and therefore easier to recycle. On the other hand, the production of

paper bags requires around four times more energy than the production of plastic bags. Furthermore, their production causes additional damage to the environment through the use of various chemicals and fertilizers. It is estimated that a paper bag will neutralize its negative impact on the environment if it is used between 3 and 43 times, which is unlikely due to the poor shelf life of paper bags [54]. While it is possible to recycle paper bags, there are certain limitations as the paper fibers weaken with each new recycling.

As many as 18.3% of respondents do not pay attention to which bags they use, but use the ones they have on hand first. Given such decisions and choices, it seems that society has a misconception of the effectiveness of individual bags.

Literacy assessment: 29.4% (assuming that a plastic bag is used as an energy efficient bag).

10: In order for a product to be recycled, it must first be collected. When asked "What type of reusable packaging do you return?", the answers were as follows: 2.8% of the respondents only return cans, 3.7% only return glass, while 21.1% only return plastic. A total of 57.8% of respondents return all three types of reusable packaging, but 14.7% of the respondents generally do not return any reusable packaging at all.

Cans are made of aluminum, which is fully recyclable. Making new cans from old ones saves 95% of the energy that would be needed to produce new cans [55]. Recycling glass and plastic bottles results in three times more losses (waste) than recycling cans. And while new cans are usually recycled from old ones, this is not always the case with glass and plastic. These are recycled into different products and can no longer be recycled or are unlikely to be recycled again.

Although not all types of jars and glass bottles can be recycled, most can be recycled.

Plastic bottles can also be recycled, and recycling uses only a third of the energy that would be required to produce new plastic. As recycling uses less energy than reprocessing, it also means fewer greenhouse gasses are emitted into the atmosphere.

And while 57.8% of the respondents return all three types of reusable packaging, 14.7% generally do not return a single type. The reasons for this vary: some are unaware of this practice, others do not have the time for such activities, and still others feel that the effort is not worth it considering the compensation on offer.

Literacy assessment: 57.8% (assuming that returning all three types of reusable packaging is valued as an energy-efficient solution).

11: In order to determine the habits of the respondents with regard to the emission of harmful gasses, the question "What type of transportation do you use most often" follows. As many as 37.6% of the respondents most frequently use a personal vehicle and drive alone, while 24.8% of the respondents use a personal vehicle but drive with another person. The car is used most frequently by 1.8% of the respondents. As many as 29.4% of the respondents most frequently use public transportation and 6.4% of them most frequently walk, while no one uses a bicycle as their most frequent means of transportation. The latter two options are not only the most energy-efficient, but also contribute to health and do not pollute the environment.

Literacy assessment: 6.4% (assuming that walking is used as an energy-efficient means of transportation).

12: The last set of questions in the behavioral group does not directly affect the respondents' financial benefits or costs, but touches on the individual's civic responsibility and home education. The respondents were asked about their daily behavior outside the home (Figure 5).

And while the answer to the first two questions should have been "*always*" and to the second two "*never*", the results are somewhat less desirable. However, with the exception of the question on the disposal of medicines, the respondents' behavior on the remaining three questions is more or less satisfactory. They decompose litter (59/109), do not throw litter while walking (88/109), and do not throw litter through the car window while driving (94/109). Finally, wrong behavior patterns can be influenced by financial sanctions, the installation of trash cans, and better domestic and civic education.

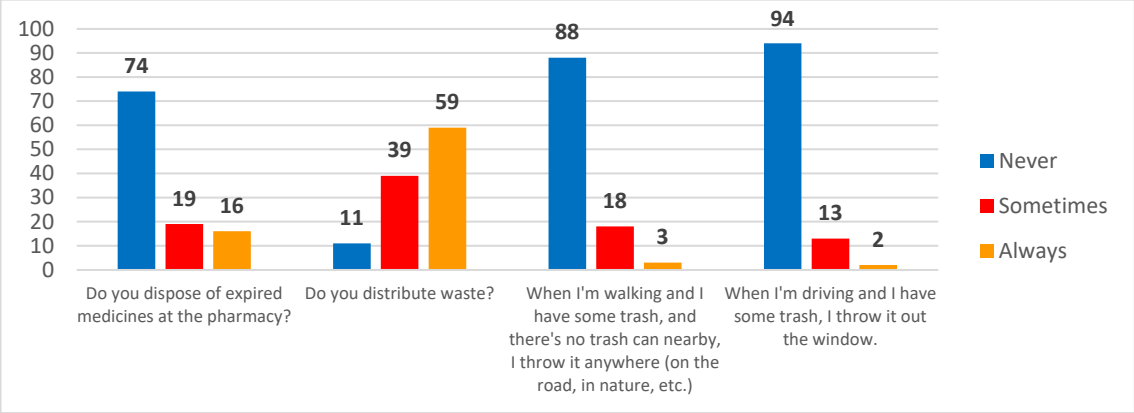


Figure 5. Answers to the question: to what extent do you adhere to the following behavioral patterns outside your home. Source: Authors' survey data.

Of the 109 respondents, 74 have never taken expired medicines in the pharmacy, which is worrying and points to the need for additional public education. Indeed, the presence of pharmaceuticals in the environment can cause them to enter the food chain and jeopardize the quality of food of plant and animal origin as well as drinking water sources [56].

