

Climate consciousness and behaviour of students of a civil engineering university: problems of education

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Abstract. The article addresses climate change and environmental degradation in many parts of the planet. Cities demonstrate an increase in air temperature; urban heat islets affect human health and rise mortality rates. This requires a change in an approach to urban planning and design, a modified of urban structure, which in turn require better environmental and climate education for students who are future civil engineers, urban planners and architects. The article discusses the results of a sociological survey conducted among students of National Research Moscow State University of Civil Engineering (NRU MGSU), which demonstrates their climate consciousness, understanding climate change triggers, as well as the willingness to combat the negative effects of climate change. The primary data, obtained in the course of the survey, were compared with the data other surveys, launched by the All-Russian Public opinion Research Centre (VCIOM), research holding ROMIR, and Eurobarometer. The conclusion was that some students of MGSU were poorly informed of the extent of climate change. In general, they judge correctly about their causes and consequences, take some actions to prevent and mitigate the scale of disasters, but that's not enough. It is necessary to improve environmental and climate education and practical training of students through improvement of educational programmes.

1 Introduction

Climate change and ecological disasters are the reality facing humanity today. The climate system of our planet demonstrates visible changes, recorded by measuring instruments. The average annual temperature is rising by 1,5 degrees Celsius in some parts of the planet. Natural disasters, natural fires, soil degradation, erosion of rivers and seacoasts are all the more frequent; some areas suffer from abnormal heat waves. Heat islands emerge in cities, affecting the health of residents and causing excessive mortality. As a result of warming, higher temperatures in permafrost areas, and melting glaciers, diseases that have already disappeared are returning, and viruses, frozen for tens of thousands of years, become active [1]. Researchers have recorded a decrease in people's cognitive abilities due to rising temperatures and mental health problems.

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Quantity of food decreases in the areas of climate disasters; there is less and less quality food; poverty incidence rises, and climate migration flows intensify [2]. Humanity's tangible and cultural heritage is also under threat. Cultural and historical landscapes, cities, open-air archaeological museums, items of architectural heritage, such as historical buildings and structures are threatened by the growing number of floods, hurricanes, landslides, and fires [3, 4].

Researchers acknowledge that humans themselves make a significant contribution to the environmental crisis and global warming. More than 50 percent of greenhouse gas emissions come from cities, industry and transportation. This fact requires a change in the approach to urban planning, design and management, as well as novel technologies for adapting cities and architecture to climate change.

Creating an adaptation model requires an interdisciplinary approach, involving urban planners, architects, meteorologists, ecologists, civil engineers, economists, sociologists and psychologists. Climate change requires modernization of engineering machines and technologies; competent professionals must be trained for this purpose. However, anthropogenic factors of climate change cannot be eliminated by engineering actions alone [5]. Socio-humanitarian technologies for restructuring consciousness and guiding personal development, as well as environmental and climate education must be developed and implemented.

2 Literature review

Many studies address problems of climate change and ecological disasters. Some studies analyze the essence of the ongoing processes; causes and consequences of climate change; those negative effects that manifest themselves today and may occur tomorrow on a larger scale. More and more studies are published which qualify these changes as crisis phenomena. [6, 7].

Among many publications a special place belongs to the works that study the socio-cultural and psychological effects, produced on human health by more frequent extreme phenomena, including floods, fires, storms, and higher air temperature [8, 9, 10]. In particular, the real impact of global climate change on mental health has been confirmed by several empirical studies of scientists from the University of Southern California (USA). The review they presented describes the effects of three types of climate phenomena on mental health: 1) acute events such as hurricanes, floods, and wildfires; 2) sub-acute or long-term changes such as drought and heat stress; and 3) the existential threat of long-term changes, including higher temperatures, rising sea water levels, altered and potentially uninhabitable physical environments. Impacts are both direct (e.g., heat stress) and indirect consequences of global climate change (e.g., economic losses, threats to health and well-being, displacement and forced migration, collective violence, civil conflicts, and abandonment of degraded environments [11].

Adaptation of cities, buildings and structures to climate change, reducing the negative effects of climate change and taking care of human health in cities is the main topic of discussion among architects, urban planners and designers. Researchers propose general and specific approaches and technologies for adaptation of cities and architectural facilities [12, 13]. Technologies are also developed to combat specific negative manifestations of the climate crisis, such as heat waves by increasing the areas of "green" and "blue" zones, planting urban forests and "forest rings" backed by careful calculations. [14, 15, 16].

