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## THE IMPORTANCE OF TECHNOLOGY IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

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**Abstract:** Environmental issues and problems of sustainable development are today the key topics of every community and society, which is why they should be an indispensable part of general and compulsory education. Given that technological knowledge needed to understand these problems and issues, it is clear that technology education is necessary to integrate into this education. However, the practice often shows that technology (technical) education neglected or completely excluded from this segment of education, as is the case in Croatia. In this context, a study of pupils' understanding of the relationship between technology with environmental issues and sustainable development was conducted. The research was conducted on a sample of pupils from 5<sup>th</sup> to 8<sup>th</sup> grade ( $N = 1980$ ) from Croatia. The results show that pupils generally consider technology important, but their answers indicate a lack of understanding of the connections between technology and issues of sustainable development and ecology. Complete misunderstanding refers to the issues of water conservation, construction of facilities, waste management, and they mostly perceive technology as an environmental pollutant. A somewhat more acceptable understanding observed for issues of production, food and animal husbandry, and the role of technology in the well-being of the community. The findings show that pupils consider technology important on a general level, but the answers that require a deeper knowledge of technology show a lack of understanding of the importance and interconnections. This shows that learning of technology is an extremely important prerequisite for developing students' awareness of ecology and sustainable development issues and for understanding these issues.

**Keywords:** ecology, education, sustainable development, understanding of technology, technology education.

### 1. INTRODUCTION

Today, it is obvious that a certain degree of planetary destabilization caused by human action is irreversible, at least in the context of one human life. Of the nine planetary boundaries defined by Rockstrom et al. (2009), climate change and terrestrial ecosystem changes are in a zone of uncertainty or increased risk, while biosphere integrity and biogeochemical flows into the biosphere and oceans are in a high-risk area. In addition to the above, there is also the destruction of stratospheric ozone, further chemical pollution, acidification of the oceans, inappropriate consumption of fresh water and the global hydrological cycle, and atmospheric aerosol filling. In order to stop and change such a trend or to maintain within the provisions of a safe operational space, it is necessary to act at the way that goes beyond exclusively economic, political, and even natural and technological frameworks. It is also obvious those idealistic aspirations to solve these problems at the world community level have proved wrong (Huckle and Wals, 2015) and that actions should focus on local communities and states, which should then lead to changes in such negative trends. In such process, a conscious population that understands environmental problems and issues of sustainability and sustainable development and that knows and can act should play the main role. A prerequisite for this is the necessary holistic knowledge that should be acquired from early schooling onwards, but also teachers who themselves understand resilience, sustainability, the environment and human influences on them from different fields. In other words, education must play a key role in the development of a planetary vision, in ensuring sustainable life chances, aspirations and a future for young generations (UNESCO 2009).

Education for sustainability and sustainable development in recent decades is based on integrating the principles, values and practices of sustainable development into all aspects of education and learning (UNESCO, 2005). However, it is certain that new directions for education and learning and quality and inclusive education are needed to respond to current and future challenges (Pavlova, 2013). In doing so, the aim of education for sustainable development is to develop thinking, caring and acting towards a sustainable future, as a mechanism for solving the problem of socio-ecological sustainability (Aguayo and Eames, 2017). So far, key approaches to learning in sustainable development education have included the development of environmental literacy, critical thinking, and action competence (Huckle and Sterling, 1996; Jensen and Schnack, 1997; Orr, 2004; Nicolaou et al., 2009; Aguayo and Eames, 2017). In this context, action competence, i.e. the ability to act, is the component that can lead to real improvement of socio-environmental problems (Aguayo and Eames, 2017). However, in order for an individual to