Although data show that, in the European Union (EU), the amount of recycled waste is increasing and landfill disposal is decreasing, the results are still not satisfactory. To further reduce the amount of waste, targets have been set for recycling and waste disposal and for the production of more efficient packaging in order to remove unnecessary and superfluous packaging and produce reusable packaging. The EU's goal is to reduce the disposal of municipal waste to 10% or less by 2035. From 2017 to 2020, the Republic of Croatia reduced the amount of waste disposed of in landfills by 31% [57].

Literacy assessment: 16 + 59 + 88 + 94 = 257/4 = 64.25/109 = 59.0% (assuming that the preferred answer to the first two questions is "always" and to the second two questions "never").

Summarizing the results from the group of behavioral questions, it can be seen that 44.1% of the respondents meet the literacy criterion in terms of positive behavioral patterns and habits (62.4% + 40.7% + 46.8% + 0.9% + 34.9% + 40.4% + 71.6% + 78.9% + 29.4% + 57.8% + 6.4% + 59.0% = 529.2/12 = 44.1%).

4.2.4. Factor Analysis

Since reliability is usually assessed on continuous scales, whereas this research questionnaire is primarily based on categorical scales and dichotomous variables, there are certain limitations in the application of exploratory factor analysis (EFA) and Cronbach's alpha analysis (CA) of reliability, as well as in the interpretation of the results of these analyses. Given these limitations, the EFA method and CA reliability analysis were selectively applied to this research's sample, focusing on items from the affective and behavioral skills domain measured with Likert scales as follows:

- Yes, no, I do not know.
- I agree, I partly agree, I disagree.
- Always, sometimes, never.

The initial analyses showed a low variability for some questions, but since it is actually an ordinal or categorical variable, a polychoric correlation was used to calculate the correlation matrix, on the basis of which a principal component EFA method was performed. In all cases, an orthogonal varimax rotation was used. Items (questions) that had a low factor saturation were excluded from the analysis, but a factor saturation of 0.3 was chosen as the threshold for their retention in the EFA.

Exploratory factor analysis (EFA)

1: Affective skills: Adhering to patterns of behavior

Example of an item: Most often, I buy products from manufacturers that have as many recyclable components as possible.

Answers on the scale: yes, no, I don't know.

The extraction of one component (C1) was subjected to a parallel analysis, after which all items were retained due to their high factor saturation. The factor structure of the scale measuring adherence to behavioral patterns related to affective abilities is presented below (Table 1).

Table 1. Factor saturations for the principal component method on an extracted component on items measuring adherence to behavioral patterns related to affective skills.

	Component 1
patterns_1	0.753
patterns_2	0.779
patterns_3	0.743

Source: Authors' survey data.

2: Affective skills: Adhering to the statements (*adherence*)

Example of an item: Climate change is a threat to society.

Answers on the scale: I agree, I partly agree, I disagree.

Parallel analyses were performed to extract two components (C1 and C2). After EFA extraction by the principal component method, some items were discarded because they were not well distributed among the extracted components. The factor structure of the scale used to measure agreement with various statements related to affective skills is shown below (Table 2).

Table 2. Factor saturations for the principal component method on the two extracted components on the items measuring adhering to different statements in the context of affective skills.

	Component 1	**Component 2**
adherence_1	−0.098	0.839
adherence_4	−0.137	0.812
adherence_6	0.113	0.454
adherence_9	0.907	−0.056
adherence_10	0.916	0.006

Source: Authors' survey data.

3: Behavioral skills: Behavior at home (*behom*)

Example of an item: When buying electrical appliances, I pay attention to consumption and choose energy-efficient appliances.

Answers on the scale: always, sometimes, never.

For parallel analyses, it is recommended to extract two components (C1 and C2). After EFA extraction by the principal component method, some items were discarded due to low factor saturation. With a reduced number of variables, the parallel analysis still suggested two components (C1 and C2). A stable solution was obtained with the principal component EFA method at a lower number of items. The factor structure of the scale measuring behavior in one's own home is presented below (Table 3).

Table 3. Factor saturations for the principal components method on two extracted components on the particles with which behavior was measured in one's own home.

	Component 1	Component 2
behom_4	0.263	0.381
behom_5	0.682	0.028
behom_6	0.639	−0.018
behom_7	−0.014	0.824
behom_8	−0.224	0.776
behom_10	−0.773	0.060

Source: Authors' survey data.

4: Behavioral skills: Behaviors outside of one's home (*outbehom*)

Example of an item: Do you dispose of expired medication at the pharmacy?

Answers on the scale: always, sometimes, never.

For parallel analyses, it is suggested to extract two components (C1 and C2). After their EFA extraction by the principal component method, all items were retained as they were well distributed between the two components. The factor structure of the scale measuring out-of-home behavior is shown below (Table 4).

Table 4. Factor saturations for the principal components method on two extracted components on items that measured out-of-home behavior.

	Component 1	Component 2
outbehom_1	0.272	0.786
outbehom_2	−0.260	0.737
outbehom_3	0.763	−0.115
outbehom_4	0.854	0.127

Source: Authors' survey data.

Cronbach's alpha analysis (CA) of reliability

Shown below is a table with the reliability coefficients of Cronbach's alpha (α), which were determined on a rank or categorical scale (Table 5). The table shows that all but one of the reliabilities are below 0.7, indicating a relatively low reliability for most of the extracted components, with the exception of the first component of the *adherence* scale (0.81). Apart from the relatively high reliability of the first component on the *adherence* scale, the other four components have a reliability above 0.5 (one on the *patterns* scale, the second on the *adherence* scale, another on the *outbehom* scale, and another on the *behom* scale).

Table 5. Reliability for the extracted main components from the area of affective and behavioral skills.

