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# Integrated Energy in Everyday Energy Practices in the Family Life of the Sixth Grade Primary School Students

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**Abstract:- The daily life of students and their families is directly and indirectly related to various daily functions and practices concerning the use of materials and energy. Transportation, water use, food types and supplies, the use of printing paper, packaging materials and their recycling are very important everyday issues that have a great impact on people's lives. They are addressed in the current study and are directly related to environmental, social, economic, and political issues. The respective governments 'role is considered primary on these affairs, while the education system and the school as an institution play an important role in providing not only knowledge but mainly raising children's awareness. The present study was conducted from November to December 2020 on primary school students with the use of a structured closed-ended questionnaire. The results show a high degree of implementation of positive practices related to the reduction and saving mainly of grey energy and resources, in fields related to student transport, the use of drinking water from the water supply network, the rational use of water in the bathroom, the consumption of food products mainly from the children's home environment, the reduction of meat consumption per week, the reduction and management of packaging and wrapping materials when purchasing products, the management of printable paper and the use of printing inks. The implementation of recycling materials and the adoption of educational practices concerning the rational use or non-use of materials and energy to a large extent in the school units of the study sample as a common element of the study population seems to significantly enhance the ecological profile and energy literacy of the students.**

***Keywords***:- *Energy Literacy, Grey Energy, Energy Saving, Perceptions, Daily Practices.*

## I. INTRODUCTION

The citizens of the current century are living in densely populated residential systems that are governed by social, financial and political conditions (Cepeliauskaite & Stasiskiene, 2020), creating issues like the production and use of energy (Chen et al., 20216), the alteration of the natural environment, the traffic, but also the waste production, overconsumption and management (Chen et al., 2018). A percentage higher than the 50% of the population is living in

urban environments imposing important pressures on the natural resources and the environment (Swert & Denis, 2014). The everyday life of the citizens is having an impact on all these sectors and vice versa, their living is in turn affected by the results of the processes that themselves are implementing, according to this contemporary way of living they have adopted (Markatou, 2020).

There are various energy sources that may be used for supporting the everyday activities of the humans, while the energy has to be transported from the production to the consumption site (U.S. Department of Energy, 2017). As a consequence of the above, the resources depletion is in the core of the everyday human social and financial processes, with negative consequences on the environment at a local and global level. The materials and energy consumption patterns are modified following an innovative overconsumption model originated from the more industrialized countries (Sahakian, 2010).

The building sector, during its operation phase, absorbs large amounts of energy out of the energy balance of a country (Amaral et al., 2020). The buildings may be intensive consumers of energy during their operation phase (operational energy), but the decisions taken during their design and construction, also affect in a considerable degree their energy demands (Bragança, 2014). Moreover, the human behavior, both as a condition and as a result of the sustainable management, drastically reduces the energy impact due to the irrational use, the resources dissipation and the decrease of greenhouse gases. In the opposite case, it drastically deteriorates the resources and energy waste (Poimenidis & Papavasileiou, 2021). Furthermore, the use and disposal of materials creates various social, financial and environmental problems of anthropogenic nature, leading to the loss of resources and the emission of carbon dioxide (Lee et al., 2020; Poimenidis & Papavasileiou, 2021) intensifying the climate crisis. The countermeasure or solution to these problems has to do with not using materials, with the limitation of buying and consuming and as the ultimate now measure, with the recycling, whose positive aspects are clearly the environmental and financial benefit (Poimenidis & Papavasileiou, 2021).

Mankind consumes huge quantities of bottled water, thus creating both directly and indirectly a wide range of unfavorable impacts (Bowyer et al., 2018) alike problems related to the use of energy and resources, to the production of plastic bottles and their disposal, to carbon dioxide emissions but also issues dealing with the recycling of the water packaging (Gleick & Cooley, 2009). Moreover, large

quantities of water provided by the water distribution network are used. This will initially have to become available, requiring financial and energy resources since production and delivery (Barberán et al., 2019), until its disposal as a waste requiring a biological treatment. The topic of the pollution and the energy waste applies to all the phases of the water cycle, either it is targeted to residential or industrial use.

