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Attitudes of Croatian Pupils on the relationship of Environmental Issues and Sustainable Development with Technology and Engineering

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Abstract
Education for Sustainable Development (ESD) is becoming an important part of general education, based on a concept that includes three components: Environmental, Social and Economic. The sustainable development curriculum in Croatia is based on this concept, and activities in this area are mainly limited to environmental protection and ecological activities. At the same time, the technological and political context needed to take the right action and develop critical thinking and a systemic approach is lacking. In this context, a survey on pupils' attitudes towards the relationship between technology and engineering with the themes of ecology and sustainable development was conducted to investigate the impact of this curriculum on students' awareness. The research was conducted on a stratified sample of primary school pupils ($N=2205$) from Croatia. The results show that pupils view technology as important for life and progress, but do not understand how it relates to sustainable development and environmental issues. This refers to issues of water conservation, construction of facilities, waste disposal, and understanding technology only as pollution. These results point to the need for "deeper" and transformative technology teaching that takes place in a real-world context. Only in this way can students understand the concept and meaning of sustainable development and the role and importance of technology in this context, and be educated to be responsible citizens.

Keywords Ecology · Education for sustainable development · General education · Technology and engineering education · Technical culture

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Introduction

For more than a decade, education for sustainable development has been trying to move from an idealistic approach to an education for sustainable citizenship approach, which is a more realistic approach to change in terms of sustainability and sustainable development (Huckle & Wals, 2015). Indeed, the longstanding efforts of UN and other international organizations to integrate the values of sustainability and sustainable development into all aspects of learning (UNESCO, 2005; UNESCO, 2009; UNESCO, 2012; UNESCO-DESD, 2014) have not mitigated the influences that do little to promote these values at the global community level. In other words, insufficient guidelines, false idealism and censorship of critical ideas and content (Huckle & Wals, 2015) have led to the need to focus education for sustainable development on local communities (states, regions) as the only way to resist global corporate interests. False idealism here refers to propagated ideal conditions and procedures that hide the interests of certain groups or companies and the long-term damage to the environment and sustainability. Such an approach requires the renewal of so-called civic pedagogy (Laker et al., 2014), which should train people to think critically about political, environmental, economic and social issues of sustainability and sustainable development. This is also seen as an issue of human and community rights to actual or simulated participation and decision-making on these issues (Huckle & Wals, 2015). Sustainability education should be inclusive and interdisciplinary, providing students with observational skills, critical thinking skills, creativity, adaptability, skills for living well where they live, and tools for building healthy and resilient communities (Robertson, 2017). However, without real knowledge about sustainable technologies and technological-ecological and energy problems of today, it is not possible to really understand the problem or to develop critical thinking. Indeed, the development of critical thinking in younger generations and criticism through "ecological indoctrination" have nothing to do with each other. Under the term "ecological indoctrination" we summarized here various influences that radically shape the consciousness of the younger generations in the direction that considers any technology a priori as a danger to people and the environment. Such ecologically indoctrinated individuals do not really understand the important issues and problems of sustainability and are easy prey for corporate and neoliberal interests because they easily accept the 'greening the capitalist exit from the crisis' (Huckle & Wals, 2015). This favor shifting responsibility to business rather than changing current patterns of production, consumption and distribution in the interests of greater environmental and social justice. In this sense, ecopedagogy (Kahn, 2010; Laker et al., 2014; Misiaszek, 2017) also does not predict the development of knowledge through which the student could understand the background processes important for sustainability and sustainable development. Thus, Global Education for Sustainable Citizenship (GESC) taught through ecopedagogy includes a scale dimension - insight into global society and mechanisms of action, an ethical dimension - sustainability as a normative concept, a relational dimension - social construction of sustainability, and a political dimension - issues of social and societal justice (Huckle & Wals, 2015). Nowhere is there any mention of the dimensions necessary to understand the actual cause-and-effect processes of human activities that have caused the current state of planet Earth, and those are the scientific and technological dimensions. Without including these dimensions, it is also not possible to find acceptable solutions to the problems of sustainability and sustainable development. With this in mind, the question is what technology education should be

and whether a unique approach can be applied to each country or community. Indeed, the approach to learning for sustainable development is not only the development of environmental literacy (Orr, 1992) and critical thinking (Huckle, 1993), but necessarily includes the action skills needed to implement change (Jensen & Schnack, 1997; Jensen, 2002). Education for sustainable development should thus be much more than the development of environmental awareness (Tilbury & Wortman, 2008; Aguayo & Eames, 2017) and consider the environmental, social and political context of cause and effect. Since technology and science form the basis for understanding changes in the environment, this means that technology education should also include these components. This means that technology education should be transformative (Pavlova, 2011) and based on contextualized approaches (Pavlova, 2013; Purković and Kovačević, 2021) to achieve transformative change towards environmental sustainability (Sterling, 2001; Raäthzel and Uzzell; 2009; Aguayo & Eames 2017). Therefore, this education should focus on actions that lead to a real improvement in socio-ecological problems and that are undertaken consciously and critically. The problem should always be approached systematically so that the individual can see the problem as a whole and understand and act upon the meaning and interrelationships of the individual elements of that whole. This requires an understanding of the whole system, but also an understanding of how things are connected (Sterling, 2001; Armstrong, 2005; Capra, 2005; Orr, 2014), that is, the development of systems thinking. Technology and its social necessity and justification are part of the whole system, which means that systems thinking cannot be developed without an education that includes it. For example, needs and technologies related to energy, production, food technology, waste management, water management, construction and housing, coastal zone and marine management, etc. are just some of the issues whose understanding, along with the social, economic and political context, is important for developing systems thinking and action skills. It follows that social learning, where communities co-create solutions to locally based problems, is a key factor in the transformation towards sustainability (Aguayo & Eames, 2017).

Education for sustainable development in Croatia

Accelerated destruction of the natural environment, population growth and associated increasing needs, and scientific advances that have provided explanations and solutions have led to the previously described guidelines and recommendations for Education for Sustainable Development (ESD). This has led many countries around the world to incorporate elements of sustainability, environmental education, and sustainable development into the curricula of general, compulsory and secondary education. In Croatia, ESD implemented in all primary and secondary schools, and applied activities, programs and projects related to achieving the goals of ESD exist in regular and supplementary work, extracurricular activities and projects (UNESCO-DESD, 2014). Since 2019, the educational reform has introduced a curriculum of the cross-curricular theme "Sustainable Development" (MZO, 2019) in the school system, which is to consider the social, economic and environmental aspects of sustainability and sustainable development. This curriculum is based on three domains: Connectivity, Action, and Wellbeing. Connectivity is considered here in the context of ecosystems, Action in a very general and vague sense as a philosophical need of human beings, while Wellbeing is related to the teaching of "new" economic models and the satisfaction of needs at a very general level. General learning outcomes and recommenda-