Scale	Cronbach's α	Intercorrelation	C
patterns_sum	0.63	0.36	3
adherence_sum_1	0.81	0.68	2
adherence_sum_2	0.52	0.27	3
outbehom_sum_1	0.30	0.18	2
outbehom_sum_2	0.56	0.39	2
behom_sum_1	0.41	0.19	3
behom_sum_2	0.52	0.27	3

Source: Authors' survey data.

Intercorrelations of more than 0.3 indicate that the items are homogeneous and capture similar content, suggesting that a low reliability is actually an indicator of a low number of measurements (i.e., a low number of items in the subscale). The above applies to the items: *patterns_sum* and *outbehom_sum_2*.

For subscales whose (average) intercorrelation between the items is less than 0.3, this indicates that the items capture heterogeneous content. This applies to the items *adherence_sum_2*, *outbehom_sum_1*, *behom_sum_1*, and *behom_sum_2*, where two of them are relatively close to the threshold value of 0.3 (*adherence_sum_2* and *behom_sum_2*).

In connection with the results obtained, a high degree of reliability of the *adherence_sum_1* subscale was established. The subscales *patterns_sum* and *outbehom_sum_2* should be used with a certain degree of caution, while the other subscales have a somewhat poorer reliability.

However, as mentioned in the introduction to this subchapter, such results should be accepted and interpreted with some caution given the limitations of using this methodology under the conditions of predominantly categorical scales and dichotomous variables.

Descriptive statistics

Finally, descriptive statistics are presented for the summative results obtained by summing the responses to the manifest variables related to the individually extracted main component from the affective and behavioral skills domain (Table 6).

Table 6. Descriptive statistics for the variables from the area of affective and behavioral skills.

Variable	Mean	SD	Min	Max	N
patterns_sum	1.40	1.19	0	3	109
adherence_sum_1	0.81	1.13	0	4	109
adherence_sum_2	3.84	1.46	0	6	109
outbehom_sum_1	1.91	1.08	0	4	109
outbehom_sum_2	0.38	0.74	0	3	109
behom_sum_1	2.56	1.42	0	6	109
behom_sum_2	3.27	0.93	1	5	109

Source: Authors' survey data.

As it can be seen from Table 6, the concentration of the arithmetic mean (mean value) and the min–max function on lower values supports the subscales with higher reliability levels (*adherence_sum_1*, *patterns_sum*, and *outbehom_sum_2*).

4.3. Discussion

The results of this study imply a relatively low dispersion of energy literacy scores of three skills: cognitive of 33.04%, affective of 36.95%, and behavioral of 44.1%. This contrasts with the results of similar studies, such as *the study conducted on students of the University of Economics in Krakow* [9], *as well as studies conducted on students and teaching and administrative staff of 20 faculties in Kuwait (10 from engineering and 10 from economic departments)* [10], which presented significantly lower results in the area of cognitive skills compared to the other two areas of the respondents' energy literacy and affective and behavioral skills. However, the results of all these studies show the same order of results for the three skills of energy literacy and confirm the worst results in the cognitive skills dimension, slightly better in the affective skills dimension, and the best in the behavioral skills dimension.

In this sense, the results obtained emphasize the role of education, the education system, and education policies, but also on the role of state intervention measures in the field of energy policy, which should motivate (measures) towards environmentally sustainable practices and oblige (legal regulations) to conserve energy, its sources, and its sustainability. In addition to the corrective mechanisms of the state in the field of public policy, it is necessary to provide models for joint negotiations between policy makers, regulatory authorities, the scientific and business communities, and representatives of civil society.

These results confirm the conditional order of the three literacy skills, but also the decisive influence of knowledge skills on the other literacy skills. Although it is important to have knowledge about energy and energy saving, as well as positive attitudes and values

about these topics, it is even more important to apply this knowledge, attitudes, and values in real life [7,13].

Finally, given the subtle insights into the deficient aspects of the various literacy skills, the results obtained offer the possibility of taking a whole series of targeted measures to promote energy literacy not only at the *macro-* but also at the *micro*-level. In addition to the *general guidelines* for improving energy literacy highlighted above, the following *specific guidelines* are proposed to address the problem of inadequate literacy:

- If deficient literacy is identified at the level of all three skills (a: cognitive, b: affective, and c: behavioral)—weak model: **abc**. *The problem*: An indifferent observer. *Solutions*: Basic education that emphasizes the importance and practicality of knowledge about energy, activities that have the potential for inclusion, etc.
- If deficient literacy is identified only at the cognitive level (intention without knowledge is the *wrong* intention)—unstable model: **a**Bc. *The problem*: Uninformed action. *Solutions*: Emphasis on practical applicability of energy knowledge, action-oriented learning, etc.
- If deficient literacy is determined only on the affective level (knowledge without intention is *dead* knowledge)—unstable model: A**b**c. *The problem*: Lack of empathy, imagination, or motivation. *Solutions*: Small energy projects with low commitment, peer tutoring, etc.
- As already mentioned, only knowledge in synergy with intention is a sufficient incentive to act—strong model: ABC.