Correspondingly, various issues also arise regarding the production, use and disposal of other materials as well. For instance, the paper is one of them as it is used in a wide range of financial and social processes, in office tasks, as packaging material, etc. (Udeajah & Nche, 2013; Ezeudu et al., 2019). What is more, the cutting of trees and the deforestation are also connected at a high degree to the paper production (Suraj & Khan, 2015). More specifically, the paper that is required for printing tasks but also the ink used in the printing process consist of a high energy intensive combination which functioning in a combi way maximizes the environmental impact, in an era when the digital technology dominates and contributes to the limitation of the quantity of printed documents and to the decrease of printing inks consumption, finally making them not necessary for a wide use. In addition, the use of low energy consumption lightning bulbs in the home environment of the children but also under a more general frame, is leading to significant electricity (Ganandran et al., 2014) and resources saving.

The city transports in the frame of the urban sustainability and in an era of intense urbanization, is an additional topic with multiple dimensions and long-term environmental, social and financial consequences (Morency, 2013). As a basic countermeasure in the frame of the sustainability, traveling on foot, by bicycle and by public means of transport consists of a powerful countermeasure against the energy waste and the carbon dioxide emissions, as the classical use of vehicles deteriorates considerably the greenhouse gases emission and increases the liquid fuels consumption (Poimenidis & Papavasileiou, 2021).

Under the frame of the living of urban citizens, the consumption of foods originated by long distance areas and produced in seasons different than the ones during which they are consumed amplify the non-sustainable management of the issues (Ritchie & Roser, 2020). On the one hand, significant amounts of energy are required for the production, treatment and maintenance of the foods inside especially designed cooling chambers (Clairand et al., 2020) and on the other hand the distance between the production site and the consumer causes significant consumption of liquid mainly fuels (EPA, n.d.), although what really matters, as the case may be, is what we eat and not where this is originated from (Ritchie & Roser, 2020). The usual foods that require such practices are concerning for instance the maintenance or cooling of meat and fishes as well as the mild cooling of fruits, which are maintained in order to avoid their quick maturation.

The transition to more sustainable consumption patterns depends on the consumers themselves (Sahakian, 2010). It is now clear that the sustainable or non-sustainable behavior at the everyday life level of a citizen lies on a wide range of processes and practices that are unconsciously implemented as natural everyday processes by the average person. At this exact point the importance of the education is highlighted, at the level of the formal education, regarding the environmental and sustainability education (Calvente et al., 2018; UNESCO, 2018). The target is the provision of information and the adoption of everyday practices of strong sustainable behavior. At the level of primary school students the suitable educational experiential interventions are able of offering a variety of didactic approaches aiming at the changing of children's behavior at the long term, as what is taught and adopted during the childhood is established in the future in the adult life of the person. Through the education the students are able of acquiring a critical way of thinking, skills and capacities and of becoming active in the achievement of the sustainable development (UNESCO, 2018). Thus, the most important benefit/tool of the contemporary society against the harms created unconsciously by the mankind, apart of course from the already advanced technology which can offer significant assets, is the education. The education can contribute to dealing with these menaces, in order for the negative impacts on the environment to be drastically mitigated (Saribas et al., 2014) by developing all these skills and opinions that will consciously and in a determined way guide the formation of the future choices concerning the environment and the sustainability (Papavasileiou et al., 2018).

## II. METHODOLOGY

The present research constitutes a part of a set of research approaches and multiple investigations related to the energy literacy of Primary school students at a range of sectors. This is implemented as the more general knowledge, the behaviors and the opinions of the students that have initially been educationally enhanced in the frame of the environmental and sustainability education in school are determinant and need some investigation concerning their degree of efficiency. For these reasons, a research was implemented with the use of anonymous questionnaires provided to 116 children of the 6th grade in various primary schools of the urban area of Rhodes Island, including mainly closed-ended questions and adapted to the age group of the children (Young, 2015). This is the second research approach, as the first one was addressing the operational energy field, while a sample of the research included 58.6% of boys and 41.4% of girls.