be able to recognize and understand environmental problems, think critically, and act appropriately to solve a problem, he or she must understand the totality of the problem and all the components that affect that problem. It is a system thinking approach, as a capacity of interrelating and making connections between the range of dynamic elements composing the different dimensions of socio-ecological sustainability (Aguayo and Eames, 2017). Among these elements is the technological one, which is often neglected or even omitted, and is necessary for understanding the causes, consequences, but also possible solutions to the problem. This is actually a definition of ecological literacy, which involves understanding the whole system or understanding the interconnectedness of things (Armstrong, 2005; Barlow, 2005; Capra, 2005). This means that education for sustainability and sustainable development is much more than the development of awareness of environmental issues (Tilbury and Wortman, 2008), because in addition to the environment, the social, political, economic, but also technological context should be considered. Such education necessarily needs to take place in a local social context because social learning in which communities co-shape solutions to locally based issues is a key factor in the transformation towards sustainability (Aguayo and Eames, 2017). Therefore, technology education, as an important factor for understanding environmental and sustainability issues, should be transformative. This involves teaching and learning processes that help students construct and adapt new and revised meanings of experiences (Pavlova, 2013). Therefore, the context of learning and teaching is an important factor that must necessarily give sense and meaning to the content being learned (Purković and Kovačević, 2020) and thus influence the transformation of behavior in a given situation. Such transformative pedagogy should help students identify an ethically problematic situation, enable students to express their feelings and thoughts, and find a solution that is in the best interest of all parties involved (Pavlova, 2013). However, such an approach to technology education requires a significant departure from the current, content-limited education. At the same time, it is looking for a completely new time plan and framework of education, to which subjects will not be an obstacle. It seeks the cooperation of teachers from different subjects and with different external partners to make the activities feasible and seeks teachers who will understand the importance and problems of sustainability and sustainable development, especially in the context of the local community.

From the aforementioned starting points, a research was launched on the perception of primary education students in Croatia towards issues of sustainable development and ecology, precisely in order to establish a deeper understanding of those issues that are specific to the Croatian social and economic context. In this way, the aim was to establish whether current education in Croatia has the expected effect on primary education students when it comes to environmental issues and issues of sustainable development. Namely, in Croatia, education for sustainable development declaratively is implemented in all primary and secondary schools (UNESCO-DESD, 2014), and since the education reform in 2019 through the curriculum of the interdisciplinary topic "Sustainable Development" (MZO, 2019). Given that, the appropriate technological component of this education was missing, because technology is taught only one hour a week and only from the 5th to the 8th grade of primary school, there were no activities that would enable transformative education. In addition, teachers who are not environmentally literate, if this term is viewed within the framework of a previously elaborated definition mainly carry out environmental activities. In other words, this segment of education mainly consists of trivial environmental activities whose background, context and problems are not understood by those who carry them out, which is why it is in fact a kind of "environmental indoctrination". In this context, as a secondary goal of the research, it was sought to establish whether the technological competencies of students are appropriate from the point of view of education for sustainable development. Since this paper is part of a more comprehensive research project, only preliminary research results are presented here.

## 2. MATERIALS AND METHODS

The research was conducted with an anonymous survey questionnaire on a stratified sample of primary school pupils ( $N = 1980$ ) from the entire territory of Croatia. The research involved pupils aged 11 to 15 (grades 5 to 8), and was conducted according to ethical codex (Ajduković et al., 2019). A validated *PUTTOR (Preferencije Učenika prema Tehnici, Tehnologiji i Održivom Razvoju)* instrument was used to examine pupils' understanding, and the items processed in this paper form a set of statements according to which pupils expressed their level of agreement. Agreeing with the any statement was evaluated according to a Likert-type scale, from 1 - completely disagree to 5 - completely agree. Items according to which the pupils expressed their agreement were:

1. *With the help of technology, everything is getting better.*
2. *Technology is important for life.*
3. *Everyone needs technology.*
4. *Technology only pollutes the environment.*
5. *If we have a water supply, we do not need to collect rainwater.*

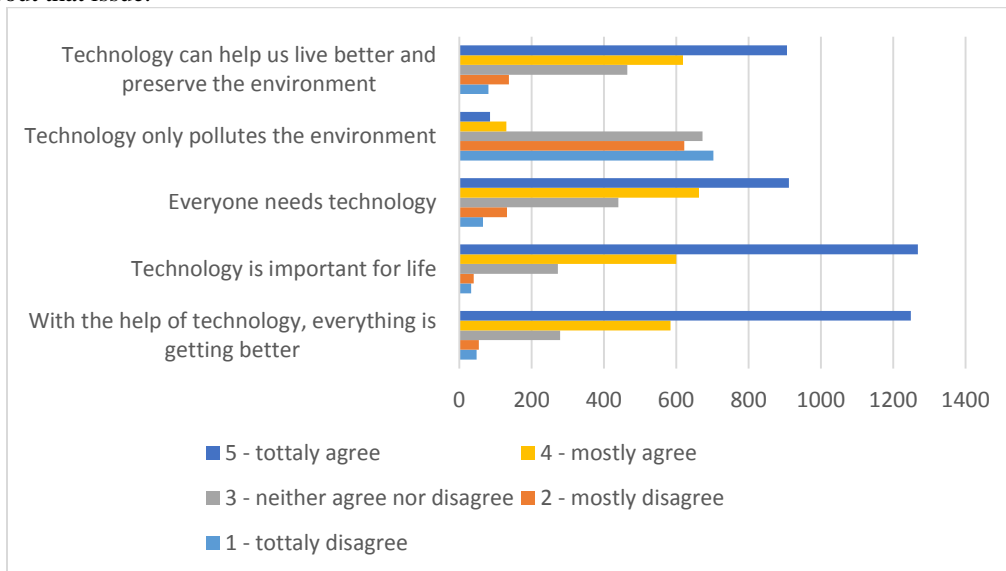
6. *In Croatia, more hotels, marinas, golf courses, and ports should be built.*
7. *Different things and food should be produced in Croatia.*
8. *We need to learn how to grow food in the garden or on the balcony.*
9. *We should learn how people used to live in our place, what they did and how they built.*
10. *Our environment is better if we have fewer meadows, forests, and domestic animals because they attract insects.*
11. *All waste should be incinerated or buried so that it does not stink.*
12. *Technology can help us live better and preserve the environment.*