Much research focuses on environmental and climate education, protection and self-protection strategies amid global warming. Climate change education at universities and schools, theoretical and practical training courses offered to students are of particular importance. Of particular interest are cross-disciplinary educational programmes combining

knowledge from climate science, physics, sociology and psychology, i.e. combining natural and behavioural sciences. Successful cases of environmental and climate-focused education programmes based on the project method are analyzed. Results of educational and character-building activities, the extent of improvement of environmental and climate literacy are evaluated by sociological surveys launched among students. [17] At the process of sociological surveys, a strong positive relationship is revealed between climate change beliefs, personal environmental norms and environmentally conscious behavior. Personal environmental norms play a strong role in environmentally conscious behaviour engagement and strengthen climate change beliefs [18].

Works that highlight the experience already gained in incorporating climate change issues into university curricula are interested. In addition to a specialized approach (where students choose programmes to become experts in the application of climate change mitigation tools), a combination of programmes or a cross-disciplinary approach to teaching is practiced by universities having different fields of study [19].

3 Research Goals and Methods

The purpose of this article is to study the level of consciousness and specific behaviour resulting from the climate and environmental training of students at National Research Moscow State University of Civil Engineering (NRU MGSU), including future urban planners, architects and specialists in the design of high-rise buildings. Evidently, future professionals, having knowledge and skills, can substantially improve urban environments and successfully adapt them to climate change to mitigate crises. Environmentally and climatically literate architects and civil engineers, their competent architectural and urban planning projects and solutions, environmentally sustainable construction technologies can reduce greenhouse gas emissions and improve the ecological condition of areas.

The method used in this study is a sociological survey, or a questionnaire. This method will be used to generate unbiased data on the climate awareness of target groups and the willingness of respondents to take some action to reduce the negative effects of climate change.

4 Research results

The sociological survey was conducted in October and December 2021. The survey was launched among the students of the National Research Moscow State University of Civil Engineering (NRU MGSU), including undergraduate students majoring in Urban Planning, undergraduate students majoring in Architecture, students, pursuing a specialist's degree in Construction of unique buildings and structures. The total number of respondents was 234. Of them 145 respondents (62.8%) were master's students, 84 respondents (37.2%) pursued a specialist's degree.

Of all respondents 80.4% called climate change a real problem, as extreme phenomena became more frequent in different parts of the world, including Russia. However, 19.6% of respondents believed that everything was within the normal range of temperature fluctuations and natural processes.

In answer to the question "How good is climate change for Russia?", 30% of respondents found positive effects of warming, particularly in the field of agriculture. However the majority of respondents pointed to the negative processes that accompanied climate change. According to the respondents, these extreme phenomena were comparable with an ecological and climatic crisis: 1) the danger of land subsidence when permafrost melts, the formation of swamps and thermokarst lakes, the danger of collapsing buildings

(68.6%), and the death of flora and fauna in Siberia and the Far East (61.9%). Respondents added other negative consequences not included in the answer options, for example:

- the impact of climate processes on other spheres of life, including social relations and social processes;
- abnormal heat and death of flora and fauna in the southern regions of Russia;
- flooded tundra adjacent to the Arctic Ocean.

Sixty-three percent of the respondents believe that climate change is a particular threat to cities due to the overheating of the urban surface (buildings, highways, sidewalks, and soil), while 33% of them think that climate change threatens the health of urban residents. Nevertheless, 22.5% of respondents believe that there will be no serious negative consequences. Some respondents suggest that climate change will proceed smoothly, so people will have time to take additional measures to protect themselves and the urban environment. 66.5% of the respondents are sure that it is just the time to prepare the city for climatic extreme phenomena, to develop technologies of adaptation to negative consequences of climate change. 33.5% of the respondents think that it is not necessary to do it now; the country has enough problems now. 82% of the respondents believe that the natural processes of climate change are accelerated by human industrial activity. The greatest harm to nature comes from coal and gas burning (73%), deforestation (67%), landfills (61%), agriculture and cattle breeding (28.5%), and the use of any types of vehicles (44%).

