

Elements of environmental education in the process of teaching university students

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Abstract. The aim of the research is to analyze the elements of environmental education in the process of teaching university students, and the level of environmental culture of students, to examine the relationship between environmental values and environmental responsibility. The obtained results show that students of civil engineering training have a medium level of environmental knowledge and skills, and pro-environmental attitudes and values are strongly expressed. Regarding the environmental orientation of teaching, the pedagogical and didactic areas were rated at a medium level, while the organizational area related to the curriculum was rated at a high level. Consequently, it is necessary to clearly specify environmental training in the curricula and study programmes of higher education institutions. The results of our study confirmed a positive correlation between environmental values and environmental responsibility. Respondents who believed that the effective functioning of society and the survival of mankind are inextricably linked to environmental protection demonstrated a greater degree of personal responsibility.

1 Introduction

The level of well-being of different segments of the population has increased due to economic development and human transformation of natural ecosystems and exploitation of natural resources. But such an increase has a reverse side, namely, significant losses of biodiversity, degradation of many ecosystems. The most important direct factors were changes in individual components of the environment: climate change, changes in soil conditions, land use, riverbeds, as well as the disappearance of forests, desertification, increased exploitation and pollution of the environment.

The principles of sustainable development, environmental conservation issues become important factors for decision-making on the implementation of infrastructure projects. The essence of the concept of sustainable development is reflected in the categorical imperative of environmental ethics about responsible attitude to the environment [1].

According to Yong Wang, Fang Li, the current lack of proper awareness, training, and proven approaches to human interaction with the environment leads to the degradation of

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natural objects and rapid depletion of natural resources. In order to ensure sustainable development and environmental security, a coordinated system of environmental education is needed, which provides for a sensitive attitude of people to nature [2].

Some real problems and prospects for the development of higher education for sustainable development have been identified in the studies and should be reflected in the curricula of higher education institutions. Among them are the following: changing the content of educational programmes in order to form values and skills for environmental conservation among students, and to develop a holistic ecological approach to economic activity. Participation of different strata of the population in environmental conservation activities is necessary for the formation of a sustainable environment on the basis of multifaceted planning, for the growth of well-being of different social groups.

The environmental culture formed by the state should contribute to a shift from a consumerist attitude to the environment towards a conscious and economical use of natural resources and active participation of the population in the implementation of sustainability principles. Environmental culture is formed through a set of measures on environmental education, continuous environmental education and enlightenment among different age groups of the population. The measure of ecological culture is ecological ethics, the priority of which is care for the natural conditions of existence in the future, harmonisation of interaction between man and nature. A reasonable and moral person cares about nature not only in connection with improving the comfort of personal life, but also for the sake of preserving life on Earth as a whole [3].

Economic development is closely linked to the construction industry, which has a great impact on the environment. Traditionally, persons responsible for construction have not been guided by environmental values and responsibilities in the design and implementation of construction projects, so the need for environmental education of construction personnel stems from the need to mitigate or solve environmental problems. For a number of socio-economic and political reasons, the environmental attitudes of socialisation and education institutions were of secondary importance. The principles and norms of responsible attitude to nature were not systematically inculcated and actualised, and little attention was paid to their independent learning in the 20th century education. The most important task of modern environmental education is the search for strategies to develop environmental consciousness in students, which will influence their attitudes and professional actions [4].

Engineering education should be constructed in such a way that decision-makers have the opportunity to make alternative decisions in accordance with environmental problems, that the construction of facilities relies on the preservation of the natural environment, and that professionals use environmentally friendly building materials. The constructed buildings and facilities should have low energy consumption or use renewable energy sources [5].

The method of cross-cutting design can play an important role in the process of formation of ecological consciousness and culture among university students. The implementation of cross-cutting design, as a rule, is the fulfilment by students of a complex design task during several semesters, from two to five. The complex task contains several interconnected local tasks, which students fulfil within the framework of course design on separate disciplines. This method is quite actively used in universities that provide training of bachelors and masters in engineering and technical profiles, in the direction of training "Construction" [6].

In an era of increasing external stakeholder pressure to implement sustainability practices in the workplace, organisations must be guided by environmental ethics to achieve synergy between business, societal and environmental needs [5].