tions for their implementation have been developed for each area and grade. According to these recommendations, subjects in which technology and engineering (Croatian: *technics*) are taught are rarely listed, so they are obviously not considered important. In primary education, it is the subject of Technical Culture, while certain technological contents are also taught in the subjects: Informatics, Physics, Chemistry and Biology. In secondary education (gymnasium), there are no subjects of technical (engineering) content, and thus no direct teaching of technology (except information and communication technology). Subjects related to technology (technical) education, in fact, should be a major player in the implementation of this curriculum, and they are insufficiently represented in the curriculum of primary education for the implementation of more complex activities (Purković et al., 2020). In these subjects, there are individual topics related to ecology and the development of environmental literacy, but the whole system does not work as a whole. The curriculum stipulates that the learning outcomes be integrated in all subjects and the school curriculum, and that the time required for teaching them be made available. At the same time, it is not clear how this time can be provided without compromising the integrity of existing subjects and the prescribed organization of instruction. The curriculum further states that "teaching days without bells," project days or weeks, extracurricular activities, and instructional hours are important to achieving the goals and expectations from this curriculum (MZO, 2019). This means that the activities from this curriculum can be performed mainly outside the time provided for regular classes and are primarily left to the enthusiasm and preferences of the teacher or individual school. Therefore, these lessons are usually realized through environmental and similar student activities that should be included in the school curriculum at the beginning of the year and are carried out by teachers of several subjects during project days or school projects. In these activities, students are not co-creators, but merely performers of something they often enjoy without understanding the true purpose of the activity or the cause-and-effect relationships behind it. One of the reasons is that these activities have nothing to do with the real issues of sustainability and sustainable development of the local community, so students lack a deeper understanding of these issues and problems. Another reason is the deliberate lack of a technical (engineering) and technological component that is often behind most sustainability issues. The third reason is the lack of competent teachers (Purković, 2015; Raditya-Ležaić et al., 2018) and those who are not considered capable of implementing education for sustainable development (Vukobratović & Rončević, 2020). These teachers often do not understand the background of environmental problems and sustainability, so sustainability in Croatia is mainly considered from the perspective of nature conservation and cultural sustainability (linguistic, traditional, etc.) and less from the perspective of economic and existential sustainability. At the same time, there is a lack of systematic teacher training and professional community support when it comes to education for sustainability and sustainable development in the local Croatian context.

Guided by such a reform pedagogical orientation, which has been intensively implemented in Croatia since 2015, we decided to investigate the attitudes of elementary school pupils towards selected statements that reflect their awareness of environmental issues and sustainable development issues. At the same time, we investigated pupils' attitudes towards technology and engineering, as well as towards the teaching of the Technical Culture. In this way, we were able to investigate the possible relationship between these lessons and students' attitudes toward sustainable development issues. In this sense, the main objective of the research was to investigate the attitudes of primary school pupils towards selected

environmental and sustainable development issues specific to the Croatian environmental, social, cultural and economic context. The secondary aim of the research is essentially to support and reject the thesis that a true understanding of sustainability and sustainable development is not possible without a deeper knowledge of the scientific and technological aspects of cause-and-effect change that are important for successfully solving environmental and sustainable development problems. Thus, the focus of this study is on students' attitudes toward selected environmental issues and sustainable development issues that require a certain technological knowledge to be systematically understood of these issues. Although student attitudes also depend on socioeconomic background, parental interest, and other factors (Davies & Brember, 2001; Lindahl, 2003; Ardies et al., 2015), and students often have limited understanding of the nature of technology (Chikasanda et al., 2011), attitudes can also be an indicator of the impact of schooling on students. This indicator is important in terms of curriculum interventions that can contribute to more successful education.

Methods

The research was conducted as a survey of student attitudes toward selected environmental and sustainable development issues as part of a larger project to explore student preferences toward technology and sustainable development. The instrument developed for the research needs of this project is an extension of the PATT-SQ (*Pupils' Attitudes Towards Technology – Short Questionnaire*) test (Ardies et al., 2013), which primarily examines students' preferences for technology. Items were added that relate specifically to the understanding of sustainability and sustainable development issues in the Croatian context. The items related to sustainability and sustainable development issues were selected to cover the most important strategic issues and sustainability topics in Croatia: waste management, protection of water resources and coastal areas, spatial planning, sustainable production and agriculture (Matešić, 2009) and the role of the importance of technology in this process. The expressions of the questionnaire were formulated in cooperation with primary school teachers in order to better understand Croatian pupils. The data were collected by instructed teachers of the subject Technical Culture, that being only subject that directly teaches technology in a broader sense and develops technological and engineering skills in primary school in Croatia. Data were collected mainly through online questionnaires, where anonymity of students was ensured, and the research was conducted in accordance with the Ethical Code for Research with Children in Croatia (Ajduković & Kolesarić, 2003). In the early stages of the research, validation of the instrument and its correction were carried out, and only part of it was used here. The collected data were processed using a descriptive statistical procedure, the reliability of the questionnaire was examined using factor analysis, while the significance of the differences was determined using the MANOVA and ANOVA statistical procedures.

Problems, aims, and hypothesis

The research problem is essentially the research question *"What are the attitudes of primary school students in Croatia toward statements reflecting the most important problems and issues of ecology and sustainable development, and how do they relate to attitudes*

toward technology and engineering (technical) education?" Namely, with the education reform, the objectives related to education for sustainable citizenship were also adopted at the declarative level. However, operationalizing such goals requires certain activities, but also changes in the content structure of the curriculum and the approaches and methods of learning and teaching, which is actually a very problematic area of any education. Since the results of such changes are best reflected in the attitudes and awareness of students, this study focuses precisely on the problem of students' attitudes and beliefs as individuals. An individual's attitudes and beliefs as a whole represent his or her personal understandings, beliefs, values, judgments, opinions, cognitions, prejudices, perceptions, preferences, personal theories, and similar constructs about a particular reality, and they are scientifically relevant only if they are the product of cognition and experience in that reality (Purković & Kovačević, 2020). Since education is an important source of such knowledge and experience, it is clear that students' attitudes and beliefs can be an important indicator of the current state of education and indicate the direction in which it should be improved.

The aim of the research is to determine pupils' attitudes towards environmental and sustainable development issues and their attitudes towards the relationship between these issues and technology and engineering. With this in mind, the following research hypotheses were formulated:

Hg - Pupils have "acceptable attitudes" toward the general aspects of ecology and sustainable development and their relationship to technology and engineering:

H1 - Pupils have clearly defined "positive" attitudes towards the importance of the content of the subject Technical Culture in relation to ecology and sustainable development.

H2 - Pupils have an "acceptable" awareness of the importance of environmental protection, waste management and marine and coastal conservation.

H3 - Pupils have a "positive" attitude towards the principle of self-sufficiency.

H4 - There are no statistically significant differences in the attitudes of girls and boys in their perceptions of ecology and sustainable development and their relationship with technology and engineering.

H5 - There are no statistically significant differences in the perceptions of ecology and sustainable development and their connection with technology and engineering, considering the age of the students.

The terms "acceptable" and "positive" student attitudes here mean that these attitudes reflect generally accepted values, both in the context of local (Croatian) and in the context of global goals and policies on these issues. These goals, policies, and strategies are mentioned in the preceding chapters. This also applies to the students' awareness of these issues, as indicated by their agreement or disagreement with the selected statements.