Among the main causes of climate change students listed "Higher greenhouse gas emissions" and "Destruction of the ozone layer", "Deforestation" (Figure 1):

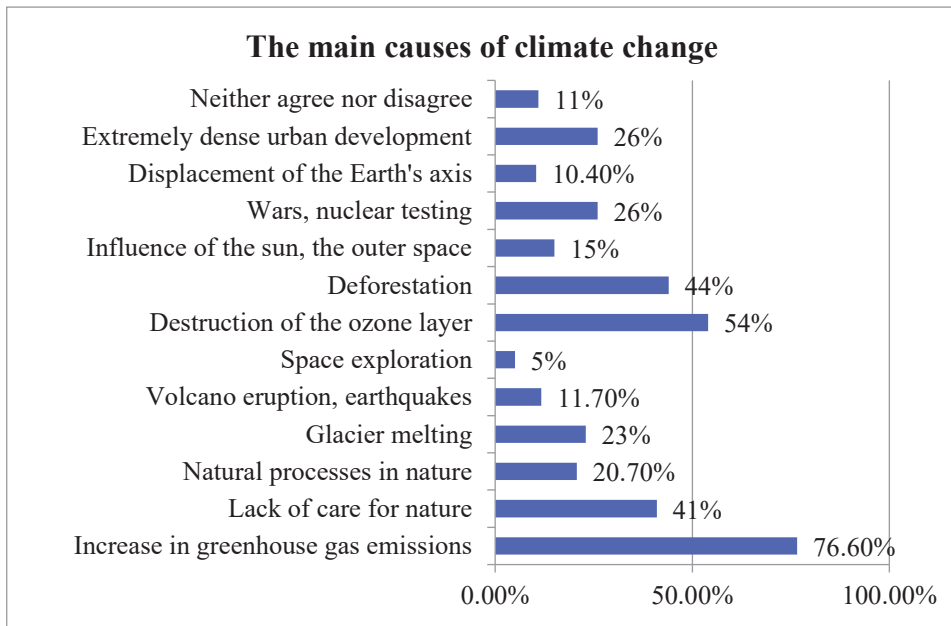


Fig. 1. The main causes of climate change.

Is it possible to solve the problem of climate change today? Most of the respondents are convinced that a solution can be found. Moreover, certain measures are already being taken. Some states as well as citizens (especially in European countries) are taking enough actions to delay climate change and mitigate the negative consequences (32%), but so far these measures are not sufficient, and all countries and regions need to act together and be more active (45.5%). After all, climate change knows no national boundaries between states

and is not subject to political decisions. Some respondents are rather pessimistic about the situation and believe that it is impossible to stop the process of climate change completely, only adaptation to the new conditions is feasible (7%). Only 5% of the respondents are optimistic; they are sure that an optimal solution will be found in the future.

Students' demonstrated civic maturity and responsibility when responding to the question "What exactly do you think needs to be done today to stop or slow down climate change and global warming?" (Figure 2).