The study was implemented during the months of November–December 2020 and the thematics of the investigation are concerning various processes and practices that the children are applying in their everyday life. In all the everyday processes, the focus is at the operational energy but also at the grey or integrated energy. More specifically, the means of transport, the use of domestic water, the consumption of food and the kilometers required for this food (food miles), the materials recycling, the use of printable paper and inks, the use of energy saving bulbs, are some of the issues that are under examination, aiming at the capturing of the energy literacy of the children and of the respective issues in their residential environment, always according to their statements.

The study includes 19 declarations of intent, while the data were encoded and processed using the statistical program SPSS Statistics 25. The research consists of a study case. The results of the research are analyzed and presented with the use of percentage descriptive analysis.

## III. RESULT

The transport to and from school is very important as it creates traffic congestion problems but also problems related to the waste of - mainly liquid – fuels. The question "How do you come to school?" was answered by many children (51.6%) mentioning that they are going on foot, while certain children replied that they are taken to school by their parents by car (48.4%). This means that there is a substantial room for changing the practice concerning the transport of children and this issue requires an educational intervention.

The answers provided by the children referring to the question asking which is the most friendly means of transport in terms of limited or not at all carbon dioxide emissions, reflect a sort of confusion. The most pollutant means seems to be the use of car with a single passenger (29.3%), while next follows the use of bus (27.6%), the bicycle (22.4%), with the car sharing being the last in ranking (20.7%). The misunderstanding lies mainly in the percentage referring to the use of bicycle as this should not exist as a choice or at least exist as the last (least pollutant) one as a means being the most friendly to the environment. The declaration did not include the option of walking on foot.

As far as the water use in the bathroom is concerned, many children (60.4%) mention that they take either a very short shower taking care of turning off the faucet while not in use (while washing) (34.5%), or a longer one but again turning off the faucet while not in use (25.9%), assuring this way a significant water and energy saving, limiting the environmental impact. Quite many children though (39.7%) still go for the option of the classical bath, which requires the use of larger amounts of water in the bathtub and this is an issue that needs an educational intervention. Regarding the everyday health care habit of teeth brushing, an especially high percentage of children (93.1%) mentions that indeed while brushing their teeth they turn off the water flow, thus saving both energy and water, while just few of them (6.9%) let the water flow through the washbasin, causing energy and water waste. Moreover, a percentage of 75.9% of the children declare that their parents do wash their family car once to twice mostly per month, with just the 8.6% of them mentioning that the car is washed once per week and twice per week (6.9%), while the 8.6% mentions that their family doesn't own a car at all. Furthermore, many students (boys/girls) (56.9%) declare that in their family they buy bottled water although the local network provides good quality water to the residencies and which of course could be absolutely improved with the use of special water filters of long-term use, in case the parents still feel like playing it safe in general. Enough children though (43.1%) mention that they use the water provided by the local distribution network of their Municipality/city, drastically reducing the environmental, energy and financial cost of the productive process as well as the amount of waste due to the used bottles.

As far as the provision of foods is concerned, many children (67.2%) declare that they don't control the origin of the products they buy, so as to calculate the "food miles" (the distance food is transported from the time of its making until it reaches the consumer). Several children (32.8%) in any case, declare that they apply this practice. This declaration is also confirmed through the next declaration of the children, according to which several children consume foods that have either been imported or transported by plane (e.g. tropical fruits, dried fruits and nuts, non-seasonal fruits and vegetables, etc.) almost on a daily basis (46.6%), twice or three times per week (27.6%), while the rest of the children (25.9%) once to twice per week. What is worth mentioning is that there is no nil declaration (i.e. not consuming at all). Regarding the meat consumption, many children (65.5%) mention that they consume once or twice on a weekly basis, several children (32.8%) consume meat more than three times per week, while a few only children (1.7%) declare a zero meat consumption (as vegetarians). Moreover, several children (34.5%) are aware of the seasonal fruits whereas most of them (65.5%) aren't. As a consequence, there is a failure to choose in order for the market to be in line with the season and the locality. These kind of issues are important, since apart from their environmental and energy dimension, they also address the local economy and the support of the foods producers at a local level. It seems that in the field of the above mentioned issues there is a need for an educational approach in the frame of the environmental and sustainability education.