Statements with which pupils expressed a level of agreement were written so that they could better understand them. At the same time, the statements intended to reflect understanding and awareness of important issues of ecology and sustainable development in the Croatian context. Statements 1, 2, 3, 4, and 12 present general view on technology and the interconnectedness of technology with issues of ecology and sustainable development. Statement 5 indirectly examines pupils' awareness of the importance of water conservation and water resources management. Statement 6 indirectly examines pupils' awareness of the conservation of the sea and coastal area as important strategic resources of Croatia. Statement 7 sought to examine awareness of the importance of preserving our own production of various products and food. Statement 8 examines the understanding of self-sustainability regarding the cultivation and production of food in one's own life-space. Statement 9 examines the understanding and importance of one's own learning about the traditional way of life and building, as a segment of sustainability that is gaining in importance. Statement 10 examines students' awareness of nature conservation and sustainable livestock. Statement 11 indirectly examines pupils' awareness of the importance of waste management.

After data collection, statistical processing and analysis of research results were performed, which are preliminarily presented in this paper. The results were processed by descriptive statistics procedures and qualitative analysis of each item was performed.

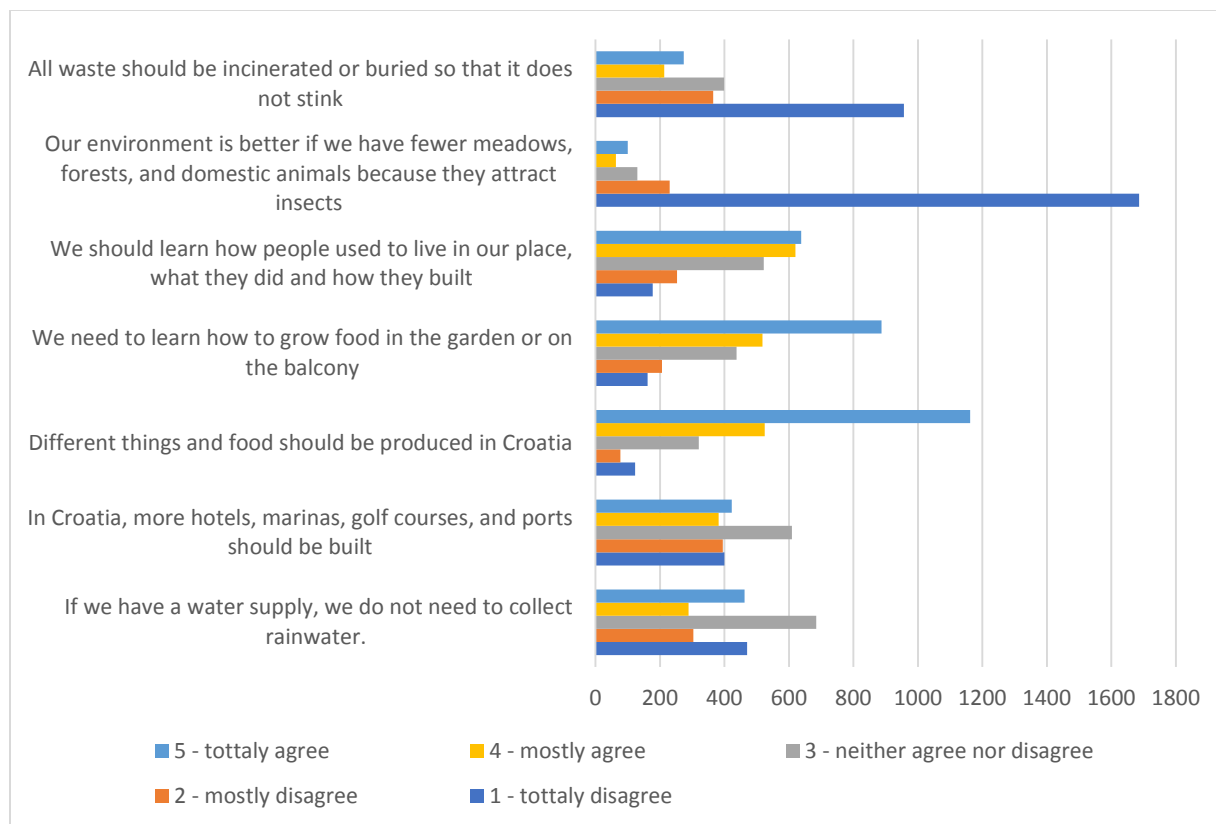
### 3. RESULTS

From the pupils' answers to the items 1, 2, 3, 4, and 12 (Figure 1), which refer to the general pupil's perception of the role and importance of technology for life and work, it can be seen that pupils are generally positive about first three issues. Thus, they completely or mostly agree that technology makes working better (82.08%), that technology is important for life (83.65%), and that everyone needs technology (70.53%). The majority of pupils (59.33%) generally or completely disagree with the statement that technology only pollutes the environment. However, a large proportion of pupils (30.14%) do not have an opinion on this, while 9.63% of pupils agree that technology only pollutes the environment. When it comes to the statement that technology can help us live better and preserve the environment, 68.29% of pupils generally or completely agree with this statement. But 9.77% of them mostly or completely disagree with that, and as many as 20.82% do not know, that is, and they do not have a clearly expressed opinion about that issue.



