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Propaedeutics of eco-friendly design and implementation of the dual program "Science - Education – Production" in the industrial design specialization

La propedéutica del diseño ecológico e implementación del programa dual "Ciencia – Educación – Producción" en la especialización en diseño industrial

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ABSTRACT

Introduction: This article presents material that reflects one of the constituent stages of the educational process, taking into account the principles of environmentally friendly and regional design, as an actual direction of innovative design practice. **Materials and Methods**: On the example of the works of students of the specialty industrial design, the options for solving problems based on the indicated principles are presented. In the modern educational process, which must take into account various factors, the concept of regional eco-design is becoming more and more popular. **Results and Discussion**: A future bachelor studying in the specialty "Industrial Design" must understand that the designed product must not only have aesthetics, but also bring real benefits to society, meeting modern environmental requirements. The design tasks of sustainable design should include creating a comfortable visual environment and microclimate, using natural materials with the possibility of their subsequent processing. Thus, the design and production of life support products, which allow, at a minimum cost of resources and energy, indirectly supports the development of earthly civilization in a safe way, preserving its natural resources. The state policy of the Republic of Kazakhstan supports the development of education in the field of industry and is interested in "bringing up a new generation of industrial engineers". IEC (KazGASA Campus) graduates industrial specialists who are able to integrate into modern space, have mobility skills, but at the same time bear the identification of the national culture, which is rich in its experience and traditions. At present, the general cultural space in Kazakhstan is, in fact, a large field and platform for disclosure and careful immersion in the rethinking of heritage, which we need to study from new modern positions. **Conclusions**: The historical analysis of traditions and way of life is currently perceived as a kind of symbolic cultural code, as a new look at the nomadic model of the life order of our ancestors.

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INTRODUCTION

In the IEC (KazGASA Campus), at the Faculty of Design, for the past fourteen years, students have been preparing for the educational program Industrial Design. The specialty "Industrial Design" refers to design, the purpose of which is to give an artistic form to objects of industrial production (from household items to industrial complexes). That is, an industrial designer is a specialist who, in his work, solves the issues of designing objects of high quality functioning in accordance with the needs of the individual and society as a whole.

Design is traditionally understood as a technical aesthetic based on the artistic and ergonomic properties of industrial products. According to the International Council of the Society for Industrial Design (ICSID): "Design is a creative activity whose purpose is to establish the multifaceted quality of objects, processes, services and their systems throughout the entire life cycle". Thus, design is a central factor in the innovative humanization of technology and a decisive factor in cultural and economic exchange[1].

The new term design entered the sphere of creative activity and W. Morris and Ruskin introduced in practical implementation, as well as in theoretical studies it at the end of the nineteenth century. Design was opposed to the existing traditional artistic culture of this period. The emphasis and attention of this sphere of creativity began to be activated and used in various areas of the life of industrial production items, the rejection of decorativeness, embellishment towards basic requirements, such as functionality and versatility[2].

The main requirements for the design project was the possibility of mass industrial production of products. The main mission and the very essence of design was consumer-oriented. Along with this, the final peak of the design activity is the creation of an object-spatial environment, which should be harmonious and fully meet the utilitarian and spiritual needs of a person[3], his optimal functional processes of life and accessibility in the marketing field. In this regard, the anthropocentric focus of object design is the leading one, which creates the maximum preferred comfort for a person[4]. Object design is embodied in the creation of the most convenient objects that must meet everyday and socio-cultural needs both from the standpoint of aesthetics[5] and from an engineering and technical position, which in turn satisfy the various needs of people. Design must be studied as the most important way to solve problems that apply to all types and types of material support in any of the areas of human activity[6].

MATERIALS AND METHOD

This article analyzes the origins and principles of the regional ecological approach in the educational process of this specialization. In the works of such authors as D. Reskin, W. Morris, Le Corbusier, A. Peccei, V. Papanek, the links between design activity, production processes and the environment are touched upon, and the impact on the nature of an artificial object-spatial environment is considered.