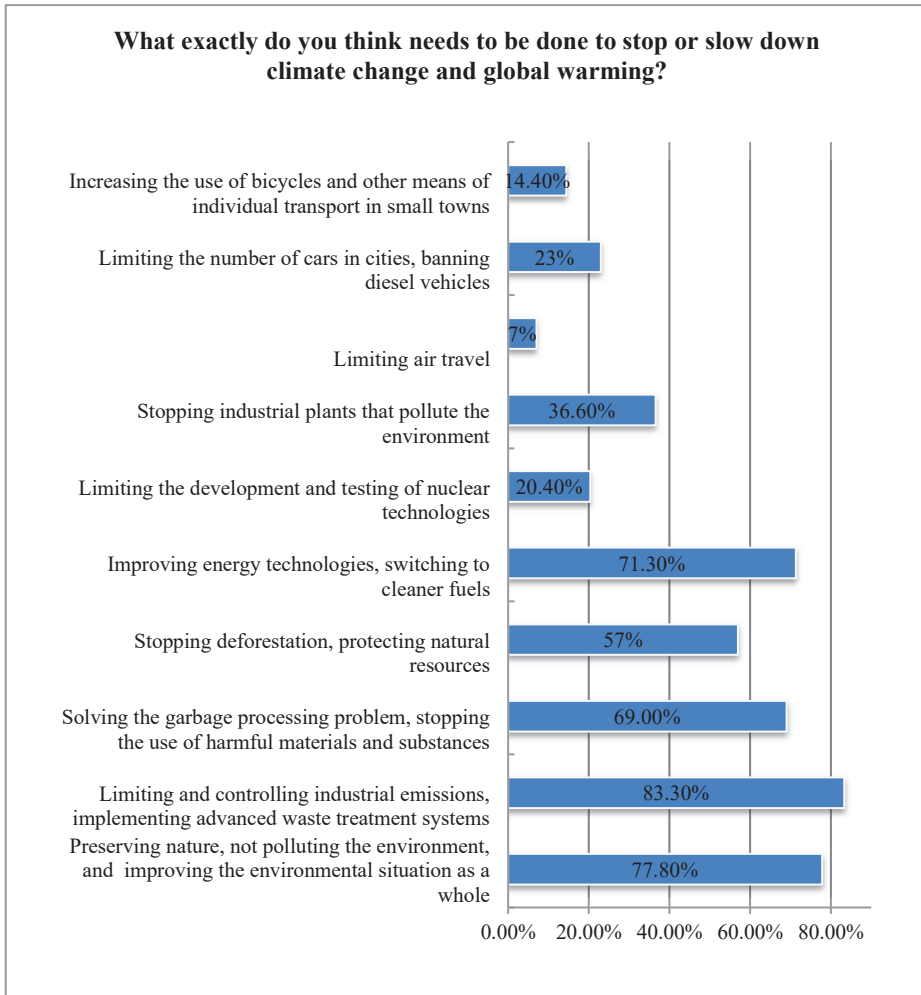


Fig. 2. Respondents' views on necessary actions to combat climate change.

According to 53% of the respondents, each household should reduce the consumption of electricity. 50% of the respondents suggested reducing water consumption; 58% of the respondents insisted on reducing heat consumption by installing heat meters in apartments/houses. Some respondents did not want to shift to economical consumption and believed that it was not necessary to limit themselves at all. However, only 9.4% of the respondents shared this viewpoint.

What kind of actions are students ready to take "here" and "now"? (Figure 3)

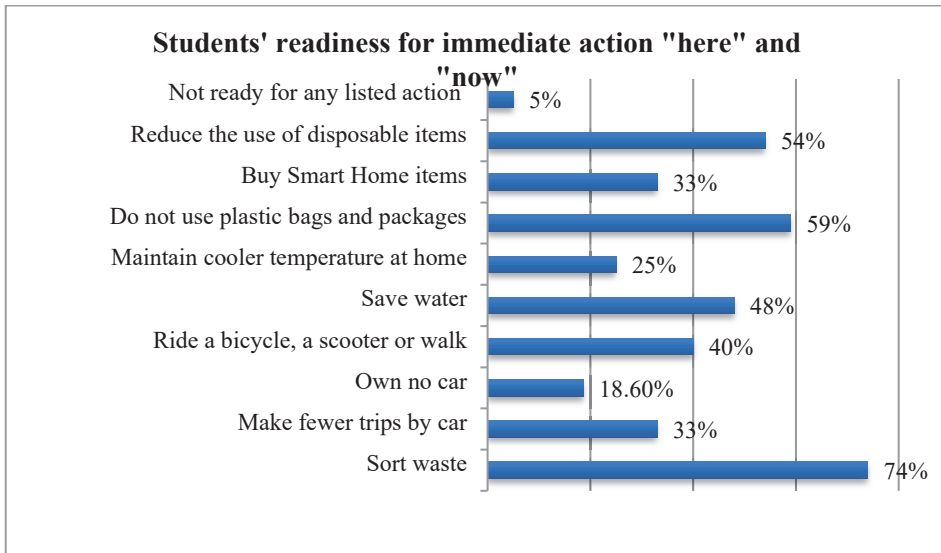


Fig. 3. NRU MGSU students' willingness to take immediate action to protect the climate.

So far, only 33% of students can still purchase Smart Home technology elements for energy-efficient home maintenance, and 25% of the respondents are willing to have lower indoor temperature in their homes. Our assumption is that the number of young people thinking this way will grow. Now the housing market offers homes equipped with "smart" and "passive" elements.