**Figure 1** Pupils' general views on technology and the interconnectedness of technology with issues of ecology and sustainable development

Pupil responses to selected statements related to environmental and sustainable development issues presented in Figure 2. Regarding the statement that "If we have water supply, we should not collect rainwater", which reflects the awareness of water resources management, as many as 33.63% of pupils generally or completely agree. Although 34.62% of students generally or completely disagree with this statement, as many as 30.68% do not know what to answer to this statement. When it comes to the statement "More hotels, marinas, golf courses, and ports should be built in Croatia", 36.05% of students generally or completely agree with this statement, and 35.60% of them completely and mostly disagree with the statement. At the same time, 27.27% of pupils neither agree nor disagree, that is, they do not have an expressed opinion about it. In the seventh item, 75.55% of pupils mostly or completely agree with the statement that different things and food should be producing in Croatia. However, 8.96% of pupils completely or mostly disagree with this statement, while 14.33% of them are indifferent, i.e. they do not have an opinion or do not know what to answer. When it comes to the statement "We need to learn how to grow food in the garden or on the balcony", as many as 62.92% of pupils generally or completely agree with this statement. Despite this, 16.44% of them generally or completely disagree with this statement, and 19.57% of pupils do not have a strong opinion on this issue. From the agreement of pupils with the statement that they should learn in school how people used to live, work and build in their places, it can be seen that 56.34% of pupils generally or completely agree with this statement. At the same time, 19.26% of pupils generally or completely disagree with this, and as many as 23.38% do not know what to answer or do not have an opinion on this issue. When it comes to a general understanding of the natural environment 85.80% of pupils generally or completely disagree with the statement "Our environment is better if we have fewer meadows, forests and domestic animals because they attract insects". Only 7.22% of pupils generally or completely agree with this statement, and only 5.82% of them do not have an opinion on this issue. Regarding the statement that all waste needs to be buried or incinerated in order not to stink, 59.21% of students generally or completely disagree with it. Nevertheless, 21.28% of pupils completely or mostly agree with this statement, and 17.87% of them do not have a clear position about this issue.