As it can be seen from the detailed consideration and analysis of the research problem and the results obtained, the contributions of this work are manifold:

✓ ***This is the first research of its kind*** *conducted on a population of Croatian students of economics and Croatian students in general: by selecting the student population as the full potential of modern society and future carriers of social development, solid foundations are laid for building a smart, sustainable, and green society.*

✓ *By focusing the research subject on economics students (as future managers, executives, directors, policy makers, and holders of other socially responsible positions), the research sample extends beyond the field of energy and related professions and provides this topic a* ***broader social context****.*

✓ *In designing the survey questionnaire as a relevant measurement tool, conceptually based on the findings of the existing literature and adapted to the European Energy Literacy Assessment Questionnaire (NEF),* ***an original set of questions*** *was created within each energy literacy skill,* ***adapted to the cultural and sociological background of the respondents****.*

✓ *In addition to the* ***qualitative approach*** *to the research problem in the form of extensive descriptive statistics, the* ***quantitative aspect*** *of the respondents' energy literacy is also analyzed, providing concrete cardinal values for each competency, albeit with a relatively low dispersion (cognitive of 33.04%, affective of 36.95%, and behavioral of 44.1%), but with low average values (38.03%), which means that only slightly more than 1/3 of the respondents have energy literacy.*

✓ *Finally, in addition to* ***general guidelines*** *to improve energy literacy (primarily in the form of corrective mechanisms of the state in the field of public policies),* ***specific guidelines*** *are also proposed to address the problem of lack of literacy, depending on whether the problem of illiteracy is identified at the level of all three literacy skills or only partially. It is assumed that such a set of corrective tools and instruments should improve the understanding and solution of the researched problem.*

5. Conclusions

The effects of climate change and global warming are visible in all areas of life and the world we live in. They not only have a negative impact on people's lives, but also on the entire ecosystem. It is believed that one of the fundamental tools that can help in the fight against the challenges of the energy future is *energy literacy*. Energy literacy is the quality of a functional individual who follows and responds to the energy challenges of modern

society, who is informed and capable of confronting the energy problems they face, and who is able to make rational energy decisions for sustainable energy management, for the benefit of themselves and society as a whole.

Since education is considered a fundamental factor that influences an individual's knowledge, awareness (attitudes and values), and behavior, the phenomenon of education played a key role in the selection of the target group, i.e., the object of research of this paper, with a focus on the student population. Students are expected to become responsible members of society and promoters of social development as members of society who are inclined towards learning, knowledge, and further education. In this sense, this research focused on students of the Faculty of Economics of the University of Rijeka, future managers, executives, directors, perhaps also members of ministries, governments, and other responsible functions.

In the set of skills that enable a person to be energy literate, three fundamental skills stand out: cognitive, affective, and behavioral. The results of the research conducted on a group of first-year undergraduate students of the Faculty of Economics, University of Rijeka, indicate a relatively low literacy of the respondents in all types of skills (cognitive of 33.04%, affective of 36.95%, and behavioral of 44.1%), with an overall average of **38.03%**, which means that slightly more than 1/3 of the surveyed population is literate. It is interesting to note the high level of criticism respondents had of their energy literacy, at just **10.1%**. However, if you add those who partially agree with the statement that they are energy literate, namely 48.6%, then the result is closer to reality.

The research results of this and other available studies suggest that the most considerable problem of energy literacy actually lies in the *cognitive skills* of the respondents, i.e., knowledge about energy, its sources, production methods, consumption, conservation, and the like. Unfortunately, a large proportion of respondents do not have sufficient knowledge and understanding of energy, related concepts, and phenomena. Therefore, educational institutions should immediately and urgently include subjects, topics, and content about energy, its importance, and the problems and challenges associated with this phenomenon in their programs.

In the area of *affective skills*, it can be observed that a large proportion of respondents are aware of problems, but not all of them have a positive attitude towards solving these problems. A very small number of respondents are willing to act proactively and outside the framework of their *ego system* and take special efforts and steps to conserve energy as well as the entire *ecosystem* for the benefit of themselves and all other species as well as planet Earth itself.

Although better, the results are not satisfactory even in the area of *behavioral skills*. A large proportion of respondents have still not adopted energy-positive behavior patterns, do not have a strong inclination to save energy, and do not pay enough attention to how they use energy in their daily lives.

Given that the respondents did not achieve a result indicating good literacy skills, with a relative homogeneity in terms of poor literacy skills on the topic studied across all three literacy skills, this points to the need for comprehensive information and education of the respondents. It appeals primarily to formal forms of education, but also to non-formal and informal education models as well as all other forms of lifelong learning.

On the other hand, in certain situations, it is necessary to apply the corrective mechanisms of the state, binding legal measures, orders, or even sanctions. Indeed, the intervention of state institutions and the legislator in the sense of introducing legal regulations to prohibit unacceptable behavior, i.e., to introduce more socially acceptable practices, is often unavoidable.

In any case, unsatisfactory results should encourage the adoption of new strategies and the creation of new public policies (energy, education, and others) that would contribute to the sustainability of energy, the protection of the ecosystem, or the development of society. In this sense, it appeals to the necessary common proverbs between the

creator of the policy, the regulator, the scientist, the representative of civil society, and the economy.

The contributions of this research are reflected in it being the first research of its kind conducted on a population of Croatian economics students (future managers, policy makers, and agents of social development) as well as Croatian students in general. There is no single comparable study on this topic or on any other population of Croatian students. In addition, when creating the questionnaire as a relevant measuring instrument, which is conceptually aligned with the findings from the existing literature, completely new questions were implemented within each energy literacy skill, adapted to the cultural and sociological background of the respondents. Besides the qualitative aspect, the study also analyses the quantitative aspect of the respondents' energy literacy, the findings of which represent progress compared to the results of previous research.