4 Discussions

Studies conducted at NRU MGSU show that the attitude of students to climate change problems is somewhat different from the attitude of other categories of the Russian population. If we compare our findings with the results of earlier surveys, we can still identify some insignificant differences. For example, our survey at Moscow State University of Civil Engineering revealed that 80.4% of the respondents called climate change a real problem, and 66.5% were sure that the city should be prepared for climate change as early as today. A 2020 survey by ROMIR, a Russian research holding company, has identified that 66 percent of respondents (about 1500 residents of various regions of Russia) thought climate change was a "real threat even now," 90 percent agreed that climate change was a "real problem," and 86 percent believed that "Russia would suffer losses from climate change. In addition, 80% of the respondents reported that they "already experienced the negative impact of climate change» and 69% of the respondents associated it with human activity.

The data from the VCIOM poll, conducted in February 2020, are totally different. According to the VCIOM poll, only 52% considered the problem of global warming as a serious one, and 40% called it "overblown". According to VCIOM analysts, the older generation takes global warming more seriously than young people. Only 52% of respondents, younger than 24 years old, consider the problem of climate change to be relevant. 66% of older people (66 years and older) treat climate change seriously.

The Eurobarometer, regularly conducted by the European Commission, reveals very different age-specific perceptions of climate change. A survey conducted in the European Union in 2021 showed that respondents aged 15-24 was much more likely to talk about climate change than those aged 55 and older. At the same time, respondents who continued

their education after the age of 20 mentioned climate change problems more often than those who finished their education at the age of 15-16 years [20]. The fact that young people are more concerned about climate change is confirmed by an Australian survey [21].

Respondents who participated in the survey at NRU MGSU were 18 to 24 years old. The survey findings can be compared with the results of a survey conducted from May 18 to June 6, 2021 in ten countries (Australia, Brazil, Finland, France, India, Nigeria, the Philippines, Portugal, the United Kingdom, and the United States). There were 1000 participants from each country [22]. 59% of respondents from all countries were "very concerned about climate change", and 84% of them were "moderately concerned" with the problem, which correlates with the results of our survey (84% at NRU MGSU).

Some differences were found between the results of the NRU MGSU student survey and the 2020 ROMIR survey in terms of climate change causes. In the ROMIR survey, "burned coal, oil, and gas" (48% of respondents) was mentioned by the largest number of respondents as the cause of climate change. In the student survey, "higher greenhouse gas emissions, other harmful emissions" topped the list of causes (76.6%). Hence, NRU MGSU students identified a wider range of causes of greenhouse gas emissions than the burning of coal, oil and gas. "Deforestation" was mentioned as a cause of climate change by 46% of respondents in the ROMIR survey and 44% in the NRU MGSU survey. Here the respondents' opinions were the same. Extremely dense development in cities, leading to overheating, increased greenhouse gas emissions, was mentioned by urban planning students. Development also affects the intensity of rainfall in and around the city, increasing the risk of floods in coastal cities.

Let's analyze the data on the priority actions ("here and now") of four surveys, launched at NRU MGSU (2021), VCIOM (2020), ROMIR (2020), and Eurobarometer (2021) to identify specific actions respondents are willing to take to combat climate change (Figure 4).