This material is based on the study of the works of leading researchers from near and far abroad who study environmental problems as the main problem of modern society: G. Semper, L. Corbusier, L. Mumford, J. Nelson, L. Sullivan, W. Morris, V. Berens[7]. Fundamental research authors: A. Glazacheva[8], V. Papanek[2], A.V. Uvarov[3], M. Pankina[9]. Others, as well as the works of Kazakh authors, historians, art historians, architects who study the traditional Kazakh identity from the standpoint of an ideal world order: A. Margulan, B. Ibraev, M. Mendikulov, & B. Glaudinovv[10], N. Kradin[11]. Research on the identity of traditions in the perception of modern Kazakhstani design of the architectural environment in the work of the authors: Zh. Imanbayeva & L. Nurkusheva[12].

The article discusses the main modern trends that underlie the formation of ideas for creating a design product and further design solutions. Examples of successful implementation of projects are collected – graduation works of students, some of them have a copyright certificate and can be successfully implemented in production. Also the international experience of holding a workshop with implemented prototypes of object design objects with the Italian manufacturers "LISAR" and "IDOGI" is given.

RESULTS AND DISCUSSION

Design education inspired by the culture of our ancestors in our time shows that culture is a viable element in the study of industrial design in both the formal and informal sectors, given its growing contribution to the economic life of the country. The works of final qualifying works can fully reflect these points[13]. The modernity of processes and products is achievable when design concepts are inspired by culture, tradition and innovation.

In the educational process, it is very important to develop students' understanding and awareness of the social, cultural, physical, technical and economic activities of society in the formation of ideas for creating high design. It is advisable

to take into account the regional, ethnic model developed by previous generations, in which there is a harmonious balance of interaction between man and nature[8].

Man and nature are the main components of the concept of interpenetration and correspondence, harmony, which determines the basis of balance. The concept of the nomadic model includes the concept of the ethnic space of the traditional housing of nomads, and here it is important to say that it is the concept of the relationship between man and nature that it is advisable to define as the main figurative-functional relationship, these issues should underlie the concepts created by students and teachers.

High-tech products in mass production, in the light of globalization and mechanization, lead to the depletion of natural resources and lose the individuality of objects of the object environment. In this connection, a design model is proposed. It is introduced into the educational process, which includes ethno design, regional design and eco design[14].

In the educational process, for example, the course of such disciplines as "Regional Design" and "Ecosystem in Industrial Design" is aimed at ensuring that students not only have an idea of the historical and cultural heritage, but also can systematically immerse themselves in the basics of environmental design. In this regard, the curriculum for industrial designers should become more integrative and generalizing, and its modification towards eco-regional design becomes the most important factor in shaping the personality of a future professional in many fields of activity. Along with this, the propaedeutics of ecological design allows students to form the most important ideas about the interaction of the subject-spatial environment[15], which should be used when designing various design objects.

Modern design, to be environmentally responsible and socially responsive, must follow nature's principle of least effort (create maximum variety with minimum tools, or achieve maximum results with minimum means). This means: consume less, use things longer and show savings in reusing materials. At the same time, the content of the concept of "ecological design" should include not only ensuring the environmental cleanliness of materials[16], production and consumption processes, but also the spatial and temporal organization of the environment, corresponding to a comfortable human existence.