Sample

The research was conducted on the target population of pupils aged 11 to 15 years i.e. from 5th to 8th grade of primary school. A total of 2205 pupils from the entire territory of the Republic of Croatia participated in the research, of which 1135 were girls and 1070 were boys. The structure of the sample by classes is presented in Table 1.

It can be seen from the table that the representation of the respondents, in terms of the class they attended, is almost uniform. According to Croatian Bureau of Statistics, at the beginning of the school year 2019/2020 in the Republic of Croatia there were a total of

Table 1 Sample structure of respondents by class

Class (age)	*f*	*%*
5.	521	23,6
6.	545	24,7
7.	564	25,6
8.	573	26,7
Sum	*2203*	*100%*

156,586 pupils from 5th to 8th grade (Croatian Bureau of Statistics (2020). It follows that the sample of respondents included here represents 1.4% of the total population of 5th-8th grade pupils.

Instrument

A specially constructed PUTTOR (*Pupils' preferences towards technology and sustainable development)* instrument was used to investigate pupils' attitudes, which was implemented in electronic form. In selecting and developing the instrument used in this research, the authors considered the following: (1) specific features and pressures on Croatian environment and its natural resources (e.g. waste, water, land use changes and coastal development for tourism purposes, nautical tourism infrastructure), self-sufficiency in food production, (2) potential interactions between society and school surroundings as well as the role of relevant sectors, and (3) their articulation in statements comprehensible to children. Based on that a series of statements were defined, always keeping in mind that their number should not be excessive and that they should arouse certain interest in children who hear about the concepts and expressions used from the media as well. In collaboration with teachers and pupils, the terms used in the statements that pupils understand were previously explored. The terms have been translated into English here so that they best reflect their meaning from the Croatian language. The questionnaire contains 15 variables in the form of statements that students could agree with on a Likert scale from 1 - *I strongly disagree* to 5 - *I strongly agree*. The 5-point Likert scale was chosen to better compare the results with those of previous research on students' preferences toward technology (Suman & Purković, 2018; Purković et al., 2020). The scale was also chosen to allow students to complete the questionnaire more intuitively; as such, a scale is used in Croatia to assess student performance. Although such a scale also entails a trap of the mean ("undecided") value, this indicator is also very meaningful and often indicates a complete lack of understanding of the problem. Therefore, such responses can provide valuable information about students' attitudes, as well as knowledge. The variables by which pupils represented their agreement were:

1. *Everything works better with the help of technology and engineering (POTIT)*,
2. *Technology and engineering are important for life (TITVA)*,
3. *Everyone needs technology and engineering (TITS)*,
4. *Technology and engineering only pollute the environment (TITOK)*,
5. *If we have water supply, we don't need to collect rain water (VOKIS)*,
6. *More hotels, marinas, golf courses and harbors should be built in Croatia (GRATU)*,
7. *Different things and food should be produced in Croatia (PRODO)*,
8. *We must learn how to grow food in the garden or on the balcony (UZGHR)*,

9. *In school we learn how people used to live in our place, what people did and how they built (POUZI)*,
10. *Our environment is better if we have less meadows, woods and domestic animals because they attract insects (ZIOKR)*,
11. *All waste should be burned or buried so that it doesn't stink (ZBROT)*,
12. *Technology can help us live better and preserve the environment (TITEK)*,
13. *We always do what is useful and important for us (PRAKT)*,
14. *Teaching of Technical Culture is important for life (VAZTK)*,
15. *We often talk about how something works and how it is made (RAZTK).*

The statements to which pupils expressed their own agreement or disagreement reflect attitudes toward important issues in technology, engineering, ecology, and sustainable development. Thus, statements 1, 2, 3, 4 and 12 represent general attitudes towards technology and the interrelationship with issues of ecology and sustainable development. With the help of statements 9, 13, 14 and 15 we wanted to determine the students' attitudes towards the content structure of the Technical Culture, its meaning, applicability, relevance, but also towards the traditional way of living and building, as a segment of sustainability that is gaining in importance. Statements 5, 6, 10 and 11 indirectly explore awareness of the importance of water conservation and management, nature protection and the importance of responsible waste management, protection of the sea and the coastal zone as important strategic resources. Statements 7 and 8 aimed to explore students' awareness of the importance of sustainable production of various commodities and foods in the country.

The reliability test of the internal consistency of the items of the PUTTOR questionnaire was performed by calculating the Cronbach's alpha coefficient of 0.718, which is at a satisfactory level. To determine construct validity, factor analysis was conducted using the principal component method. Preliminary analyzes indicated the adequacy of the data for performing factorization ($KMO=0.811$; $\chi 2=5832$; $p=0.00$). Considering the Guttman-Kaiser (GK) criterion of extracting factors whose eigenvalues are greater than 1, a four-component solution was obtained explaining 49.8% of the total variance. Of this proportion, 17.8% of the variance was explained by the first, 13% by the second, 10.4% by the third, and 8.6% by the fourth component. The orthogonal varimax factor rotation procedure yielded a simple factor structure in which each individual variable correlated with only one factor. The factor structure after rotation is shown in Table 2.

Table 2 shows that the first component consists of variables that represent, in the manifest space, pupils' general attitudes towards technology and its relationship with issues of ecology and sustainable development, therefore it is a factor of general attitudes.

The second component is a pure linear combination of variables that determine students' attitudes towards the content structure of the subject Technical Culture, its meaning and relevance in the context of sustainable development. Therefore, the second component is referred to as the content determinant. The variables extracted in the third component are related to pupils' environmental awareness, and the third factor is called the environmental awareness factor. The fourth component consists of two variables that, in their original form, maintain pupils' attitudes towards sustainable development, i.e. it is a factor of self-sufficiency.

Table 2 Rotated factor structure of *PUTTOR* questionnaire items

Variable	*Component*			
	1	***2***	***3***	***4***
Technology and engineering are important for life (TITVA)	0,774	0,231	0,033	0,147
Everything works better with the help of technology and engineering (POTIT)	0,704	0,161	-0,018	0,109
Everyone needs technology and engineering (TITS)	0,691	0,287	0,002	0,149
Technology can help us live better and preserve the environment (TITEK)	0,561	0,233	0,050	0,151
Technology and engineering only pollute the environment (TITOK)	0,465	-0,175	0,055	-0,131
We always do what is useful and important for us (PRAKT)	0,357	0,692	-0,012	-0,112
In school we learn how people used to live in our place, what people did and how they built (POUZI)	0,025	0,670	-0,053	0,099
Teaching of Technical Culture is important for life (VAZTK)	0,503	0,548	0,063	-0,100
We often talk about how something works and how it is made (RAZTK)	0,212	0,499	-0,088	0,238
More hotels, marinas, golf courses and harbors should be built in Croatia (GRATU	-0,201	0,188	0,646	-0,132
All waste should be burned or buried so that it doesn't stink (ZBROT)	0,092	-0,153	0,626	0,021
Our environment is better if we have less meadows, woods and domestic animals because they attract insects (ZIOKR)	0,206	-0,180	0,581	0,119
If we have water supply, we don't need to collect rain water (VOKIS)	0,001	0,044	0,575	-0,004
Different things and food should be produced in Croatia (PRODO)	0,229	-0,108	-0,133	0,765
We must learn how to grow food in the garden or on the balcony (UZGHR)	-0,035	0,347	0,206	0,698

Given the factor structure found, which is fully consistent with the theoretical concept of sets of manifest variables and the phenomena they measure, it is appropriate to conclude that the construct validity of the PUTTOR questionnaire is satisfactory.