**Figure 2** Pupils' answers on selected environmental and sustainable development issues

#### 4. DISCUSSIONS

The presented results clearly shows that pupils' understanding about technology, ecology, and sustainable development are acceptable in some general aspects, i.e. that pupil perceive the general importance and role of technology as it is today. When it comes to general understanding and awareness of pupils towards the role and importance of technology, importance for life and importance for each individual, the pupils' responses show that a large proportion of pupils (70-80%) accepts technology from the point of view of social and individual importance. These findings support the thesis that pupils during school, but also under the influence of the environment, generally accept the importance and significance of technology for them personally and for society. They also accept the fact that technology can ensure a better life and preserve the environment. However, when pupils are not directly asked about the stated importance and interdependence, there is a significant departure from acceptable answers, but also inconsistency of answers and a high level of uncertainty (lack of clear opinion). When it comes to the perception of technology, only as something that pollutes the environment, convincingly the largest share of pupils does not have a clear opinion about it (more than 30%), despite the high share of acceptable answers of pupils. The situation is similar to the water-related statement, which actually represents the pupil's perception of the importance of water management. The high dispersion of pupils' answers on this issue and more than 30% of the share of those pupils, who do not have a clear position, indicates a lack of knowledge on water management, which is today an important issue of human survival. A similar dispersion of pupils' answers can be seen for the item related to the construction of hotels, marinas, golf courses, and ports. Namely, this issue reflects the awareness of the importance of coastal zone management and conservation, as an important strategic resource of Croatia, which has been quite devastated in the last two decades. The high share of pupils who do not have an opinion on this issue (almost 30%) and the equal share of those who agree and those who disagree clearly shows that pupils are not sufficiently aware of the importance of the resource on which they may depend in the future. In terms of awareness towards production, as a guarantor of a country's economic stability, the views of pupils are overwhelmingly acceptable. However, it is worrying that almost a fifth of pupils either do not have an opinion on this issue or have an unacceptable answer. Given the transition processes in Croatia in the last 30 years, this is a kind of progress. Which means that the social importance of technology and production is gradually stabilizing in the consciousness of the population. Pupils' understanding and awareness towards their own food cultivation and learning about it are largely acceptable. This theme reflects individuals' awareness of the importance of their own food production as a guarantor of sustainability in the future. However, although more than 60% of pupils think acceptably about this issue, there is still a large proportion of those who do not consider it important or do not have a clear opinion about that (almost 40% of pupils). This indicator supports the fact that food technology and the importance of cultivation for the sustainability and self-sustainability of society should be more intensively included in the teaching process. Pupils' awareness about learning and teaching the traditional way of life and building show that pupils have surprisingly positive and acceptable opinions towards this issue. Namely, the traditional way of living, resource management, and construction of facilities has proven to be an important element of sustainability of many micro-locations around the world, especially in developed countries. After the devastating hyper-industrial period, many countries have adopted some new technologies, but also ways of living and building, thus giving new value to their areas and significantly improving the quality of life. Despite a generally accepted understanding on this issue, it was observed that almost half of the students stated that this should not be taught in school or does not have a clear position on this issue. When it comes to pupils' awareness towards nature (meadows, forests, domestic animals), the acceptable answers are mostly recorded here. This is probably the product of the universal and permanent action of all factors of society on the awareness of the population about nature conservation, and less the consequences of schooling. When it comes to understanding towards waste management, as an important segment of sustainability, about half of pupils have acceptable opinions on this issue. It is worrying that more than 20% of pupils do not have an acceptable answer, and a significant part of them (about 18%) do not have a clear opinion about it. This indicator supports the thesis that the importance of waste as a resource and the technology of its disposal insufficiently taught during schooling or that teaching realized at a level that does not sufficiently affect the consciousness of students. When it comes to pupils' perceptions of the relationship between technology and environmental issues and sustainable development, pupils' answers are mostly acceptable. This means that most pupils understand technology as something that can help preserve the environment while ensuring a better life. However, such an opinion not shared by a third of students, including more than 20% of those who do not have a clear opinion on this issue. This finding indicates a still insufficient understanding of technology as something that can affect the preservation of the environment and improve the quality of life. It is evident that pupils do not gain insight into modern technologies during the schooling process, so they do not have sufficient knowledge on this issue.