The norm activation theory explains how a pro-environmental norm of behaviour is formed at the individual level from primary environmental knowledge and values, and then transformed into pro-environmental practices. The norm activation component consists of

the subject's awareness of the environmental problem and personal ability to influence the situation; this component explains the formation of attitudes [7].

According to this theory, the motivation to perform certain socio-environmental actions is the result of the comparison of personal norms and beliefs with social norms and expectations, which motivates the subject to act outwardly, causing him or her to do something in the interests of others. In particular, this includes actions in defence of the environment, which is associated with altruistic agency [7]. Depending on expected social sanctions or approval, norms influence people's behaviour. They refer to the level of self-esteem, which causes pride or guilt for the subject's actions [8].

According to the research, respondents who are more concerned about climate change actively promote sustainable development through reuse, waste reduction and recycling practices, and participate in organised activities to protect the environment [8].

Quality education is an integral part of sustainable development and an essential strategy for achieving its remaining goals. This idea was expressed in the Education for Sustainable Development (ESD) programme proposed by UNESCO in 1992 and subsequently in the Global Action Programme on Education for Sustainable Development. In 2015, members of the United Nations (UN) signed the 2030 Agenda for Sustainable Development with a special focus on education [9]. The Framework for Action on Education 2030, adopted at the Incheon World Education Forum in November 2015, emphasises the need to ensure that the theoretical knowledge and practical skills needed to promote the values of sustainable development and to develop lifestyles in line with the principles of sustainable development are acquired in the coming years [10].

Universities operate in three areas: teaching, research and social design. Modern engineering training implies active formation and development of students' environmental values and competences. Social design is considered as a reliable way of their formation, with its help the necessary qualities for future professional life are formed. It is within the framework of social projects that university management introduces elements of environmental education, which should be related to all environmental protection activities [11].

Environmental education is necessary to provide future professionals, social groups, public officials, companies and industries, citizens with information, knowledge and methods to solve environmental problems, to respond actively and successfully to external challenges, to guarantee the preservation of a healthy and sustainable environment for present and future generations [12], [13].

Elements of environmental education should be included in the training of future engineering specialists based on the principles of sustainable development as cross-cutting elements. Environmental education cannot be isolated as an independent discipline or a separate section of the curriculum, but should be introduced as a general interdisciplinary topic in professional training. Environmental education should be designed to take into account local customs and culture, coordinated with other fields of knowledge to promote activities in favour of the environment, and it should respond to the institutional policies envisaged by state, non-state and non-formal educational organisations [14].

Some attitudes and stereotypes of the subjects of management decisions obtained in everyday professional and economic activities may pose a serious problem in environmental education.

The traditional view of nature as an endless source of raw materials and energy is deeply rooted. This stereotype often becomes a serious obstacle to identifying both existing and new environmental problems and to making environmentally acceptable decisions. It corresponds to the tendency of anthropocentrism, i.e. the tendency to attribute intrinsic value only to humans; another tendency is to attribute intrinsic value to ecosystems (ecocentrism).

At the same time, people often think that in principle they will not be able to have a significant impact on environmental problems, and this vision significantly limits the human contribution to improving or preserving the environment.

Another important problem of environmental education can be considered as insufficient motivation. Environmental awareness, the problem of mankind's survival in the context of environmental crisis is usually not considered as a priority among the main problems of education. In addition, the decline in popularity of natural sciences over the last two decades, while they play a crucial role in the overall system of ecological knowledge, has had a negative impact [15].

In the face of environmental challenges, education is faced with the task of developing strategies to improve learning and develop the competences needed to face today's challenges. It is necessary to create and implement new educational practices that contribute to environmental protection [16].

The symposium "Key competences for Europe" defined a list of key competences. Competences integrate various aspects of activity (learning to do, learning how to learn, learning how to assimilate knowledge, learning how to live together, learning how to be), to perform professional activities and/or solve problems perceived as a challenge [17]. A set of competences is formed not only as a structured social and personal experience, but an important role is played by students' activities, which allow them to acquire practical skills [18].

D. Raven believes that environmental competence is absent in the list of competences, the closest in content are the tendency to think about the future, the study of the environment to identify its opportunities and resources (both material and human), the ability to make decisions, personal responsibility [19].