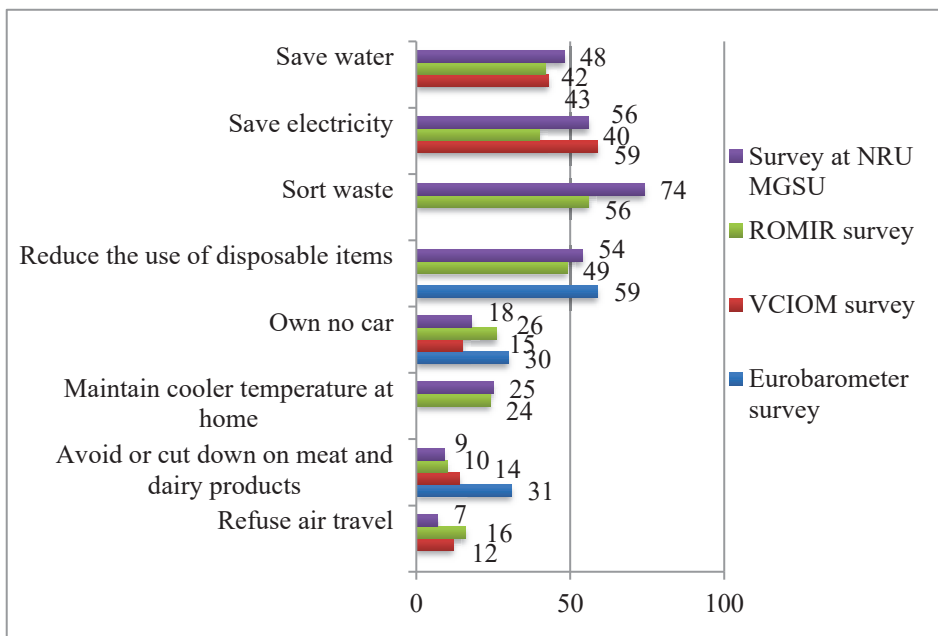


Fig. 4. Respondents' readiness for personal action.

This figure highlights the positions that coincided in two or more surveys. There are some differences, but the results of these surveys show a fairly close opinion shared by all categories of respondents. Separate waste collection is an extremely relevant issue both in Russia and in Europe. In Russia, local housing and utility services pay little attention to waste large-scale waste sorting. This trend is explained by the fact that the waste recycling industry is underdeveloped in Russia; there are no strict requirements for waste collection and transportation. In addition, waste sorting is a very complicated business. You need to know what materials discarded things are made of and how long they decompose; in what containers we shall put this or that garbage. Recycling is also a long and troublesome undertaking, as there are very few collection points in cities, and they may be too far from homes.

The situation in European countries is different. For example, in such countries as Germany, Finland, Sweden, separate garbage collection is part of a daily routine. In Sweden garbage is divided into 8 categories, separate bins are installed for each type of waste. Unfortunately, the good intentions of many Russian respondents willing to sort garbage cannot be implemented. The way out is to make fewer purchases in plastic packaging, as well as to reduce the use of disposable things at home. Willingness to take such actions is in second place in all four surveys.

In terms of the readiness to reduce the consumption of meat products, the data from studies in European countries (31%) differ significantly from those in Russia. Young people, such as students of NRU MGSU, are not inclined to give up meat and dairy food, although they understand that animal husbandry contributes to global warming.

In European countries saving energy and water has already become a habit for all residents; energy consumption is an important factor when household appliances (a refrigerator, a washing machine or a TV) are bought. In Russia, about half of the respondents are ready for thrifty behaviour. The lowest number of respondents who are ready to save electricity (40%) and water (42%) is found in the ROMIR survey. NRU MGSU students lead in positions on saving water (48%), electricity (56%), separate waste collection (74%), reducing the use of disposable items (54%), but they are behind the ROMIR, VCIOM and Eurobarometer surveys, since they are not willing to give up personal cars (82%), meat and dairy food (91%), air travel (93%).

5 Conclusions

Having analyzed the results of the sociological survey launched among the NRU MGSU students and compared them with the results of other surveys, we can draw some conclusions about the level and nature of climate consciousness and behaviour features of NRU MGSU students majoring in "Urban Planning", "Architecture", and "Construction of unique buildings and structures".

1. The level of consciousness and behaviour of NRU MGSU students make them different from other categories of respondents, probably, due to the special education of architects and urban planners involved in the formation of the urban environment. Students design residential complexes, recreational areas, green urban frameworks, trying to ensure the eco- and climate-resilient state of the city. They pay special attention to the presence and condition of waste collection sites in planning projects; accordingly, their own perception of climate change processes changes. Climate change becomes not a distant and abstract event, but an actual and concrete one that can be influenced.

2. Higher energy and water savings of NRU MGSU students, compared to other categories of respondents, are associated with modern requirements for the design of energy-efficient homes, the use of environmentally friendly building materials, and

compliance with green space regulations. Students take these regulations into account in their study projects.

3. Those questions that did not address students' vocational education had lower scores.

4. The results of the survey show that environmental and climate education is organized quite rationally at NRU MGSU, but it is necessary to incorporate climate disciplines into some educational programme. Particular attention should be paid to the practical training of urban planners and architects for them to be able to master technologies to adapt cities, buildings and structures to climate change.

5. As there are fewer ecological and climatic disciplines in the curricula of specialist-degree seekers, it is necessary to improve curricula by adding these disciplines.

It is required to provide more information and perform more educational work with students in terms of environmental problems and climate change in general.

6. The study will continue, the next step will be to identify the degree of professional responsibility and professional preparedness of future builders, urban planners and architects for combatting the negative processes of climate change.

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