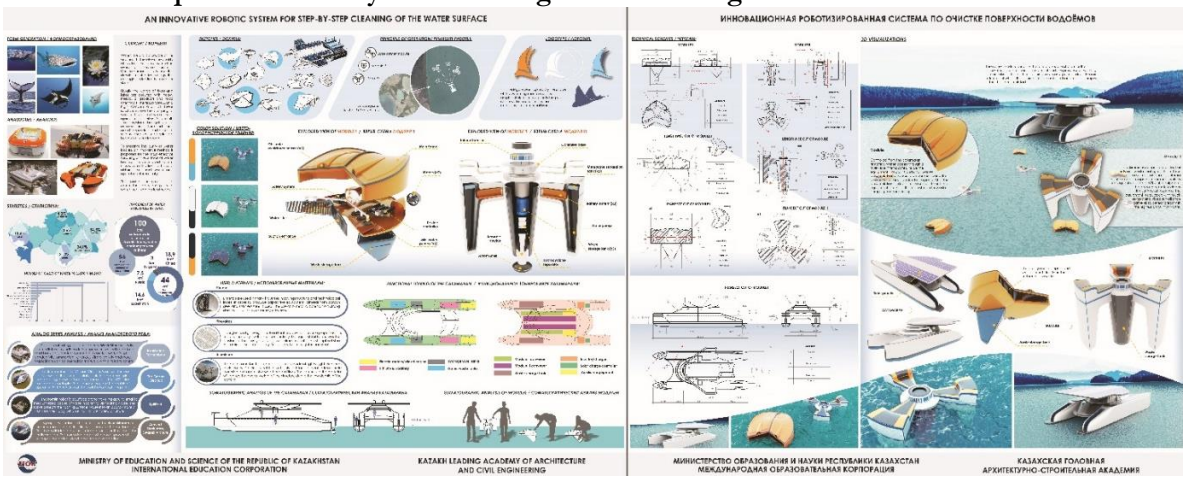
Ecological design as a projected area combines artistic and aesthetic values based on ideological and social paradigms, as well as scientific understanding of a number of human activity factors aimed at caring for the environment, as well as the consequences of the interaction of human activity and nature. The worldview platform of values of design tasks, which is based on the unification of the concepts of design, where the concepts of ecological design and artistic design concept are reunited, based on theoretical models of traditional design.

When designing objects of object design and creating the design concept itself, the corresponding tasks are structured, aimed at connecting the components of science and education, comparing the connecting link of the eco-educational process with the ethno-cultural heritage from the standpoint of the historical and modern innovation process. The corresponding tasks in the concept reflect the requirements: man and culture, man and natural eco-requirements that meet the tasks of improving the ecological situation by creating industrial design objects that correspond in form and function to the modern concept of consumer culture.

The unification of the principles of consumption requires not only a high-quality object of subject design, but also the ability to have an object that becomes both multifunctional and transformable, as well as environmentally friendly and durable in use[9].

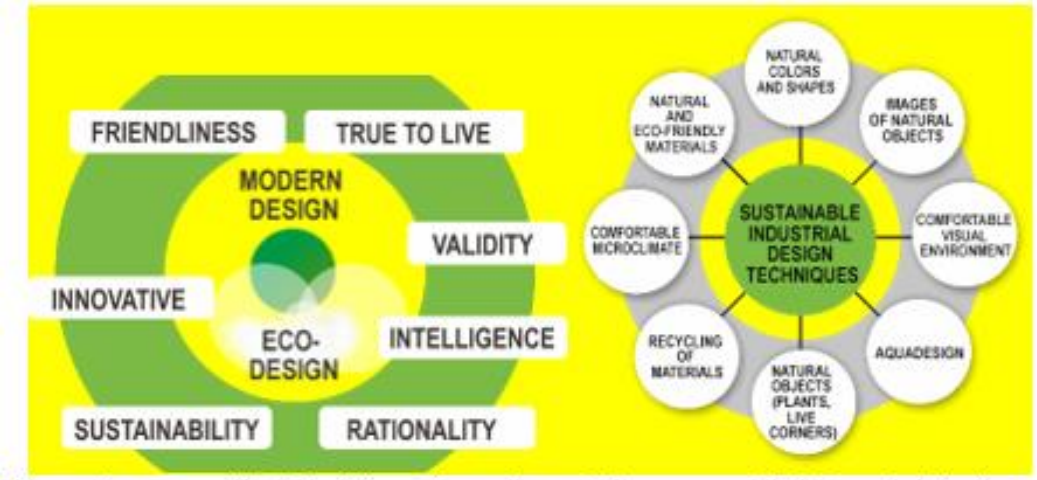
Studying the discipline "Ergonomics" in our educational program, we are immersed in a detailed somatographic analysis, which helps to analyze not only the comfort of using an object for a person during design, but also provide for the corresponding requirements in terms of ergonomics from the standpoint of physiological, hygienic and other parameters. In the thesis work of a student, a stylistically correct and functional image of a robotic mobile mechanism for ecological cleaning of water bodies was created (Figure 1).