Results

The collected results on the variables characterizing the factor general attitudes were subjected to descriptive analysis. The frequencies and relative percentages of each statement collected on each of the manifest variables are presented in Table 3. From the results of pupils' responses to the first three items, which relate to general perceptions of the role and importance of technology in life and work, it can be seen that pupils are generally positive about these issues. The statement that technology and engineering are important for life (TITVA) is generally or completely agreed by 84% of the pupils, 82.2% that everything works better with the help of technology (POTIT) and 70.8% that everyone needs technology and engineering (TITS). Summarizing the percentages recorded on the statements of

Table 3 Frequencies and relative percentages of variables of factor General attitudes of pupils

	Variables									
	TITVA		POTIT		TITS		TITEK		TITOK	
	SD	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*
	0,874	4,37	1,056	4,00	1,073	2,22	1,093	3,97	0,93	4,3
Agreements	***f***	***%***	***f***	***%***	***f***	***%***	***f***	***%***	***f***	***%***
I strongly disagree	32	1,5	45	2	65	2,9	79	3,6	695	31,5
I disagree	40	1,8	53	2,4	130	5,9	137	6,2	617	28,0
I neither agree nor disagree	271	12,3	278	12,6	438	19,9	462	21,0	669	30,3
I agree	595	27,0	581	26,3	659	29,9	614	27,8	128	5,8
I strongly agree	1256	57,0	1237	56,1	901	40,9	898	40,7	84	3,8
Missing	11	0,5	11	0,5	12	0,5	15	0,7	12	0,5
SUM	2205	100	2205	100	2205	100	2205	100	2205	100

disagreement and complete disagreement on these three variables, there is a relatively small interval of 3.3 to a maximum of 8.8%. However, the number of students who do not have a clear attitude towards the role and importance of technology and engineering in life and work should not be neglected. For example, 12.3% of the students are not sure about the importance of technology for life (TITVA), 12.6% are not sure about the importance of technology and engineering in work (POTIT), while even 19.9% of the students do not have a clear position on whether technology and engineering are needed by everyone (TITS). A total of 68.5% of pupils generally or completely agree with the statement that technology and engineering can help us live better and protect the environment (TITEK), 9.8% of them generally or completely disagree, and a full 20.82% have no clear position on this issue. As expected, the majority of pupils disagree or strongly disagree with the statement that technology only pollutes the environment (TITOK). The sum of the percentages of these two categories is 59.5%. However, 30.3% pupils do not have a clear opinion on this, while still 9.63% of the pupils mostly or completely agree that engineering and technology only pollute the environment.

Multivariate analysis of variance (MANOVA) was used to determine the significance of differences between pupil responses by gender and class. One-way multivariate analysis examined assumptions about the presence of differences in students' attitudes regarding general perceptions of the importance of technology, engineering, and ecology in relation to gender. Preliminary analyzes indicated homogeneity of the variance and covariance matrices (*Box M=38.556; p=0.001*), and Leven's test indicated that the variances were equal and no significant violation of the basic assumptions for performing MANOVA was found. Further analyzes revealed a statistically significant difference between boys' and girls' attitudes with respect to general attitudes [*F (5, 2019)=17.06; p=0.00*; *Wilks' Lambda=0.960*, $\eta_p^2=0.04$]. The analysis of the recorded results on each variable, considering the Bonferroni's adjustment of the value of $\alpha=0.01$, revealed that there was a statistically significant difference in the responses of boys and girls on the four variables. These are the variables: *Technology and engineering are important for life* (TITVA) [*F (1, 2023)=23.43, p=0.00;* $\eta_p^2=0.11$]; *Everything works better with the help of technology and engineering* (POTIT) [*F (1, 2023)=12.87, p=0.00,* $\eta_p^2=0.06$]; *Technology can help us live better and preserve the environment* (TITEK) [*F (1, 2023)=46.11, p=0.00,* $\eta_p^2=0.19$], and *Technology and engineering only pollute the environment* (TITOK) [*F (1, 2023)=59.12, p=0.00,* $\eta_p^2=0.26$]. However, examination of the partial eta squares on these variables suggests that the propor-

Table 4 Frequencies and relative percentages of variables of factor Content structure

	Variables							
	PRAKT		POUZI		VAZKT		RAZTK	
	SD	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*
	1,18	3,56	1,24	3,58	0,94	4,01	1,08	3,88
Agreements	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
I strongly disagree	145	6,6	175	7,9	43	2	88	4
I disagree	244	11,1	252	11,4	82	3,7	147	6,7
I neither agree nor disagree	616	28	516	23,4	450	20,4	453	20,6
I agree	608	27,6	614	27,9	864	39,2	746	33,9
I strongly agree	578	26,2	633	28,7	760	34,5	758	34,4
Missing	11	0,5	13	0,6	4	0,2	11	0,5
SUM	2203	100	2203	100	2203	100	2203	100

tion of variance in the dependent variable of general attitudes explained by the variable gender is small. The actual effect size with respect to gender ranges from 1.9% for the variable TITEK to a maximum of 6% for the variable POTIT. A review of the arithmetic means recorded on the measurement scales of the variables of the general attitudes of the pupils also showed that the variations in the responses, in relation to the gender of the pupils, were negligible.

Multivariate analysis of variance also examined assumptions about the existence of differences in students' general attitudes in relation to the grade attended, i.e., the age of the pupils. Preliminary analyzes determined homogeneity of the variance and covariance matrices (*Box M=63.92; p=0.35*), Levene's test determined that the variances were equal, and no barriers to performing the MANOVA were found. Based on the results of the multivariate analyzes conducted, no statistically significant difference was found between the students according to the dependent variables, considering that the age (class) of the pupils. Wilks Lambda did not reach statistical significance [*F (20, 7228)=2.39; p=0.00; Wilks' Lambda=0.960;* $\eta_p^2 = 0.05$], and it was stated that there is no statistically significant difference in students' attitudes about the general perception of the importance of technique, technology and ecology with respect to the class they attend.