Professional engineering competences are usually divided into general and specialised ones. General competences allow to achieve self-realisation in life and in the professional sphere, to manage projects, to contribute to the ecological balance and to work in a profession, position and/or specialty. It is necessary that they are shaped by basic and higher education in which environmental topics are integrated. On the other hand, a number of specialised competences are proposed for civil engineering, among which are those related to environmental issues, such as assessing the environmental and social impacts of construction works and proposing solutions that contribute to sustainable development [20].

The graduate profile describes the skills and competences, the training obligations, and is designed as a tool to give meaning to the training programmes of a particular training area. The graduate profile should include environmental knowledge and skills as cross-cutting, they are embodied in general, special or professional competences in which environmental issues are involved. Future professionals will thus possess a culture of environmental assessment and realise civil engineering projects in accordance with the principles of sustainable development. The graduate profile should not only focus on job duties, but also imply a comprehensive self-determination of the specialist in environmental issues and environmental ethics [15].

Environmental ethics is defined as the systematic study of human behaviour in the field of environmental sciences, and there are two trends: a) the incorporation of ecoethical principles into professional deontologies that directly affect environmental conservation issues (ecologists, engineers, architects, chemists, biologists); b) the incorporation of ecoethical principles into environmental legislation [21] [22].

Incorporating an environmental focus into the curriculum is the best strategy for students to receive training that is relevant to today's sustainability requirements [23] [24].

In connection with the above, the objectives of this study are to analyse the level of development of environmental culture norms and environmental values (ecocentric and

anthropocentric) in construction students, the degree of their influence on environmental responsibility, to assess the level of application of environmental education by teachers and to analyse the environmental topics embedded in the graduate profile in the direction of construction.

2 Methods and materials

The study was conducted at a technical university in Moscow. The sample of the study consisted of 120 senior students studying in the field of Civil Engineering. The sample of teachers consisted of 32 specialists teaching on professional civil engineering programmes.

The survey method was used to assess the level of development of environmental culture of civil engineering students. The questionnaire contains three indicators: knowledge, skills, attitudes and values, respectively, seven, five and seven items for each indicator. Each statement of the questionnaire was evaluated on a scale from 0 to 1. The following ranges were taken as scoring criteria: below 0.33 - very low, [0.34; 0.50] - low, [0.51; 0.75] - medium, [0.76; 0.90] - high and over 0.91 - very high.

Prior to the questionnaire survey, a pilot study was conducted to test the completeness and validity of the questionnaire with three subject matter experts. The experts were asked to rate the degree of expression of each indicator. Some items of the questionnaire were modified based on the feedback from the pilot study.

The EAATE [25] was used to measure ecocentric and anthropocentric attitudes toward the environment, with three scales: ecocentric (12 items), anthropocentric (12 items), and environmental apathy (9 items). Only the first two scales were used in the study. A 5-point Likert scale (from 1 - completely disagree to 5 - completely agree) was used to evaluate the responses. Examples of statements of ecocentric value orientation: "I need to spend time in nature to feel happy", "Nature is valuable in itself". Examples of anthropocentric value orientation: "We need to conserve natural resources to maintain a high quality of life", "The most important reason for conserving nature is the survival of mankind". The factor loadings for all items of the first scale ranged from 0.69 to 0.83, only one factor was identified that explained 56.7% of the variance. Based on the distribution coefficient analysis, it can be concluded that the scores are normally distributed, the Cronbach's alpha coefficient showed a high value (0.86).

To measure students' environmental responsibility, a separate scale (8 items) was used, a five-point Likert-type response rating scale, ranging from 1 to 5 points, depending on the degree of agreement was used. The coefficients of skewness (-0.22) and kurtosis (-0.39) showed that the scale had sufficient symmetry as the distribution of scores was within acceptable limits (-0.5 to +0.5). The Cronbach's alpha showed a high value (0.91). Using principal component analysis (PCA), one factor was identified that explained a total of 68.7% of the variance. The primary loading on the first factor was high for all items (0.81 to 0.88).

To check the level of teachers' implementation of teaching and methodological support for environmental education, a questionnaire with a dichotomous scale was used as a tool, which is divided into the following criteria: pedagogical, didactic and organisational, corresponding to the curriculum and syllabus. The reliability of the questionnaire was checked using Cronbach's alpha coefficient, the value of 0.85 indicated sufficient reliability.

