

<http://jates.org>

Journal of Applied Technical and Educational Sciences jATES

ISSN 2560-5429



Light pollution as environmental problem appearance in national core curriculum and in other educational documents

Anna, Apró

*Eszterhazy Karoly University, Institute of Geography and Environment, Leányka Street 6. Eger 3300, Hungary,
apro.anna@uni-eszterhazy.hu*

Abstract

The paper presents the elaboration of light pollution environmental problems, the partial results of which can be seen in the National Core Curriculum (2020) (NCC in the following) i.e. the most relevant content of pedagogy in Hungary. Concepts related to the topic rarely appear in the analysed documents. The unified structure of the topic, the exploration of the causes and consequences of light pollution, and the students' understanding of their role are equally missing. In the course of this approach, efficient lighting can be introduced and cost-effective methods can be developed. We have sought out professional workshops on research topics that, due to their current activities, contribute to the integration of light pollution into education. The study presents some of the key elements of the National Core Curriculum. The first part describes the content regulation and regulation levels of school education, the learning and educational goals, the principles of learning and teaching, and the educational stages. The second half of the description deals with competence development, learning areas and knowledge contents. During the characterization, issues related to light pollution also appear.

Keywords: light pollution; National Core Curriculum; education; sustainability; competences

1. Introduction

It is a kind of expectation of our modern society to illuminate the night with artificial light sources. When we emit more light than necessary, we cause the phenomenon of light pollution, which has a detrimental effect on our environment and health. Light pollution can also be considered as one of the new environmental challenges of our time, the reduction of which also depends on the inhabitants of the settlements.

Teaching the problem is also justified in the educational institutions for which science subjects are best suited. The complex approach to light pollution in the educational sciences is closely related to the subjects of geography, physics, chemistry, biology. Interdisciplinary relationships in science play an important role in seeing the relationship between theoretical and practical knowledge, and in developing, applying and using knowledge. It is advisable to record the topics, tasks, knowledge that can be related to the teaching of light pollution. As a result, it is

possible to create knowledge systems and relationship systems that promote understanding and application. The study presents some of the key content of the National Core Curriculum (NCC, 2020).

NCC defines and ensures:

- content issues in school education,
- learning content,
- interoperability between schools,
- the content of basic education.

The goal of public education is to support students in the areas of self- and others' acceptance, community responsibility, initiative, and active participation.

2. A new environmental problem and its challenge

Light pollution can be a problem for human health, wildlife, the magnitude of energy consumption, and thus global warming, and research into the night sky (Muhamad, Nur Nafhatun, & Zety, 2019).

However, light is not only a source of energy but also determines the rhythm of life in the biosphere. Wildlife has adapted to changes caused by day-nights of varying lengths, moon phases, and seasons (Taylor, 2017). During evolution, species that lived by day and night lifestyles were separated, which evolved in response to changes in the light of nature. The characteristic daily rhythm of the production of the hormone melatonin produced by the pineal gland can be detected, which shows the highest level in the evening. The hormone itself is present in our body as a kind of antioxidant, in the activity of which activity can be detected in order to prevent the development of cancer. Light has an inhibitory effect on its production. Its low concentration promotes the appearance of cancerous diseases (Muhamad, Nur Nafhatun, & Zety, 2019). Studies have shown that the incidence of breast cancer among women working shifts and breast cancer has increased (Bashiri, 2014).

However, the widespread use of artificial light sources can also be confusing for wildlife, such as birds. This can manifest itself in a disturbance of their orientation, such as the fact that during their journey, artificial light sources disturb their orientation in their orienteering, which can lead to a landing different from the intended location.

At the same time, in areas where it is not possible for birds to avoid artificial lighting, their biorhythms are upset, meaning that daytime species are also active at night (Kyle, eds., 2019).

However, it can also affect a lot of the entire ecosystem, as many insects are attracted to artificial light, but it can also be a fatal attraction for them. Declining insect populations have a negative impact on any species that relies on insects for food or pollination. Some predators take advantage of this attraction and affect the food web in unexpected ways.

The issue of light pollution also raises serious sustainability issues. The answers to these questions can be found in the previous thoughts. Another possible way of raising awareness is in education. In the next chapter, we first review the general objectives of the National Core Curriculum, the areas related to the topic of sustainability, and then the content sections on light pollution.

3. Learning and educational goals

In this chapter, a special role is given to the promotion of social, economic and intellectual development and the coordination of social and individual needs. Due to the rapid changes in technological development, it is becoming difficult to define requirements in the field of education. Complex environmental changes, such as climate change, pollution, etc., are challenging humanity and wildlife.