Some limitations of the paper are also noted, such as the relatively small number of respondents (109) and the relatively small number of questions within the three literacy skills (30 in total), although some of the questions were actually asked through a set of multiple-choice questions. Although the quantitative analysis of the respondents' literacy skills represents an advance on the results of previous research, the conclusions are somewhat rigid and only the best choices are assessed, not the other, less acceptable choices. Additional ratings would require the use of an analogous Likert scale, for example, but this would not (given its limitations) significantly improve the quality of the results and conclusions.

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Appendix A. Questionnaire

Energy literacy of students of the Faculty of Economics in Rijeka

Instructions: For all questions, mark only one answer, unless otherwise indicated!

PART ONE: Identification questions

1. What gender do you identify as?

- ○ Female
- ○ Male
- ○ Other

2. Which type of high school did you graduate from?

- ○ Grammar *secondary* school (Gymnasium)
- ○ Vocational *secondary* school

3. Are you a part-time or a full-time student?

- ○ Full-time
- ○ Part-time

4. Which is your undergraduate study major?

- ○ General economics
- ○ Finance
- ○ Marketing
- ○ International business
- ○ Management

- ○ Entrepreneurship

5. To what extent do you agree with the statement: "I am energy literate"?

- ○ I completely agree
- ○ I partially agree
- ○ I neither agree nor disagree
- ○ I partially disagree
- ○ I strongly disagree

6. Which of the offered information sources has contributed most to your knowledge of energy and energy problems?

- ○ School, college
- ○ Internet
- ○ Books, magazines, newspapers
- ○ Television, radio
- ○ Word of mouth (family, friends, others)

7. During your education, did you attend any course in the field of energy, environmental protection or similar?

- ○ Yes
- ○ No

8. Do you live in a city, municipality or village?

- ○ City
- ○ Municipality
- ○ Village

9. Do you live in a house or in an apartment?

- ○ House
- ○ Apartment

PART TWO: Analysis of energy literacy

(A) COGNITIVE SKILLS: Your knowledge of energy is tested by the following questions.

10. What is the basic unit of measurement for energy?

- ○ Kilowatt (kW)
- ○ Volt (V)
- ○ Joule (J)
- ○ Newton (N)

11. What proportion of the total energy generated by burning coal reaches the end consumer in the form of electricity?

- ○ 1/3
- ○ 2/4
- ○ 2/3
- ○ 3/4

12. Which type of light bulb is the most energy efficient?

- ○ Incandescent light bulb
- ○ Compact fluorescent light bulb
- ○ LED light bulb

13. What percentage of the electricity consumed is lost in the form of heat when using an incandescent light bulb?

- ○ 35%
- ○ 50%
- ○ 85%
- ○ 95%

14. Which type of energy currently produces the most greenhouse gases worldwide?

- ○ Coal
- ○ Natural gas
- ○ Oil
- ○ Nuclear energy

15. How many years does it take nature to produce oil?

- ○ 2.000 years
- ○ 2 million years
- ○ 20 million years
- ○ 200 million years

16. What is the optimum refrigerator temperature?

- ○ 2 °C
- ○ 4 °C
- ○ 6 °C
- ○ 8 °C

17. What is the optimum temperature in the freezer?

- ○ −14 °C
- ○ −16 °C
- ○ −18 °C
- ○ −20 °C

18. What is the range of energy efficiency classes?

- ○ A–D
- ○ A–E
- ○ A–F
- ○ A–G

19. Which of these acronyms stands for the agency that operates in the field of energy in the Republic of Croatia?

- ○ HIRENA
- ○ REGEHA
- ○ ENEHA
- ○ HERA

20. For what period does the *Energy Development Strategy of the Republic of Croatia* apply?

- ○ Period up to 2030
- ○ Period up to 2035
- ○ Period up to 2040
- ○ Period up to 2045

(B) AFFECTIVE SKILLS: The following questions test your personal attitudes and values in relation to saving energy.

21. I am trying to get additional information about how I can contribute to conserving energy on planet Earth.

- ○ Yes
- ○ No

22. I advise friends and family about energy efficient behaviours.

- ○ Yes
- ○ No

23. I take part in various energy projects (professional or scientific) organized by school, college or university.

- ○ Yes

○ No

24. I take part in reforestation, underwater cleaning, etc.

○ Yes
○ No

25. I consider myself an environmental activist.

○ Yes
○ No

26. Indicate whether you adhere to the following behavioural patterns:

Most often, I buy products from manufacturers that have as many recyclable components as possible.	○ Yes	○ No	○ I do not know
I mainly buy products from small farms (and not from large corporations) because I believe that small producers pollute the environment less and therefore cause less damage.	○ Yes	○ No	○ I do not know
I mostly buy organic (and non-traditional) produce because it is not treated with pesticides and does not use inorganic fertilizers that affect other species, the water and the air.	○ Yes	○ No	○ I do not know

27. Indicate the extent to which you agree with the following statements.

Climate change is a threat to society.	○ I agree	○ I partially agree	○ I do not agree
I want to use a solar system in my home.	○ I agree	○ I partially agree	○ I do not agree
I try to make more energy-efficient decisions.	○ I agree	○ I partially agree	○ I do not agree
Stricter laws should be introduced to further regulate energy consumption and environmental pollution.	○ I agree	○ I partially agree	○ I do not agree
Saving energy takes too much time and effort.	○ I agree	○ I partially agree	○ I do not agree
Major changes in the rationalization of energy consumption are too expensive.	○ I agree	○ I partially agree	○ I do not agree
I don't care about saving energy, I have other worries and obligations.	○ I agree	○ I partially agree	○ I do not agree
I believe that others will take the necessary measures to save energy.	○ I agree	○ I partially agree	○ I do not agree
Why should I try when it's too late anyway.	○ I agree	○ I partially agree	○ I do not agree
Why should I try when others don't.	○ I agree	○ I partially agree	○ I do not agree

(C) BEHAVIORAL SKILLS: The following questions are used to examine your habits and patterns of behaviour and actions in energy consumption.