The descriptive indicators of the variables that determine students' attitudes towards the content structure of Technical Culture, its meaning and relevance in the context of sustainable development are shown in Table 4. The frequency analyses and percentage agreement with the statements on the variables that determine pupils' attitudes towards the content structure of the subject Technical Culture and its meaning and relevance in the context of sustainable development recorded similar trends to the assessment of pupils' general attitudes towards technology and its relationship to environmental and sustainability issues. The majority of pupils (53.8%) agree or strongly agree with the statement that they always do what is useful and important to them in the subject Technical Culture (PRAKT). The sum of the percentage of pupils who disagree or strongly disagree with this statement is 17.7%, while 28% of pupils have no clear position. Similar results were recorded for the variable POUZI, which refers to the statement that pupils learn how people used to live in their place, what people did and how they built. 56.8% of the pupils agree or strongly agree with this statement, 23.4% have no clear position, while 19.3% of the pupils disagree or strongly disagree with this statement. It should be noted here that for the variables PRAKT and POUZI, by summing the frequencies and percentages of pupils who disagree, totally disagree, and

those who neither agree nor disagree, we obtain an almost equal ratio with those who agree and totally agree. Somewhat greater dispersion of frequencies and percentages in favor of those pupils who agree and totally agree were recorded for the variables VAZTK - *Teaching of Technical Culture is important for life* (73.7%) and RAZTK - *We often talk about how something works and how it is* (68.3%). The percentage of those who disagree or agree is 5.7% for the variable VAZTK and 10.7% for the variable RAZTK. The percentage of pupils who do not clearly agree is relatively large here and is 20.4% for the variable VAZTK and 20.6% for the variable RAZTK.

The significance of differences between students' attitudes towards the content structure of the subject Technical Culture, its importance and relevance in the context of sustainable development in relation to gender and grade level attended were investigated using the MANOVA procedure. When examining possible gender differences, preliminary tests confirmed the assumptions for conducting MANOVA (*Box M=23.36; p=0.35;* Leven's test determined equality of variance). The analysis revealed a statistically significant difference between boys' and girls' attitudes toward the content structure of the subject Technical Culture [$F\ (4, 2022)=14.87;\ p=0.00;$ *Wilks lambda=0.960;* $\eta_p^2=0.29$]. When further analyzing the dependent variables considering Bonferroni's alpha level, the only difference that reached statistical significance was recorded for the variable VAZTK [$F\ (1, 2025)=56.03,\ p=0.00,\ \eta_p^2=0.027$]. Examination of the mean scores revealed that boys (M=4.15, SD=0.859) considered the teaching of the subject Technical Culture to be more important in life than girls (M=3.84, SD=0.967).

When it was intended to conduct a multivariate analysis of variance to investigate statistically significant differences in pupils' attitudes towards the content structure of the subject Technical Culture and its importance in the context of sustainable development given the class they attended, the preliminary analysis revealed that the homogeneity of the variance and covariance matrices was disturbed. Therefore, four individual analyzes of variance (ANOVA) were conducted and all assumptions were met when they were performed.

A one-factor analysis of variance examined the influence of classes taken by students on their perceptions of the importance of technological culture to life (VAZTK). A statistically significant difference was found in the results of all four groups of classes (from 5 to 8) [$F\ (3, 2159)=15.5,\ p=0.00$]. By calculating the square of Eta, as the effect size, a value of 0.002 was obtained, suggesting that the actual difference is very small. Tukeys' post hoc HSD test showed that there was a statistically significant difference in arithmetic means in pupil attitudes between all grades. Examination of the arithmetic means revealed that the arithmetic means of pupil responses in fifth grade (M=4.23, SD=0.89) were statistically different from the arithmetic means of pupils in sixth grade (M=4.00, SD=0.864), seventh grade (M=3.96, 0.968), and eighth grade (M=3.86, SD=0.976). Although the actual difference is small, it is clear that in the upper grades there is a steady, linear decline in the intensity of acceptance of Technical Culture as a vital subject.

Using the statistical procedure ANOVA, a statistically significant difference was found between the fifth, sixth, seventh and eighth grade pupils in terms of attitude towards the statement represented by the variable PRAKT (*We always do what is useful and important for us*) [$F\ (3,2187)=18,99,\ p=0.00,\ \eta^2=0.025$]. So, the effect size is small in this case. Subsequent tests and cheques of the mean differences of all groups in the upper grades revealed a statistically significant decreasing tendency of agreement with the assertion that what is useful and important is always done in Technical Culture. The most marked significant dif-

Table 5 Frequencies and relative percentages of variables of factor Environmental awareness

	Variables							
	GRATU		ZBROT		ZIOKR		VOKIS	
	SD	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*
	1,18	3,56	1,24	3,58	0,94	4,01	1,08	3,88
Agreements	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
I strongly disagree	400	18,2	950	43,1	1674	76,0	466	21,2
I disagree	392	17,8	364	16,5	228	10,3	302	13,7
I neither agree nor disagree	604	27,4	395	17,9	129	5,9	681	30,9
I agree	376	17,1	211	9,6	61	2,8	286	13,0
I strongly agree	418	19,0	270	12,3	98	4,4	455	20,7
Missing	13	0,6	13	0,6	13	0,6	13	0,6
SUM	2203	100	2203	100	2203	100	2203	100

ference was found in the eighth-grade pupils as compared to all others. This is shown by the arithmetic means of M = 3.84, SD = 1.136 in the fifth grade; M = 3.59, SD = 1.114 in the sixth grade; M = 3.54, SD = 1.176 in the seventh grade; and M = 3.30, SD = 1.232 in the eighth grade. If one were to opt for the median rather than the arithmetic means for the measures of central tendencies, an undecided attitude would prevail in the eighth grade (median = 3), in contrast to the fifth, sixth, and seventh grade pupils, who are overwhelmingly committed to agreement (median = 4) that in the subject Technical Culture they always learn what is useful and important.

The results of the variable RAZTK, which refers to the content for understanding work and production processes, also showed a statistically significant difference in relation to the class that pupils attend [$F\ (3,\ 2188) = 21.857,\ p = 0.00,\ \eta^2 = 0.029$]. Post-hoc tests revealed a statistically significant difference in arithmetic mean responses between fifth grade (M = 3.62, SD = 1.181) and seventh grade (M = 4.14, SD = 0.955) pupils. Contrary to the linear decreasing trend of the feedback for the variables VAZTK and PRAKT, an increasing tendency towards higher grades can be observed here, with the maximum in the seventh grade.

The final analysis of variance also revealed the existence of a statistically significant difference in students' attitudes towards learning traditional content in the subject Technical Culture (POUZI), in relation to the class they attend [$F\ (3,\ 2186) = 27.46,\ p = 0.00,\ \eta^2 = 0.036$]. A subsequent test revealed that there was a statistically significant difference in arithmetic mean between fifth grade (M = 3.90, SD = 1.190) and eighth grade (M = 3.24, SD = 1.273) pupils. Thus, the median score for fifth grade students would be 4, consistent with the assertion, while the median score for eighth grade students would be 3, consistent with an indecisive attitude toward learning traditional content within the Technical Culture, as an important determinant of sustainable development.