3 Results and discussion

The results of the study are grouped as follows: analysis of the level of environmental culture of civil engineering students, the relationship of respondents' environmental values with

environmental responsibility, and the assessment of environmental aspects of education by teachers. This will help to put forward proposals for filling higher education curricula with environmental content.

The results of assessing the level of environmental culture of civil engineering students are shown in Table 1.

Table 1. Indicators of environmental culture of civil engineering students

№	Indicator	N	Value
Knowledge			
1	A strong commitment to environmental protection	0.79	High
2	Level of ecological knowledge in the university	0.57	Medium
3	Identification of environmental problems in professional activities	0.69	Medium
4	Knowledge of environmental norms of behaviour	0.71	Medium
5	Importance of observing environmental ethics when carrying out work	0.73	Medium
6	Ability to solve environmental problems	0.76	High
7	Interdisciplinary nature of environmental knowledge in engineering studies	0.88	High
Skills			
8	Work to reduce harmful environmental impact	0.84	High
9	Work to eliminate environmental violations at construction sites	0.76	High
10	Participation in maintaining a favourable environment	0.65	Medium
11	Participation in collective work for the preservation of the environment	0.56	Medium
12	Critical appraisal and environmental judgement in professional activities	0.74	Medium
Attitudes and values			
13	Ethical behaviour, respect for environment	0.79	High
14	Environmental awareness in the performance of work	0.85	High
15	Awareness of the harmful impact of construction works on the environment	0.83	High
16	Justification of environmental degradation as a result of the works execution	0.60	Medium
17	Biodiversity conservation efforts	0.86	High
18	Proactivity in the implementation of environmental initiatives	0.70	Medium
19	Self-assessment of environmental actions	0.75	Medium

Note. N = level of environmental culture by item, Value = score.

The level of environmental culture by indicators: knowledge - 0.73 (medium), skills - 0.71 (medium), attitudes and values - 0.77 (high).

Among the knowledge items, the items on a firm stance on environmental protection, the ability to solve environmental problems and the interdisciplinary nature of environmental knowledge received a high level of evaluation, which means that they are the most important for the respondents; the other indicators reached the medium level, and the medium value for the indicator is 0.73, which reflects the medium level of knowledge in the field of environmental culture. Therefore, it is necessary to include topics related to environmental culture in professional education.

Among the skills, the work on mitigation of environmental impact and work on elimination of environmental violations at construction sites reached a high level, which

implies that students have intentions to mitigate environmentally harmful impacts, as well as to eliminate environmental damage in case of its presence, for the other skills the medium level was reached, the medium score for the indicator is 0.71, which corresponds to the medium level of development of environmental skills. Consequently, there is a need to develop students' practical approaches in caring for the environment.

Finally, among attitudes and values, three indicators - justification of environmental degradation, pro-activity in implementing environmental initiatives and self-assessment of environmental actions - reached the medium level of assessment, but the medium value for the indicator is 0.77, which corresponds to a high level with regard to attitudes and values of environmental ethics. This means that civil engineering students are aware of the need to preserve nature and care for the environment.

From the analysis we can conclude that students perceive the principles of environmental ethics as a social value, because their observance can guarantee a favourable coexistence with nature, as evidenced by high scores on attitudes and values. However, it is necessary that social values are transformed into the sphere of professional activity, i.e. that the future specialist in his/her professional activity realises in practice the acquired knowledge and skills. Values can be considered as sources of environmental responsibility, which have a direct impact on its development [23].

After measuring ecocentric and anthropocentric attitudes towards the environment using the EAATE methodology and measuring students' environmental responsibility, linear regression analysis was conducted [26]. It confirmed that the respondents' environmental values (ecocentric and anthropocentric) have a high positive linear relationship with environmental responsibility ($R = 0.71$, $p < 0.05$). The results of hierarchy analysis show that anthropocentric values of respondents ($R = 0.76$, $p < 0.05$) have a higher degree of influence on the sense of personal environmental responsibility than ecocentric values ($R = 0.54$, $p < 0.05$).