28. Which appliance do you often leave plugged in even when you are not using it? (it is possible to choose more than one answer)

- ○ Television
- ○ Music system
- ○ Cell phone
- ○ Landline telephone
- ○ Computer/laptop
- ○ Microwave
- ○ Kettle
- ○ Coffee machine
- ○ Floor lamp (work, night, energy)
- ○ Room freshener

29. Indicate the extent to which you adhere to the following behaviour patterns in your home:

When buying electrical appliances, I pay attention to their consumption and choose more energy efficient ones.	○	Always	○	Sometimes	○	Never
When I leave the room, I switch off the light behind me.	○	Always	○	Sometimes	○	Never
When leaving the heated room, I close the door behind me.	○	Always	○	Sometimes	○	Never
In winter, I prefer to dress warmer, rather than turn up the heating.	○	Always	○	Sometimes	○	Never
I switch off devices that I am not currently using (TV, radio, computer, etc.)	○	Always	○	Sometimes	○	Never
I close the tap when I brush my teeth and only open it when I wash up.	○	Always	○	Sometimes	○	Never
I only switch on the dishwasher/washing machine at night.	○	Always	○	Sometimes	○	Never
I only switch on the boiler (water heater) at night.	○	Always	○	Sometimes	○	Never
I spend a long time showering.	○	Always	○	Sometimes	○	Never
Instead of taking a shower, I prefer to take a bath.	○	Always	○	Sometimes	○	Never

30. What type of light bulbs do you use most often in your household?

- ○ Incandescent light bulb
- ○ Halogen light bulb
- ○ Fluorescent light bulbs (energy saving bulbs)
- ○ LED light bulb
- ○ I do not know

31. What is the main source of heating in your household?

- ○ Wood or pellets
- ○ Electricity
- ○ Heating oil
- ○ Heating plant, gas
- ○ Solar system

32. What is the primary source of cooling in your household?

- ○ Air conditioning
- ○ Cooling fans
- ○ Cold shower
- ○ Balcony blinds and awnings, blinds and curtains, room ventilation

33. Do you cook with gas or electricity in your household?

- ○ Gas
- ○ Electricity

34. How do you wash dishes in your household?

- ○ By hand
- ○ Dishwasher

35. How do you dry the washed laundry in your household?

- ○ Air—dried
- ○ Tumble dryer

36. What type of transportation do you use most often?

- ○ Personal vehicle (I drive alone)
- ○ Personal vehicle (I drive with another person)
- ○ Motorcycle
- ○ Public transportation
- ○ Bicycle
- ○ I talk a walk

37. Which bags do you use when shopping?

- ○ Plastic bags
- ○ Paper bags
- ○ Cloth bags
- ○ I do not know (I don't keep track of it, the ones that come to my hands first)

38. What type of reusable packaging do you return?

- ○ Glass
- ○ Plastic
- ○ Cans
- ○ All
- ○ None (I'm not used to it, I don't have time for such an activity, it's not worth it because the compensation is too little, etc.)

39. Indicate the extent to which you adhere to the following behaviour patterns outside your home:

Do you dispose of expired medicines at the pharmacy?	○	Always	○	Sometimes	○ Never
Do you distribute waste?	○	Always	○	Sometimes	○ Never
When I'm walking and I have some trash, and there's no trash can nearby, I throw it anywhere (on the road, in the nature, etc.).	○	Always	○	Sometimes	○ Never
When I'm driving and I have some trash, I throw it out the window.	○	Always	○	Sometimes	○ Never

40. Your additional comments, observations and opinions (for any area of literacy):

_____

_____

References

1. Bowman, A. *Literacy and Power in the Ancient World*; Cambridge University Press: Cambridge, UK, 1997.
2. Biller, P. *Heresy and Literacy*; Cambridge University Press: Cambridge, UK, 1996.
3. Man, J. *The Gutenberg Revolution: The Story of a Genius and an Invention That Changed the World*; Review: London, UK, 2002.
4. World Bank. *World Bank Education Statistics*; World Bank: Washington, DC, USA, 2023.
5. Kress, G.R. *Literacy in the New Media Age*; Routledge: New York, NY, USA, 2003.