Descriptive indicators measured by variables related to pupils' environmental awareness are presented in Table 5. From the overall results recorded on the variables related to pupils' environmental awareness, it follows that most pupils disagree, strongly disagree or are undecided on the statements manifesting these variables. Precisely, 36.1% of pupils agree or strongly agree with the statement that more hotels, marinas, golf courses and ports (GRATU) should be built in Croatia, and 36% of them generally or completely disagree with it. At the same time, 27.4% of pupils neither agree nor disagree, i.e. they have no explicit opinion on the matter. Regarding the statement that all waste should be buried or

burned so that it does not stink (ZBROT), 59.6% of the pupils disagree or strongly disagree. Nevertheless, 21.9% of the pupils completely or mostly agree with this statement and 17.9% have no clear position. As much as 86.3% of students disagree or strongly disagree with the statement that our environment is better if we have fewer grasslands, forests, and domestic animals because they attract insects (ZIOKR). Only 7.2% of pupils agree or strongly agree with this statement and only 5.9% of pupils have no position on this issue. With regard to the statement that if we have a water supply, we should not collect rainwater (VOKIS), 33.7% of the pupils agree or strongly agree, 34.9% of the pupils disagree or strongly disagree, while as many as 30.9% have no clear position.

Whether there are statistically significant differences between pupils' attitudes toward environmental awareness in relation to gender and grade level attended was examined using the MANOVA procedure. Conducting MANOVA (while meeting its underlying assumptions) revealed a statistically significant difference in pupils' perceptions of environmental issues in relation to the class they attended [$F\ (12, 5776) = 2.434;\ p = 0.04,\ Wilks'\ Lambda = 0.987;\ \eta_p^2 = 0.04$]. Further post-hoc analysis of the dependent variable considering the Bonferroni alpha level (0.0125) revealed that the only difference that reached statistical significance was for the variable GRATU [$F\ (3,2186) = 7.554,\ p = 0.00,\ \eta^2 = 0.01$]. To determine which classes differed, a univariate analysis of variance was performed with the dependent variable GRATU. Only the difference in arithmetic means between the fifth (M = 2.80, SD = 1.4) and seventh grade (M = 3.19, SD = 1.356) pupil response measures proved statistically significant. However, since $\eta 2 = 0.01$, we can conclude that the true effect size of the observed differences is very small.

When examining the presence of gender differences, a statistically significant difference was found in the attitudes of girls and boys related to environmental awareness [$F\ (4,\ 2022) = 9.251,\ p = 0.00;\ Wilks'\ Lambda = 0.960;\ \eta_p^2 = 0.18$]. In the individual analysis of the results measured by the dependent variables, considering the Bonferroni alpha level (0.0125), the variables GRATU [$F\ (1,\ 2025) = 22.872,\ p = 0.00,\ \eta^2 = 0.11$] and ZIOKR [$F\ (1,\ 2025) = 15.037,\ p = 0.00,\ \eta^2 = 0.07$] reached statistical significance. A review of arithmetic means revealed that boys (M = 3.18, SD = 1.361) support the construction of hotels, marinas, golf courses, and harbors in Croatia to a greater extent than girls (M = 2.89, SD = 1.361). It was also found that girls disagree to a higher degree than boys with the statement that the environment is better if we have fewer meadows, forests and domestic animals because they attract insects.

The measured frequencies and percentages on the PRODO and UZGHR variables used to examine pupils' attitudes toward the elements of self-sufficiency are presented in Table 6. 76.1% of pupils agree or strongly agree that various things and food should be produced in Croatia (PRODO). 8.9% of the pupils disagree or strongly disagree with this statement, while 14.3% are indifferent to it, i.e. they have no opinion or do not know what to answer. On the statement that we need to learn how to grow food in the garden or on the balcony (UZGHR), as many as 63.3% of the pupils agree or strongly agree, 16.6% of the pupils disagree or strongly disagree, and 19.6% have no clear opinion on this issue.

The influence of gender on students' attitudes towards sustainable development, with all assumptions previously made, was examined using multivariate analysis of variance. A statistically significant difference was found between girls and boys in terms of attitude towards self-sufficiency development [$F\ (2,\ 2022) = 8.436,\ p = 0.03,\ Wilks'\ Lambda = 0.992,\ \eta_p^2 = 0.08$]. Considering the Bonferroni's' adjustment ($\alpha = 0.025$), the only statistically

Table 6 Frequencies and relative percentages of variables of factor Self-sufficiency

	Variables			
	PRODO		UZGHR	
	SD	M	SD	M
	1,13	4,15	1,26	3,80
Agreements	**f**	**%**	**f**	**%**
I strongly disagree	120	5,4	160	7,3
I disagree	77	3,5	205	9,3
I neither agree nor disagree	315	14,3	432	19,6
I agree	522	23,7	516	23,4
I strongly agree	1154	52,4	877	39,8
Missing	15	0,7	13	0,6
SUM	2203	100	2203	100

significant difference was found for the PRODO variable [$F\ (1,\ 2023) = 8.803,\ p = 0.02,\ \eta_p^2 = 0.04$]. The insight into the arithmetic means of the results showed that boys (M = 4.23, SD = 1.119) support the production of various things and food in Croatia to a slightly greater extent than girls (M = 4.08, SD = 1.157).

By conducting a multivariate analysis of variance to determine if there are statistically significant differences between groups of students in terms of class (age), with respect to the dependent variable PRODO, a statistically significant difference was found [$F\ (6,463) = 8.239,\ p = 0.00,\ Wilks\ Lambda = 0.978,\ \eta_p^2 = 0.011$]. Further analysis revealed that a statistically significant difference was obtained in both variables reflecting pupils' attitude towards sustainable development, PRODO [$F\ (3,\ 2184) = 10.631,\ p = 0.00,\ \eta_p^2 = 0.014$] and UZGHR [$F\ (3,\ 2184) = 5.198,\ p = 0.00,\ \eta p2 = 0.07$]. To detect statistically significant differences between groups, two separate univariate analyses of variance were performed. The first analysis with the dependent variable PRODO determined the presence of significant differences in the arithmetic means of attitudes between fifth (M = 4.00, SD = 1.305) and sixth (M = 4.02, SD = 1.238) grade pupils relative to the attitudes of seventh (M = 4.30, SD = 0.954) and eighth (M = 4.25, SD = 0.986) grade pupils. In principle, 7th and 8th grade students largely agree that different things and food should be produced in Croatia. However, if we look at the differences between the arithmetic means and the calculated eta squares, we find that the actual difference is very small. The second analysis of variance with the dependent variable UZGHR revealed only a statistically significant difference in the arithmetic mean between fifth (M = 3.94, SD = 1.249) and sixth (M = 3.64, SD = 1.344) pupils. However, this difference is repeatedly small, and we find that fifth graders prefer food growing content to a slightly greater extent than sixth graders.