The attitude that the natural environment should be preserved to preserve the ecosystem and biosphere is a less strong predictor of personal environmental responsibility. Respondents with more pronounced anthropocentric values are more inclined to believe that preservation of the natural environment is unthinkable without a personal contribution that every person should make.

The results of the study show that up to 51% ($R^2 = 0.51$) of respondents' environmental responsibility can be explained on the basis of their environmental values. After introducing anthropocentric values into the predictor cluster in the second step of the hierarchical analysis, the increase in the explained variance of personal environmental responsibility was 27% ($R^2 = 0.57$). The values of the partial standardised regression coefficients also show that anthropocentric values ($\beta = 0.54$, $p < 0.05$) can be considered as moderators of the relationship between ecocentric values ($\beta = 0.63$, $p < 0.05$) and respondents' personal environmental responsibility.

In general, individuals with less expressed and realised environmental values pay less attention to the fact that in the course of their daily economic activities they constantly cause damage to various components of the environment, so they do not think about changing their lifestyle in order to reduce this damage. As a rule, they try to justify their behaviour by the influence of higher-level factors, such as the development of industrial production, governmental orders, political decisions, and the costs of scientific and technological progress. The formation of environmental values among students will help to form a sense of personal environmental responsibility, which can lead to the formation of pro-environmental intentions and, finally, pro-environmental behaviour.

The environmental values of an individual, based on the results obtained, can be considered mediators between environmental responsibility, on the one hand, and the above-

mentioned social-and-psychological factors, on the other. If students have a better understanding of environmental problems, they will better understand the relationship between these problems and their professional activities and develop pro-environmental attitudes. This finding is consistent with the theory of planned behaviour and the norm activation model [7].

The evaluation of environmental aspects of education by engineering teachers is presented in Table 2, which presents three criteria: pedagogical, didactic and organisational with eight, five and four items respectively. Each item was rated on a scale from 0 to 1, and qualitative assessment was given for each indicator.

Table 2. Assessment of environmental aspects of education by engineering teachers

Nº	Indicator	N	Value
Pedagogical			
1	The disciplines contain topics on environmental ethics	0.42	Low
2	Application of teaching and learning methods related to the environment	0.75	Medium
3	Availability of courses and programmes that are developed in direct contact with the environment	0.73	Medium
4	Visual support of training sessions with pictures of nature	0.63	High
5	Building teaching that takes into account the relationship between professional activity and the environment	0.70	Medium
6	Formation of knowledge about the causes and consequences of environmental problems in urban planning activities	0.72	Medium
7	Analysis of situations related to the deterioration of the environmental situation during operations	0.80	High
8	Promotion of green technologies as an option to reduce pollution and environmental damage in construction industry	0.66	Medium
Didactic			
9	Creative approach with scientific knowledge in solving environmental problems in practice	0.51	Medium
10	Interest in raising awareness of environmental culture issues as they relate to construction work	0.70	Medium
11	Active participation in activities aimed at protecting the environment	0.49	Low
12	Active participation in activities aimed at improving the environment	0.59	Medium
13	Research related to the application of environmental ethics in addressing environmental problems associated with the construction process	0.56	Medium
Organizational: Syllabus/Curriculum			
14	Profile of a construction student's final qualification work with the manifestation of environmental culture in order to prevent, reduce and/or restore environmental damage caused by construction works	0.87	High
15	The curriculum provides for the teaching of environmental culture	0.59	Medium
16	Professional development programmes for teaching environmental culture	0.61	Medium
17	Interdisciplinary nature of teaching ecological culture to consolidate values for a change in attitudes towards environmental issues	0.94	Very high

Note: N = level of ecological culture by indicator, Value = evaluation.

The level of ecological culture by indicators: pedagogical - 0.68 (medium), didactic - 0.57 (medium), organisational - 0.77 (high).

The pedagogical indicator in Table 2 shows that there is no ecological theme in the description of disciplines, as it has a low level of evaluation, but the items: analyses of situations related to the deterioration of the environmental situation when performing works, visual accompaniment of training sessions with pictures of nature have a high evaluation, the indicator has a medium level of 0.68.

According to the didactic indicator there is a lack of active participation of teachers in active environmental protection activities, the indicator has a medium level of 0.57, in this sense it is necessary to implement projects for public participation in solving environmental problems.