6. UNESCO Institute for Statistics. Available online: https://uis.unesco.org/node/3079547 (accessed on 1 December 2023).
7. Martins, A.; Madaleno, M.; Ferreira Dias, M. Energy literacy assessment among Portuguese university members: Knowledge, attitude, and behavior. *Energy Rep.* **2020**, *6* (Suppl. S8), 243–249. [CrossRef]
8. Van Khuc, Q.; Tran, M.; Nguyen, T.; Nguyen, A.T.; Dang, T.; Tuyen, D.T.; Pham, P.; Dat, L.Q. Improving Energy Literacy to Facilitate Energy Transition and Nurture Environmental Culture in Vietnam. *Urban Sci.* **2023**, *7*, 13. [CrossRef]
9. Bialynicki-Birula, P.; Makiela, K.; Mamica, L. Energy Literacy and Its Determinants among Students within the Context of Public Intervention in Poland. *Energies* **2022**, *15*, 5368. [CrossRef]
10. El-Kanj, H.I.; Alshdaifat, N.M.; Alomari, M.; Topal, A. Assessment of Energy Literacy among University Occupation: The Case of Kuwait. *Int. J. Appl. Eng. Res.* **2022**, *7*, 1–13.
11. Zhou, Y.; Smith, J.D.; Gelles, G. Teaching Energy Economics in the GCC: A Synergistic Approach between Engineering and Economics. *Energies* **2022**, *15*, 6953. [CrossRef]
12. Blasch, J.; Boogen, N.; Daminato, C.; Filippini, M. Empower the Consumer! Energy-Related financial literacy and its socioeconomic determinants. Center of Economic Research (CER) at ETH Zurich. *Econ. Work. Pap. Ser.* **2018**, *18*, 289.
13. Kalmi, P.; Trotta, G.; Kazukauskas, A. The role of energy literacy as a component of financial literacy: Survey-based evidence from Finland. In Proceedings of the 15th IAEE European Energy Conference, Vienna, Austria, 3–6 September 2017.
14. Sutlović, I. *Energetika: Povijest Korištenja Energije*; Fakultet Kemijskog Inženjerstva i Tehnologije: Zagreb, Croatia, 2018.
15. Union of Concerned Scientists. A Short History of Energy. Reports & Multimedia. 2006. Available online: https://www.ucsusa.org/resources/short-history-energy (accessed on 25 February 2024).
16. Bhutada, G. The 200-Year History of Mankind's Energy Transitions. World Economic Forum. 2022. Available online: https://www.weforum.org/agenda/2022/04/visualizing-the-history-of-energy-transitions/ (accessed on 25 February 2024).
17. U.S. Global Change Research Program Partner Agencies. *Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education*; U.S. Department of Energy: Washington, DC, USA, 2012.
18. 2030 Climate Target Plan Impact Assessment. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176 (accessed on 25 February 2024).
19. DeWaters, J.; Powers, S.; Graham, M. Developing an energy literacy scale. In *American Society for Engineering Education, Proceedings of the 114th Annual ASEE Conference and Exposition, Honolulu, HI, USA, 24–27 June 2007*; ASEE PEER: Baltimore, MD, USA, 2007.
20. Brounen, D.; Kok, N.; Quigley, J. Energy literacy, awareness, and conservation behavior of residential households. *Energy Econ.* **2013**, *38*, 42–50. [CrossRef]
21. Segal, E.A.; Gerdes, K.E.; Mullins, J.; Wagaman, M.A.; Androff, D. Social empathy attitudes: Do Latino students have more? *J. Hum. Behav. Soc. Environ.* **2011**, *21*, 438–454. [CrossRef]
22. Segal, E.A.; Wagaman, M.A.; Gerdes, K.E. Developing the Social Empathy Index: An Exploratory Factor Analysis. *Adv. Soc. Work* **2012**, *13*, 541–560. [CrossRef]
23. DeWaters, J.E.; Powers, S.E. Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect and behavior. *Energy Policy* **2011**, *39*, 1699–1710. [CrossRef]
24. Ham, M. Segmentacija potrošača prema razini ekološke odgovornosti. *Market-Tržište* **2009**, *21*, 183–202.
25. Caputo, R.K. Family Characteristics, Public Program Participation, & Civic Engagement. *J. Sociol. Soc. Welf.* **2010**, *37*, 35.
26. Lee, L.S.; Lee, Y.F.; Wu, M.J.; Pan, Y.J. A study of energy literacy among nursing students to examine implications on energy conservation efforts in Taiwan. *Energy Policy* **2019**, *135*, 111005. [CrossRef]
27. Bagozzi, R.P. The Self-Regulation of Attitudes, Intentions, and Behavior. *Soc. Psychol. Q. Spec. Issue Theor. Adv. Soc. Psychol.* **1992**, *55*, 178–204. [CrossRef]
28. Andolina, M.; Jenkins, K.; Zukin, C.; Keeter, S. Habits from Home, Lessons from School: Influences on Youth Civic Engagement. *Polit. Sci. Polit.* **2003**, *36*, 275–280. [CrossRef]
29. Babao, J.N.A.; Adiatma, D. Intercultural Communication Competence: Unravelling the Role of Cognitive, Affective, and Behavioral Factors. *Int. J. Adv. Multidiscip.* **2023**, *2*, 393–397. [CrossRef]
30. Rosenberg, M.J.; Hovland, C.I. Cognitive, Affective and Behavioral Components of Attitudes. In *Attitude Organization and Change: An Analysis of Consistency among Attitude Components*; Rosenberg, M.J., Hovland, C.I., Eds.; Yale University Press: New Haven, CT, USA, 1960.
31. Ostrom, T.M. The relationship between the affective, behavioral, and cognitive components of attitude. *J. Exp. Soc. Psychol.* **1969**, *5*, 12–30. [CrossRef]
32. Taylor, S., Jr.; DiPietro, R.B.; So, K.K.F. Increasing experiential value and relationship quality: An investigation of pop-up dining experiences. *Int. J. Hosp. Manag.* **2018**, *74*, 45–56. [CrossRef]
33. Kaushik, B.; Foster, J.E. On Measuring Literacy. *Econ. J.* **1998**, *108*, 1733–1749.
34. DeWaters, J.E.; Powers, S.E. Establishing measurement criteria for an energy literacy questionnaire. *J. Environ. Educ.* **2013**, *44*, 38–55. [CrossRef]
35. DeWaters, J.E.; Qaqish, B.; Graham, M.; Powers, S. Designing an Energy Literacy Questionnaire for Middle and High School Youth. *J. Environ. Educ.* **2013**, *44*, 56–78. [CrossRef]
36. Varghese, A.F.; Chandrasenan, D. Energy Literacy Scale (ELS): Validated Survey Instrument to Measure Energy Knowledge, Attitude, and Behaviour. In *The 9th International Conference on Energy and Environment Research*; Caetano, N.S., Felgueiras, M.C.,