Discussion

The results presented clearly show that Croatian primary school pupils' attitudes towards technology, engineering, ecology and sustainable development are generally acceptable, that is, pupils perceive the general importance and role of technology and engineering as it is today. When it comes to the general attitude of the pupils towards the role and importance of technology and engineering, the significance for life and for each individual, the answers of the respondents show that the majority of the students (70–85%) accept engineering and technology from the point of view of social and individual importance. Such findings

suggest that during school years, but also under the influence of the social environment, pupils generally accept that technology and engineering offer a higher quality of life and work. It should be noted, however, that more than one-fifth of students do not have a clear opinion about whether everyone needs technology. This could be a consequence of years of neglecting the role and importance of technology and engineering in society and education (Purković, 2015). In addition, a relatively high percentage of students (10%) believe that technology does not contribute to a better quality of life and environmental protection, or they do not have a clear position on this (20%). However, a much wider dispersion of pupils' attitudes and a clear deviation from declaratively accepted environmental and technological values is evident in the perception of engineering and technology as something that only pollutes the environment. A surprisingly large proportion of students (more than 30%) do not have a clear position about that. If we add the group of those who are undecided on this issue and those who think that technology actually only pollutes the environment, we conclude that almost 40% of respondents do not see the possible role of technical (engineering) achievements and technological processes in preventing pollution. This is not surprising, as engineering and technology are so underrepresented in general education in Croatia (Purković et al., 2020) that students do not have the opportunity to learn about technologies that enable sustainability and sustainable development. Since technology education is also part of culture, its quality can also influence the development of social values, the promotion of which can play an important role in education for sustainable development. This is also noted in some empirical studies that emphasize that virtues, prudence, stakeholder orientation, and enabling culture are important predictors of improved education for sustainable development (Suriyankietkaew and Hallinger, 2018). Such a finding may also indicate insufficient development of students' systematic and critical thinking, which should be fostered by the activities in the primary school curriculum. Although these objectives are included in the curriculum of the cross-curricular topics of "Sustainable Development" (MZO, 2019), technological activities and topics are almost absent from this curriculum. The acquisition of knowledge important for understanding the functioning of production systems and their relationship with ecological systems is not provided at all. At the same time, there is a lack of application of modern teaching methods and technologies that can contribute to the development of systematic thinking and thus to the understanding of environmental problems and sustainable development. In this sense, the use of various interactive and dynamic simulations can enable students to perform actions (operations) and build their understanding of the system through 'operational thinking' (Olaya, 2015) and improve the understanding of sustainability problems, even if they are unsupervised and performed remotely (Green et al., 2022). The value of simulations in the process of knowledge development is also emphasized by teachers (Purković & Kovačević, 2020), who place such activities alongside hands-on activities in an extremely important context of teaching in technology education. At the same time, meaningful use of ICT to achieve a deep understanding of the local characteristics and needs of the target community and the design of appropriate web content for learning and interaction can promote knowledge development and critical thinking and take actions for socio-environmental sustainability (Aguayo & Eames, 2017). Such and similar opportunities are underutilized in teaching the subject Technical Culture or in the Croatian educational system and the systematic understanding of the relationship between different processes, which is extremely important from education for sustainable development perspective. Despite the fact that the results of the study of

pupils' general attitudes towards technology and engineering issues and their relationship to ecology indicate that most pupils have positive (desirable) attitudes related to educational outcomes, a worryingly high proportion of pupils do not have clearly formed attitudes or have negative attitudes.

A similar dispersion of students' attitudes was found in the variables related to the content structure of the Technical Culture, i.e. the assessment of the importance and timeliness of the content of the Technical Culture in the context of sustainable development. In principle, most pupils have a positive attitude towards the content structure of Technical Culture as a subject and technological field of education. What is worrying, however, is the number of indifferent pupils, as well as the large number who express a negative attitude towards the importance of the content of Technical Culture. Although slightly more than half of the pupils think that they always learn important and useful content in the subject, there are almost the same number who do not have a clear position on this or do not agree with this statement. Moreover, the results recorded on this variable in relation to grade (age of pupils) show a continuous decrease in pupils' agreement with the assertion that useful and important content is always learned in the Technical Culture. In the eighth grade, then, an indecisive attitude toward the subject prevails, which undoubtedly indicates the dissatisfaction of the students with the content structure of the subject. When evaluating the subject Technical Culture in the context of relevance to life, three quarters of the students consider it important. The number of students who deny the importance of Technical Culture, even in the field of technology and engineering is negligible, but even here there is a relatively large number of those students (20%) who do not have a clear position. It should be noted that boys perceive the subject of Technical Culture as more important in their lives than girls, as previous research on student preferences shows (Suman & Purković, 2018; Purković et al., 2020). Moreover, the perception of the importance of Technical Culture decreases in higher grades. Although the reason may be a decline in interest in school during maturation, research shows (Purković et al., 2022) that the reasons may be sought in insufficiently challenging content and activities during school. An almost identical distribution of results was found for students' attitudes toward the subject Technical Culture and for their assessment of the functional value of technology and engineering. This could mean that students' attitudes toward the subject nevertheless influence students' general attitudes toward engineering and technology. In other words, when more importance is given to a subject, students are more likely to have a "more positive" attitude toward engineering and technology. The relatively high percentage of students who do not have an acceptable attitude towards this teaching or are indifferent to it indicates that technology (technical) education or the primary school curriculum in Croatia requires certain changes. This is also indicated by the recent study of students' interests (Purković et al., 2022), which revealed that students show a great interest in engineering (technical) and technological activities, but the subjects of the curriculum apparently do not allow them to do so. Although the results of this research do not show the direction in which the changes should go, the experts on ESD agree that the context, especially the local one in which it is realized, and the possibility of transformative action in this context (Pavlova, 2013) should be characteristics of this education. Considering that the focus of ESD in technology education depends on the specifics of each country, i.e., it may be on environmental or social issues, the economic dimension should be the basis for both (Pavlova, 2013). Such an approach requires that technology education be given

more importance and time, but also that environmental education be included in all subjects (UNESCO, 2017) and that teachers receive special training (Runko Luttenberger, 1996).