From the organisational indicator, the points of inclusion of environmental culture in teaching and professional development programmes for teaching environmental culture have a medium score, which means that it is necessary to pay attention to the topic of environmental culture in the curriculum. Therefore, teachers should actively participate in environmental projects that reinforce students' values of caring for and preserving the environment, for which it is necessary to form an environmental policy on an interdisciplinary basis.

According to pedagogical and didactic indicators, environmental education is at a medium level, which should be improved by working in university classrooms and motivating individual students. It is important to know the current environmental problems and how to solve them, this leads to personal involvement, willingness to participate in pro-environmental actions to reduce harmful emissions in the future [27].

D. Li, L. Zhao see the task of environmental education not in the one-way transmission of information, but in creating a means to develop and improve environmental attitudes, values and knowledge, as well as skills that prepare individuals and communities to take positive environmental actions in co-operation with university students in the interests of the environment [27]. This is where civil engineering educators should utilise appropriate teaching and learning methods that foster knowledge building in interaction with the environment, the use of sustainable technologies and materials to solve environmental problems, and full participation in social responsibility activities and research for environmental protection.

On the other hand, a study of environmental practices in higher education has shown that a combination of a "vertical" approach and public participation is needed to sustain environmental management system practices, and bureaucracy is a major obstacle [20]. If environmental topics are not provided in the curricula, motivation for environmental management practices should be initiated by the participants of the educational process: dean's offices, lecturers and students.

Consequently, higher education institutions should teach understanding of environmental issues and sustainable development to decision makers at different levels [28], therefore, it is necessary that civil engineering teachers should be trained to engage students in environmental issues. Also, university management should provide environmental awareness programmes for all their staff if they have not been trained before.

It is necessary to revise the curriculum, objectives and outcomes, as well as teaching methods in engineering programmes, so that environmental education can effectively influence the formation of environmental values and responsibility [24]. In this sense, the analysed graduate profiles represent environmental topics in an interdisciplinary and explicit way.

Based on the above, there is also a need to discuss the development of specialised courses on strategic environmental assessment that respond to societal needs in civil engineering curricula. The integration of this assessment tool into curricula could have significant implications for improving the practice of higher education for sustainable development. The

graduate profile of civil engineering programmes should be based on intention, ethics, responsibility, creativity and inclusion in the development and implementation of plans that affect the quality and conservation of the environment, the inclusion of action projects in local natural areas and the development of environmental initiatives in response to the needs of society [23].

In accordance with the profile of graduate training and research areas in the field of environmental education in training competent specialists on the basis of sustainable development, the following research topics are considered relevant: natural disasters, endangered species, natural phenomena, use of natural resources, environmental pollution, environmental consciousness, environmental cleaning and others [22].

Finally, the findings suggest that civil engineering curricula and programmes should present environmental issues, promote cooperation with other countries to create structures and share experiences for the environment.

4 Conclusions

The level of environmental culture among construction students can be considered average in terms of knowledge and skills and high in terms of attitudes and values, which means that it is necessary to strengthen the environmental component in curricula and programmes so that students can participate in activities and projects to protect and preserve nature based on the principles of sustainable development in order to develop appropriate knowledge, skills, values.

As for the environmental education carried out by the teachers of the civil engineering training programme, the medium level of assessment is achieved for pedagogical and didactic indicators and a high level of assessment for the organisational indicator, which implies the presence of a positive attitude of the university teacher to teach environmental actions in the education process, which help students to accept personal environmental responsibility in the process of professional training and to implement it in practice in the field of the profession.

The results of the study showed that there is a high positive linear correlation between environmental values and environmental responsibility. Values are strong predictors of environmental responsibility among young people and significantly influence its development. Anthropocentric values had a greater influence on the development of personal environmental responsibility than ecocentric values.

Based on the results obtained, it can be concluded that respondents who believe that care for the preservation of the natural environment is the most important prerequisite for economic activity, that the protection of the natural environment should be prioritised for the benefit of present and future generations, demonstrate a greater degree of personal responsibility for environmental protection. It is therefore necessary to develop more effective ways of developing knowledge and skills systems related to environmental issues. It is necessary to form environmental values in students through environmental education, improving curricula, textbooks, teaching methods and involving students in environmental education projects and extracurricular environmental activities.

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