Eds.; Greening Energy to Shape a Sustainable Future: Part of the Environmental Science and Engineering Book Series (ESE); Springer: Berlin/Heidelberg, Germany, 2023.
37. National Energy Literacy Survey Assessment Questionnaire. Available online: http://nef1.org/wp-content/uploads/2018/01/NEF-Energy-Literacy-Questionnaire-FINAL.pdf (accessed on 25 February 2024).
38. National Energy Foundation (NEF). Available online: https://nef1.org/ (accessed on 25 February 2024).
39. Go Construct. Construction and the Environment. CITB. 2020. Available online: https://www.goconstruct.org/why-choose-construction/whats-happening-in-construction/construction-and-the-environment/ (accessed on 25 February 2024).
40. Martins, A.; Madaleno, M.; Ferreira Dias, M. Energy Literacy: Does education field matter? In Proceedings of the TEEM'19 Conference: Technological Ecosystems for Enhancing Multiculturality, Salamanca, Spain, 19–21 October 2019.
41. Domac, J.; Šegon, V.; Kufrin, K. Stavovi i informiranost javnosti o obnovljivim izvorima energije i energetskoj efikasnosti. *Energija* **2004**, *53*, 165–171. [CrossRef]
42. Van den Broek, K.L. Household energy literacy: A critical review and a conceptual typology. *Energy Res. Soc. Sci.* **2019**, *57*, 101256. [CrossRef]
43. Worldometer. Energy Used Today in the World. Statistics Counters. 2024. Available online: https://www.worldometers.info/energy/ (accessed on 25 February 2024).
44. European Parliament. Gospodarenje Otpadom u EU-u. Vijesti. 2023. Available online: https://www.europarl.europa.eu/news/hr/headlines/society/20180328STO00751/gospodarenje-otpadom-u-eu-u-infografika (accessed on 25 February 2024).
45. He, H.; Wang, C.; Wang, S.; Ma, F.; Sun, Q.; Zhao, X. Does environmental concern promote EV sales? Duopoly pricing analysis considering consumer heterogeneity. *Transp. Res. Part D Transp. Environ.* **2021**, *91*, 102695. [CrossRef]
46. Orlov, A.; Kallbekken, S. The impact of consumer attitudes towards energy efficiency on car choice: Survey results from Norway. *J. Clean. Prod.* **2019**, *214*, 816–822. [CrossRef]
47. Caperello, N.D.; Kurani, K.S. Households' Stories of Their Encounters with a Plug-In Hybrid Electric Vehicle. *Environ. Behav.* **2012**, *44*, 493–508. [CrossRef]
48. Božić, L. Attitudes Towards Climate Change and Electric Car Purchase—The Case of European Consumers. *Tržište/Mark. Časopis Za Tržišnu Teor. I Praksu* **2021**, *33*, 81–94.
49. Rezvani, Z.; Jansson, J.; Bodin, J. Advances in Consumer Electric Vehicle Adoption Research: A Review and Research Agenda. *Transp. Res. Part D Transp. Environ.* **2015**, *34*, 122–136. [CrossRef]
50. Biresselioglu, M.E.; Kaplan, M.D.; Yilmaz, B.K. Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes. *Transp. Res. Part A Policy Pract.* **2018**, *109*, 1–13. [CrossRef]
51. IEA. *The Future of Cooling*; IEA: Paris, France, 2018; Available online: https://www.iea.org/reports/the-future-of-cooling (accessed on 25 February 2024).
52. Richter, C.P. Usage of dishwashers: Observation of consumer habits in the domestic environment. *Int. J. Consum. Studi. Spec. Issue Househ. Technol. Sustain.* **2011**, *35*, 180–186. [CrossRef]
53. Gammage, E. Plastic Vs Cotton Bags: Which Is More Sustainable? Save Money Cut Carbon. 2021. Available online: https://www.savemoneycutcarbon.com/learn-save/plastic-vs-cotton-bags-which-is-more-sustainable/ (accessed on 25 February 2024).
54. National Geographic Society (n.d.). Sustainable Shopping—Which Bag Is Best? National Geographic. Available online: https://education.nationalgeographic.org/resource/sustainable-shoppingwhich-bag-best/ (accessed on 25 February 2024).
55. Aco Recycling. Materials Which Have the Highest Efficiency on Recycling. High Tech Solutions for Environment. 2022. Available online: https://www.acorecycling.com/blog/materials-which-have-the-highest-efficiency-on-recycling/ (accessed on 25 February 2024).
56. Rayan, R.A. Pharmaceutical effluent evokes superbugs in the environment: A call to action. *Biosaf. Health* **2023**, *5*, 363–371. [CrossRef]
57. European Parliament. Klimatske Promjene: Zdravim Šumama Protiv Emisija Stakleničkih Plinova. Vijesti. 2023. Available online: https://www.europarl.europa.eu/news/hr/headlines/society/20170711STO79506/klimatske-promjene-zdravim-sumama-protiv-emisija-staklenickih-plinova (accessed on 25 February 2024).