## 5. CONCLUSIONS

The results of the research show that primary school pupils in Croatia have acceptable understanding and awareness only towards general issues of ecology, sustainable development, and the interdependence of technology with these issues. These are mostly general issues of the importance of technology, the production of things and food, and the preservation of the natural environment. Although acceptable awareness towards general and well-known issues are partly a product of schooling, we believe that they are largely a reflection of the influence of various external factors (family, environment, media, etc.). In contrast to such general issues, a high proportion of unacceptable awareness and unclear opinions were found on issues related to water management, marine and coastal conservation, and waste management, awareness towards traditional construction and living, but also technology as an important part of sustainability. Such findings clearly show that pupils do not have insight into important issues of ecology and sustainability during schooling, nor into technologies that can ensure the sustainability of society and the economy. All of the above shows that technology education in Croatia in general and compulsory education is insufficient because students do not have acceptable views on all issues of ecology and sustainable development that require a deeper knowledge of the subject. Given the importance of developing students' awareness of the environment, but also knowledge related to technologies that will ensure the sustainability of society, it is certain that in Croatia there is no transformative education. Therefore, it is clear that students will not develop the desired environmental literacy if technological education is not more intensively included in general education. Therefore, it is necessary to include the contents and activities in this area more intensively in the curriculum of general and compulsory education, and thus to develop the desired action competencies of students. Otherwise, everything will be reduced to pupils' "ecological indoctrination", without understanding the importance of these issues, but also without perspectives that will ensure the successful development and life of students as future citizens that will ensure the socio-ecological sustainability of society.

## REFERENCES

- Aguayo, C. & Eames, C. (2017). Promoting community socio-ecological sustainability through technology: A case study from Chile. *Int Rev Educ* (2017) 63:871–895, <https://doi.org/10.1007/s11159-017-9685-7>
- Ajduković, M., Kolesarić, V., Ručević, S., Šverko, I., Vejmelka, L. & Jukić, R. (2019). Revizija etičkog kodeksa istraživanja s djecom: ravnoteža između potreba djece, roditelja, istraživača i psihologa praktičara. U: Šincek, D., Rudolfi, N. & Penezić, Z. (ur.), 27. godišnja konferencija hrvatskih psihologa Psihologija i digitalni svijet - Sažetci priopćenja.
- Armstrong, J. (2005). En'owkin: Decision making as if the sustainability mattered. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 11–17). San Francisco: Sierra Club Books.
- Barlow, Z., & Stone, M. (2005). Introduction. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 1–8). San Francisco: Sierra Club Books.
- Capra, F. (2005). Speaking nature's language: Principles for sustainability. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world*. (pp. 18–29). San Francisco: Sierra Club Books.
- Huckle, J., & Sterling, S. (1996). *Education for sustainability*. London: Earthscan Publications.
- Huckle, J. & Wals, Arjen E. J. (2015). The UN Decade of Education for Sustainable Development: business as usual in the end. *Environmental Education Research*, 21(3), 491-505, DOI: 10.1080/13504622.2015.1011084
- Jensen, B. B., & Schnack, K. (1997). The action competence approach in environmental education. *Environmental Education Research*, 3(2), 163–178.
- MZO (2019). Odluka o donošenju kurikulumu za međupredmetnu temu Održivi razvoj za osnovne i srednje škole u Republici Hrvatskoj (NN 7/2019). [https://narodne-novine.nn.hr/clanci/sluzbeni/2019\\_01\\_7\\_152.html](https://narodne-novine.nn.hr/clanci/sluzbeni/2019_01_7_152.html)
- Nicolaou, C., Korfiatis, K., Evagorou, M., & Constantinou, C. (2009). Development of decisionmaking skills and environmental concern through computer-based, scaffolded learning activities. *Environmental Education Research*, 15(1), 39–54.
- Orr, D. (2004). *Earth in mind: On education, environment, and the human prospect (10th anniversary edn)*. Washington, DC: Island Press.
- Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *Int J Technol Des Educ* (2013) 23:733–748, DOI: 10.1007/s10798-012-9213-9
- Purković, D. & Kovačević, S. (2020) Teachers' perception of the influence of the teaching context on cognitive achievements in general technology education. *International journal of cognitive research in science, engineering and education*, 8 (Special issue), 1-15 doi:10.23947/2334-8496-2020-8-SI-1-15

- Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, & J. Foley (2009). Planetary boundaries:exploring the safe operating space for humanity. *Ecology and Society*, 14(2): 32. <http://www.ecologyandsociety.org/vol14/iss2/art32>
- Tilbury, D., & Wortman, D. (2008). How is community education contributing to sustainability in practice? *Applied Environmental Education and Communication*, 7(3), 83–93.
- UNESCO (2005). *United Nations decade of education for sustainable development 2005–2014*. Paris: UNESCO Education Sector: International implementation scheme.
- UNESCO. (2009). Bonn Declaration on Education for Sustainable Development. UNESCO World Conference on Education for Sustainable Development, Bonn, Germany. Bonn: German Commission for UNESCO.
- UNESCO-DESD (2014). *Shaping the Future We Want: UN Decade of Education for Sustainable Development (2005-2014) – FINAL REPORT*. <https://unesdoc.unesco.org/ark:/48223/pf0000230171>