Pupils' responses about learning and teaching the traditional way of life and construction show that pupil' attitudes towards this issue are generally positive and acceptable. Indeed, traditional lifestyles, resource management and construction have proven to be an important element of sustainability for many microsites around the world, especially in developed countries. After the intensive industrial period, many countries have adopted some new technologies, as well as ways of living and building, adding new value to their territories and significantly improving the quality of life. Despite the generally acceptable attitude of the pupils, it should be noted that almost half of the pupils stated that this is not taught in school or do not have a clear position on the issue. The dispersion of pupils' attitudes is also evident with regard to the construction of hotels, marinas, golf courses, and harbors. This issue reflects the attitude towards the management of the coastal zone, as an important strategic resource of Croatia. This resource has come under intense pressure in the last two decades and requires a high degree of awareness and conscientiousness in its management. The high percentage of pupils who do not have a point of view on this issue (almost 30%) and the same percentage of those who agree and disagree clearly shows that pupils are not sufficiently aware of the importance of the resource on which they will depend in the future. Considering the fact that Croatia is a tourist country, it is interesting that this topic is not represented in primary and secondary education. Therefore, it represents a certain taboo, which is certainly not in the spirit of sustainability, but which is in the interest of certain economic subjects. When it comes to attitudes towards waste management as an important sub-area of sustainability, 60% of the students have an acceptable attitude towards this topic. It is interesting to note that almost 22% of the students could not "acceptably" comment on this seemingly simple statement, and a significant portion of them (about 18%) did not have a clear opinion. This indicator supports the thesis that the importance of waste as a resource, the possibilities of recycling, and disposal technology are not sufficiently taught in school or are taught at a level that does not sufficiently influence pupils' awareness. This means that pupils do not have the opportunity to participate in activities during school that critically examine waste management technologies in the local community. In contrast, the pupils' attitude towards nature (meadows, forests, domestic animals) is on a high positive level. More than 86% of the pupils were positive about the role of meadows, forests and domestic animals in the context of environmental protection. However, the pupils' perception of the importance of water resource management is quite different. Only one third of pupils are aware of the importance of sustainable water management, while the same number of pupils do not have a clear position or do not see the need for water conservation. These results clearly show the lack of knowledge about water management, which is the subject of human survival today, and imply the necessary outcome interventions in the subject curriculum and in the curriculum of primary education as a whole. When it comes to attitudes towards the production of things and food as a guarantor of a country's economic stability, the pupils' attitude is largely acceptable. However, what is always problematic is the fact that almost one fifth of the pupils either have no opinion on the subject or have an unacceptable attitude. Considering the transition processes in Croatia over the last 30 years, still an ongoing progress, through which the social importance of production, including technology and engineering, is gradually stabilizing in the minds of the population. Pupils' attitudes toward growing their own food and learning about it are largely acceptable. This

question essentially reflects the individual's awareness of the importance of his or her own food production as a guarantee of sustainability in the future. However, although more than 60% of pupils expressed a positive opinion on this issue, there is a large proportion of those who do not consider it important or do not have a clear position (almost 40% of pupils). This indicator argues that the technology of food cultivation and pupils' activities in this regard should be more intensively integrated into the teaching process during school hours so that pupils understand the importance of such cultivation for future sustainability and self-sufficiency. In fact, this important segment of self- sufficiency has completely disappeared from Croatian education, contrary to the efforts at the level of the world community for a justified reassessment of such values.

The test of the first hypothesis that pupils have well defined positive attitude towards the importance of the content of Technical Culture subject in relation to ecology and sustainable development was performed through frequency analysis, central tendencies and percentages. There was a wide dispersion in the attitudes of the students, which is reflected in the fact that only slightly more than half of the respondents have a positive attitude towards the importance and relevance of content of Technical Culture subject in relation to ecology and sustainable development. Therefore, this hypothesis was rejected. The distribution of recorded results on the variables related to pupils' environmental awareness, manifested as positive attitudes towards environmental protection, waste management, protection of the sea and the coastal zone does not support the confirmation of the second hypothesis. The only exception is the extremely positive attitude of students towards nature, in relation to environmental protection. However, this is not sufficient to confirm this hypothesis and it is necessary to reject it. Student perceptions of ecology and sustainable development and its relation to technology and engineering were examined in relation to student gender using the MANOVA procedure. There were statistically significant differences in the responses of girls and boys with regard to only two variables (GRATU and ZIOKR) of the four variables describing the model of students' environmental awareness. It should be noted, however, that the effect size here is very small, implying that gender differences are not a critical factor influencing student attitudes. In the model describing the context of sustainable development, no statistically significant differences were found in students' attitudes towards gender. Therefore, the fourth hypothesis was confirmed. The determination of statistically significant differences in the attitudes of students regarding the perception of ecology and sustainable development and their relationship with technology and engineering, with respect to the age (grade) of the students, was carried out using the MANOVA procedure. The results revealed the existence of statistically significant differences in the attitudes of the students with respect to grade. However, further analysis revealed that the actual difference was very small, implying the confirmation of the fifth hypothesis. Based on these results, which do not confirm the usual gender and age differences between students on certain ecology and sustainable development topics, it could be concluded that the sustainable development curriculum did not influence students' attitudes or was not implemented as planned. This result may indirectly point to the necessary changes in education for sustainable development, which will more intensively incorporate content and activities from related subjects in which technology is an indispensable segment.

Research limitations

Although the research results show students' attitudes toward selected environmental and sustainable development issues, the results should still be viewed with some scepticism. Namely, the instrument used included students' preferences towards technology and students' attitudes towards selected sustainable development issues, but did not examine respondents' arguments regarding the choice of statements. It is therefore necessary to conduct a deeper investigation of their arguments in order to determine students' true understanding of these issues. This should consider the narrower and broader context of their lives and schooling, which would certainly provide more comprehensive answers on how to influence the development of students' critical thinking and awareness of environmental issues and sustainable development.

Conclusion

The results of the survey at a general level show an "acceptable" level of student awareness of the importance and connection of technology to environmental and sustainable development issues. However, a deeper analysis of the expressed views may reveal certain anomalies that point to a possible problem and direction of Croatian education for sustainable development.

Regarding the factor of students' general awareness of technology, engineering, ecology, and sustainable development, students show a highly developed awareness of the importance and connection of technology to these issues. The factor linking issues of sustainability to the content structure of the subject of Technical Culture already shows a poorer "picture" of attitudes. Although the majority of students also have "acceptable" attitudes on this factor, a high proportion of undecided students can be observed. At the same time, the proportion of "acceptable" attitudes was found to decrease with increasing maturity, which may mean that the content of this subject is not sufficiently meaningful to students and connected to the context of their lives and environment. The results for the factor of students' environmental awareness clearly show that a large number of students have not developed an "acceptable" awareness of the basic strategic issues of sustainability in Croatia. This is reflected in the high percentage of students who have no opinion about it and those whose attitude is the opposite of what was expected. This refers to statements about the protection of the coastal zone, waste management and water management. The exception is the attitude towards the natural environment, on which the students have an "acceptable" attitude. For the self-sustainability factor, the majority of students were found to have "acceptable" attitudes toward these issues. However, again, a high percentage of undecideds and those with attitudes contrary to expectations were found. Although there are some gender and age differences in attitudes toward certain issues, due to the small size of the effect, it can be concluded that these differences are not crucial for attitudes toward environmental issues and sustainable development issues. Therefore, it can be concluded from the research that students have "acceptable" or expectedly developed attitudes and awareness of the issues of ecology and sustainable development, which are generally known and widely accepted by the public. A large percentage of undecided students and those who do not have acceptable attitudes towards certain sustainable development issues may indicate inconsistencies

in this education in Croatia with the country's strategic guidelines. This means that primary school students in Croatia have not acquired enough experience and knowledge that are important for understanding environmental issues and sustainable development, of which technological and engineering knowledge is an indispensable component.

Despite these findings, education for sustainable development is very complex, and students' attitudes may be influenced by various factors from their immediate or wider environment. For this reason, a deeper investigation of the reasons that influenced students' attitudes should be conducted, but the research should also be extended to many other topics that have not been investigated here. In this way, a clearer "picture" of the factors that influence students' attitudes and the role of formal education in this process would be obtained.

Declarations

Conflict of interest Conflict of Interest - None.

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