Based on the answers of the children it is obvious that as regards the topic of papers printing a significant paper and ink saving is achieved, as 60.3% of the children declare that printing is taking place extremely rarely, while also several children (29.3%) mention they do print occasionally. Very few children (10.4%) mention that they proceed with printing in their households. Thus, an important paper and ink saving is observed. Nevertheless, although the paper printing is indeed extremely rare in the families, a potential for improvement of this practice still exists. This is due to the fact that the 44.8% of the kids mentions that while printing or copying files, they select some options for paper and colored ink saving (black & white printing and "printing on both sides" options), in addition to also using unused/surplus of paper (55.2%). For instance, they may use a piece of paper, which is only printed on the one side, thus using the other blank side as a draft, for keeping notes, etc. Nevertheless, many children,(55.2%) neither proceed with paper and colored ink options when printing or copying (they don't select black & white printing or "printing on both sides" options), nor use the unused pages of paper (already printed on the one only side) as draft/for keeping notes, etc. (44.8%).

As far as the products packaging issue is concerned, in total several kids declare they either take into consideration (as preventive for buying the product) the packaging materials (25.9%), while others sometimes/occasionally (41.4%), whereas several children (32.8%) mention that they don't really count this as a criterion. Evidently many children

(60.3%) mention that they proceed with recycling steps at their houses by collecting various materials (bottles, aluminum cans, batteries, paper, etc.) significantly contributing to the energy, resources and money saving. Nevertheless, several households (39.7%), according to the children's declarations don't follow recycling procedures and it is extremely important to support towards this direction of the systematic recycling the families that don't regularly recycle, through specially designed programs of non-formal education provided by legally established bodies (Municipality, Technical Chambers, Professionals Institutes, etc.) with the contribution of experts on this issue. In addition, there seems to be a need for the implementation of a campaign at local level for the mitigation or even elimination of this malfunctioning. What is more, based on the answers provided by the children, there is a sort of confusion in the field of more specific waste as the glass, this green material, as e.g. the light bulbs are disposed after their use in common recycle bins by several families (36.2%), making their recycling procedures more difficult. On the other hand, many families (51.7%) suitably place the bulbs in the special waste bins for light bulbs, as these indeed consist of a specific kind of waste. Of course, a few families (12.1%) don't proceed at all to respective recycling procedures and instead dispose useful material to common garbage bins, functioning this way at the expense of the environment.

At last, the school units which the children that have provided the answers are attending, the procedures of recycling of valuable materials (bottles, aluminum cans, batteries, paper and plastic) are implemented, as mentioned by the majority of the children (93.1%) while only a few kids (6.9%) mention that no respective recycling procedures take place. These declarations are inaccurate though since in all the participating school units similar procedures of recycling and disposal of the recyclable waste/materials per type, to special authorities for their collection and promotion are being implemented.

## IV. DISCUSSION AND CONCLUSIONS

The topics that are addressing the materials and energy management in the children's personal life are affected at a significant degree by but also shaped up according to the education these receive. More specifically, the education that is an environment and sustainability centered one is of a fundamental importance for the shaping of environmentally aware and characterized by a large degree of awareness to anthropogenic issues, citizens (Poimenidis & Papavasileiou, 2021). Nevertheless, what has also to be taken into account is the possible effect of the family environment to the children by either their parents or caretakers, directly or indirectly. This is possible due to the everyday practices/way of living of the families, primarily under financial and social and then environmental terms. In addition, the environmental awareness and the feasible practices of the caretakers in houses, may significantly affect the opinions and the practices that may be implemented by the children, either enhance them or on the other hand cancel them (Halmatov & Ekin, 2017). Evidently, the enhanced and shaped views as well as the environmentally friendly behaviors of the children derived by the school education may have a positive impact and either modify or affect the behaviors and practices of their own parents regarding issues that have to do with the environment (IOP, 2013; Damerell et al., 2013). The main target in the frame of the environmental and sustainability education is the environmentally responsible behavior, but the latter becomes really complex at the level of the parents- children interaction.

The present study is investigating information provided by the residential field of both students and parents, always according to the statements of the children. It offers valuable quantitative data of everyday practices and basic feedback of the environmental behavior of the students' families, addressing basic everyday sectors, which are highly related to the grey or integrated energy.