We can distinguish several learning and educational goals, such as:

- physical and mental health education: lifestyle habits that help to establish physical and mental health, such as the importance of a healthy diet and prevention
- education for self-knowledge, human knowledge: the focus is on self-expression and healthy self-esteem. It can be achieved through the development of emotional intelligence and the application of positive social behaviours, such as honesty, justice, fairness.
- education for cooperation and mutual respect in social relations: the learner knows that he/she can build relationships based on reciprocity and ethical behaviour, increase his / her independence, recognize those in need, find solutions, become compliant.
- education on communication culture and media use: the use of infocommunication channels is closely linked to everyday life. In the traditional form of communication and infocommunication, it is necessary to follow a polite, eclectic and cultured style. Awareness is also important when using digital tools. It is important for students to be able to select from

websites that do not describe reality. This is a difficult task despite the fact that the young age group is open to receiving all the information that can be connected to the digital world.

- education for autonomous learning and conscious career building: the learner has the opportunity to develop the most effective way of learning for his or her age. In order to promote development, he/she develops his/her skills and becomes able to make decisions about further learning and, if necessary, modify it. The teacher and the parent, as well as their relationship, also have a special role to play, as the parents can support the student in accordance with the educational institution in order to facilitate the above.

- education for patriotism and active citizenship, democracy: students are involved in community programs such as the living environment is cultural, traditional opportunities, environmental protection, charitable activities. The importance of emphasizing sustainability can also play a central role here, in which both educators and parents can be actively involved, primarily by setting a personal example.

- commitment to a sustainable present and future: The goal is to develop learners' sense of responsibility for sustainability and environmental awareness. It can be achieved by organizing various project days and theme weeks, activating students, and joining national and international programs. Local specificities are also becoming important at both the social and cultural levels. It is important to develop a sense of responsibility that is relevant to the future of communities and that learners understand that they are actors in their environment who are involved in the processes that shape the future. Parents' and teachers' views on sustainability are also authoritative, as if family and school habits are consistent in educating about sustainability, it facilitates effective integration into students' lives.

3. Educational sections and special educational tasks

The aim of the first stage of primary education (grades 1-4) is to transfer the child from pre-school activities to school-based learning activities. It is important to develop the basic abilities and skills to solve creative tasks and problem-solving tasks in the meantime. Understanding, cognition can be developed, students can be aroused interest in learning, responsibility, perseverance and independence.

In the second phase, the foundation of the basic competencies, skill sets and knowledge contents necessary for effective learning will be continued, and active learning will be supported. The

learning style in grades 5 and 6 is different. It is also necessary to apply the learning methodology of the lower grades and raise it to a higher level. In grades 7-8, it is also possible to try new types of learning in order to learn the methods of active knowledge expansion. A key goal is for students to become more responsible and independent. In the course of motivation, continuous acquisition of knowledge and problem solving, we can connect this stage of education with sustainability.

In the third stage (grades 9-12), learning pathways are differentiated according to school choices. Vocational high school education and training, which also provides professional qualifications, lays the foundation for meeting the requirements for graduation. It must be possible to enter higher education even after graduating from a vocational high school. With regard to high school education, students should be given the opportunity to enter various vocational training instead of (or in addition to) higher education. In the case of vocational secondary schools, it is necessary to create the acquisition of knowledge that will enable the continuation of studies after the vocational qualification. During the four grades of secondary education, the learner undergoes a number of changes in both cognitive and emotional as well as personality development. Career orientation appears as a priority pedagogical task.

4. Special rules for certain tasks and institutions of the public education system

Kindergarten education plays a significant role because addressing sustainability issues proves to be more effective the earlier we start addressing it at an earlier stage in life. According to the NCC, science education appears as one of the priority tasks of public education, namely according to the following definition:

In the learning-teaching process of science, it is essential to get to know the problems and real-life situations relevant to the student, which the subject can achieve by discussing the problem in an integrated way, with the active participation of students, planning, carrying out, observing and analyzing simple experiments, even at home. el. It is very important to supplement all this with field activities, which are not only studies in nature, but can even take place in an urban environment (NCC, 2020, p. 369.).

The foundation of science thinking in education can begin in the first stage of primary education with the help of Mother Tongue Communication and Literary Literacy. This can continue within the Natural and Geography learning area in the subject of Environmental Education. One of the aims of the subject of environmental education is to get to know the phenomena and

events of the environment in a narrower environment and then in a wider environment, according to the age characteristics. Another aim is to thematically structure the knowledge and emphasize the importance of the observer role, to develop a sensitivity to the problems, and to establish a natural science literacy for the expansion of their later studies. Building on current, directly experienced problems is effective in processing the curriculum. To create this, the local curriculum is best suited for this purpose. The exploration of the causal connection (e.g. the functioning of the human body), the systematization (living and inanimate natural phenomena), the need to apply the acquired knowledge become more and more important. The process helps to lay the foundations for science literacy. Pupils get to know the sights of Hungary in a wider environment and in a narrower environment, or the natural endowments of a chosen national park / landscape protection area. Examining the relationship between man and nature in the spirit of the environment and sustainability, students learn why nature conservation is important, how our ancestors met their nutritional needs, how they took care to protect their immediate environment. National parks or nature reserves play a role here.