The transport of the children to school are at a significant degree made on foot and by bicycle, contributing to resources and energy saving. In parallel, the children are developing skills they may benefit of in conditions beyond their everyday travel from home to school and vice versa, like the safe driving, the accessibility to pedestrian crossings, the traffic awareness and the behavior of other persons in the streets (Neves & Brand, 2019; McAuley & Pedroso, 2012). Furthermore, many children have to get to school using the family vehicle due to the distance, yet they also mention the issues of the group transport (bus or car sharing) aiming at the carbon dioxide emissions reduction and the energy saving. Nevertheless, the bicycle being the absolute non- pollutant means of transport, not requiring any kind of fuel, is not placed at the absolute gradient of reducing the use of fuels and energy saving.

In the water use sector, the usage behavior during the shower of the children and their families, especially if a quick shower is preferred instead of a longer one, demanding very large quantities of water, but also the practices referring to the intermittent water flow during the shower and the teeth brushing, consist of an important practice of water and resources saving in general. These two practices and behaviors, the faucet turning off between uses or while not in use and the shorter showers, can assure a significant benefit (Dobroski, 2016; EPA, 2013). In addition, the family vehicles washing once or twice per month contributes significantly to the resources and energy saving. On the other hand, the use of bottled water in a large degree, due to the insecurity as far as the quality of the water provided by the local water distribution network is concerned (March et al., 2020), seems to consist a week point of energy waste mainly but also of production and management of waste (Jain et al., 2019; Javidi & Pierce, 2018), as the best waste is the one that was actually never produced. Moreover, any choice of not drinking water flowing out of the kitchen faucet is not the optimal one (Javidi & Pierce, 2018) given the development of drinking domestic water filtering technologies.

The non-existent control concerning the origin of the food and aliments for both the children and their families at a large degree, but also the consumption of aliments produced in remote from the place of residence areas, are related to the additional burden to the environment due to the transport and

the maintenance processes needed for these aliments (Ritchie & Roser, 2020). On the contrary, the locally produced products require less resources (Barska & Wojciechowska-Solis, 2020) and enhance the local community. The relatively infrequent consumption of meet by the subjects of the research, highly contributes to the decrease of both the resources and energy and of the greenhouse gases. This is an important element since the husbandry sector is highly connected to the use of resources and energy (Rotz et al., 2019) as well as to the production of methane.

The realization of important printing paper saving, alongside the parallel saving in printing ink in the family environment of the children, but also the satisfactory reuse of printed paper as draft paper used for keeping notes contribute to the saving of raw materials and energy, as well as to the environmental impact mitigation (EPN, 2019; Čabalová et al., 2011).

The focus on the paper and the wrapping items/bags which are taken into account, but also the intense recycling of materials and products, together with the limitation of the consumption, are contributing towards the sustainable development and the mitigation of environmental impacts through the collecting of these materials (Grosse & Mainguy, 2010). Nevertheless, an educational intervention at a small extent is needed, since the procedure of disposal of some materials which should be placed in specific separate recycle bins (e.g. glass, lightning bulbs) seems to still be confusing. In a more general sense, a more complete approach of the human behavior and practices is summarized in the "3 Rs" (Reduce, Reuse, Recycle), which stand for not purchasing / limiting, reuse and recycle (Abdul-Rahman, 2014).

Furthermore, the fact that in the school units of the participating in the research children an extended collecting of recycle materials is being implemented as part of an educational program, contributes to the environmentally friendly edification, enhances their environmental and energy literacy as well as the dissemination of practices, habits but also knowledge inside the domestic environment of those children (parents, siblings, relatives, etc.) (Parejo et al., 2021; YPEN, 2020).

In terms of behavior rating, the present study highlights the level of sustainable management and behavior of the kids and their families, between the level of a satisfactory sustainable behavior and the one of a high sustainable behavior in total. This is conducted based on the answers provided by the sample children and it consists of a very positive clue in profit of the environment and the sustainability, although there is still a field for improvement in the frame of the environmental and sustainability education.

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