5. Competence development, learning areas and knowledge contents

In the first stage of primary education, the conditions necessary for the development of key competencies are created in public education institutions. Acquiring basic competencies makes it possible to acquire usable knowledge as a result of acquiring a system of knowledge, skills and attitudes (*Table 1.*). The following are some examples of learning processes that play a major role in developing applicable knowledge:

- observation: learning about the signs of phenomena that can be detected by the senses, ie gathering information. In the process, students try to move forward in the formation of ideas, relying on their existing knowledge. Proper application of experience and method of illustration provides a basis for the conceptualization process.
- analysis: this phase can also be called the process of conceptualization. In terms of its design, we distinguish between inductive (moving from the concrete to generalization) and deductive (moving from the general approach to the concrete) modes. The next step requires the right conceptualization, otherwise there will be failure and misunderstanding in the application of knowledge.
- application: skill and skill development required. Students will be able to apply known algorithms (Teperics, 2015).

Table 1. Relationship between competency types and light pollution

Competence types	Knowledge	Skills	Attitude	Nature of connection to light pollution
Basic Competence	speaking, writing, reading, calculation	getting information	self-confidence, openness, decision-making	A, B, C, D, E, F, F
Learning competencies	self-knowledge, field of interest	learning objectives, strategies	initiative, sense of responsibility	A, C, E
Communication competencies	basic vocabulary, knowledge of verbal and nonverbal communication	socially connecting, correct use of language, active hearing, persuasion	open, sensitive and critical attitude towards the opinions and arguments of others	A, B, D, E
Digital competencies	operating systems, digital forms of communication, protection of personal data	use of software, information retrieval, collection and processing	ethical use of digital technologies	D, E, F
Competences of thinking	models, data analysis tools, recognizing the differences between scientific and pseudo-scientific claims	drawing conclusions based on facts, recognition of correlations	interest, identification of problems	A, F
Competences in social participation and responsibility	society's values, moral norms, ethical behaviour	following social rules and moral norms	taking responsibility, keeping with tradition	A, B, C, D, E, F
Personal and social competences	identification of own abilities, mental and emotional health, recognition of community standards	teamwork, critical consumer approach	own and social health awareness, compromise, active way of life	A, B, C, D, E, F
Competences in creative creation, self-expression and cultural awareness	knowledge of the main elements, traditions and cultural products of the cultural heritage of countries, nations, Europe and the world	engaging in creative activities	considers openness to culture to be valuable	A, C, D
Employee, innovation and entrepreneurial competencies	future shaping, understands the evolution of labour market opportunities	adaptation in the world of work, creativity, problem solving and critical thinking, objectives	flexible adaptation to changing roles, sense of responsibility, cooperation	A, B, C, D, E, F

In the following, characteristics that define the knowledge, skills, and attitudes associated with core competencies that support the acquisition of usable knowledge about light pollution are defined. Abbreviated in the table, their initials are shown.

- A: Apply knowledge of the problem can circle
- B: The presence of energy saving in everyday life
- C: Knowledge of the harmful effects of light pollution on the environment
- D: Encouraging active action to mitigate the problem
- E: Distinguish between physiologically favorable and unfavorable light sources
- F: Use of reliable and modern lighting methods

6. Another possible occurrence of light pollution within the framework of some of the studied subjects

In the framework curricula of the subject of biology 11-12. Examining the relationships between material flow and energy flow in the ecosystem thematic unit, the exploration of its quantitative relations in living communities, results in the exploration of local problems with students, including light pollution. In the 10th grade textbook, the analysis of animal communication focuses on the function of light and pheromone traps in insects. In the year, the Hortobágy National Park and the star shop established there will play a role in the discussion of national parks on the topic of Hungarian living communities.

Within the framework of the subject of physics, light pollution in general schools is dealt with in the chapter Our Environment and Physics, where energy saving possibilities are examined in households, schools and residences. In the chapter Optics, astronomy, the relationship between man and light comes to the fore, where the concept of light pollution and the light pollution of our country appear. These will also appear later in the grammar school framework curricula. As stated in the NCC, in Class 8, the above also appears in textbooks. In grades 9 and 11, on the topic of Models of the Solar System, the message of the Starlight appears in the curriculum as a reading of the Earth Hour event.

In geography, in the name of cultural heritage, light pollution can be mentioned in connection with the systematization of cultural values, national parks and world heritage sites and values, and in the case of global challenges in exploring the territorial characteristics of the urbanization process and the essence of energy management. It also appears in textbooks, as in 7th grade the night lights of Eurasia can be seen on a light map during the population density of Asia and the study of its settlements. In 8, the Zselic Star Shop Park is mentioned in terms of the protection of Hungary's values. In the first year of high school, the chapter from the Edge of the Universe

to the Sun emphasizes light pollution, star shop parks, and in the 10th grade, the night lights of cities appear in the form of tasks.

In chemistry, in terms of the history of science, we can explore the history of light sources within the framework of a project work. In the chemical aspects of environmental systems, we can approach light pollution from the candle to LED bulbs from the point of view of the history of science.

In general, it can be said that in the light of science subjects, the causes and socio-economic effects of the teaching of global problems can be explored in the causal contexts of light pollution in the energy and infrastructural topics of the subjects. Following the science side, in the processing of the harmful effects on the living world, including those that occur due to the behavioral patterns that appear in the age group of the students. The topic is also suitable for comparing the development of countries and learning about future solutions.

7. Summary

Due to the proliferation of environmental problems, environmental education is one of the outstanding tasks of public education; nowadays it includes the pedagogy of sustainability, the education of the “environmental citizen”. This pedagogical practice covers human coexistence, the relationship between man and nature, physical and mental health education, and the development of social skills. The core competencies and their characteristics were initially highlighted individually. In this analysis, core competences for social participation and responsibility may have come to the fore as an area that also emphasizes sustainability and light pollution. Almost all of these include the importance of the appearance of light pollution in educational settings, awareness of the energy-saving uses of artificial light sources, and the physiological impact of these light sources on the entire ecosystem. Overall, the concepts and phenomena closely related to the topic, although with a small number of mentions, occur in the analyzed documents. However, there is a lack of a unified structure of the topic, therefore, the exploration of the causes and consequences of light pollution in the geographical topics, and the understanding of the students' own role and possible solutions in the knowledge of them.

Acknowledgments

The research has been supported by EFOP-3.6.2-16-2017-00014 project.

References

- 5/2020. (I. 31.) Korm. rendelet: A Nemzeti alaptanterv kiadásáról, bevezetéséről és alkalmazásáról szóló 110/2012. (VI. 4.) Korm. rendelet módosításáról. *Magyar közlöny* 2020 (17), pp. 290-373. Letöltés (2020. 07. 20.)
<https://magyarkozlony.hu/dokumentumok/3288b6548a740b9c8daf918a399a0bed1985db0f/letoltes>
- Bashiri, F. (2014). Light Pollution and Its Effect on the Environment. *International Journal of Fundamental Physical Sciences (IJFPS)*, 4(1), 8-12.
doi:<https://doi.org/10.14331/ijfps.2014.330061>
- Kyle, G. H., Cecilia, N., Benjamin, M., Frank, A., Adriaan, M., & Andrew, F. (2019). Bright lights in the big cities: migratory birds' exposure to artificial light. *Front Ecol Environ*, 17(4), 209– 214,. doi:[doi:10.1002/fee.2029](https://doi.org/10.1002/fee.2029)
- Muhamad, F. S., Nur Nafhatun, S. M., & Zety, H. S. (2019). The Risk of Light Pollution on Sustainability. *ASM Science Journal*, 1(12), 134-142. doi:[ISSN 1823-6782](https://doi.org/10.1823-6782)
- Taylor, S. (2017). Light Pollution: A Case Study in Framing an Environmental Problem. *Ethics, Policy & Environment*, 20(3), 279-293. doi:[DOI:10.1080/21550085.2017.1374010](https://doi.org/10.1080/21550085.2017.1374010)
- Teperics, K. (2015). A földrajztudomány/földrajztanítás szerkezete, egyedi vonásai, hatásuk a földrajztanítás folyamatára. In K. Teperics, E. G. Sáriné, G. Németh, L. Sütő, & E. Homoki, *Földrajztanítás - válogatott fejezetek* (pp. 29-34). Debrecen: Debreceni Egyetem Kiadó.

About author

Anna Apró PhD student graduated from Károly Eszterházy University in 2017 as a teacher of geography and mathematics. She is currently pursuing her studies at the Doctoral School of Education at the university, in the Environmental Pedagogy module as a chosen doctoral subject area. She writes her doctoral dissertation on the topic of environmental pedagogical aspects of light pollution, which is a lesser-known form of environmental damage, but also a present problem, so it is necessary to include it into education in a gap-filling manner.