Figure 1. The concept of a robotic system for the gradual cleaning of the surface of water bodies



Design tasks correlated with the image of a natural series of an ergonometric and ecological nature, we cannot design according to the principle of direct similarity of natural bionic forms, repeating their design, on an automatic basis, based on the usual perception of visual forms[5]. When designing objects of environmental and subject design, somatographic analysis dictates its own specific principles of shaping, which meet the objectives of creating psychological and functional comfort (Figure 2).

Figure 2. Conceptual schemes of the ecological component in the formation of modern design objects



A), environmentally friendliness in modern design B) Industrial design and its environmental components

C) factors of high-quality ecological design

It is difficult to overestimate the importance of each of the listed qualities in the connection chain nature-object-man. The exclusion of one element leads to a violation of the integrity of the structure. For example, the use of the resource-saving system "Smart Home" is largely environmentally justified in relation to the natural environment, but excludes aesthetic aspects due to its super-technological nature, thus denying the scope of environmental design. An object that copies the natural form may not be ergonomic and may not be functional enough[17].

The characteristic features of sustainable design are a set of multifaceted disciplines, a set of design tasks and an integrative approach.

"Sustainable, green ecological design" is directly related to the concept of alternative energy - these are renewable, so-called regenerative energy resources. These are the resources that a person receives with natural manifestations: geothermal energy, solar energy, wind energy, hydropower, biomass and tidal energy. "Green energy" can sufficiently provide humanity with energy without the use of artificially produced non-renewable sources that can be depleted: natural gas, oil, coal and uranium ore. Connecting to sustainable energy sources is environmentally friendly, can be used indefinitely and at minimal cost, so when designing facilities, these factors should be prioritized. The implementation of this concept is formed in the framework of the thesis (Figure 3).

Figure 3. Compact collapsible generator synthesizing three energy resources: water, wind, sun

The objectives of this direction in design: minimizing waste; creation of a healthy environment; reducing the consumption of non-renewable resources. Renewable energy sources have great prospects, because their use reduces the cost of their operation. This means that "clean energy" sources may soon replace the use of fossil fuels as sources of energy production.

Analysis by T.Yu. Bystroy, regarding the terms "green design", "ecological design", "sustainable design" according to the principles of shaping, ideology and interaction, showed that in practice these concepts mean the same thing. At the same time, the term "ecological design", which seems to us still more widespread in everyday life. It is found in not only the scientific literature on industrial design, architecture, and applied ecology, but also in philosophy, sociology, psychology, medicine, and pedagogy[18]. Ecological design has the following definition: the solution of modern social problems of protecting the environment by methods and means of design and preventing its pollution by technogenic waste of civilization from the standpoint of the value of nature and culture[6]. This complex activity takes into account the requirements of the natural environment and culture (1). In the natural-spatial environment, each object of subject design forms a design task, as a complex solution of concepts that needs certain types and nature of human activity. The problem is that when shaping these objects, aesthetic and stylistic principles of design are very rarely taken into account.

The main focus of environmental design in design is aimed at protecting the environment at any stage of the life cycle of a design object: from the stage of its design, during use and subsequent disposal. Of particular importance are the consumption of resources, the origin of materials, safe use, the possibility of trouble-free disposal, and the reuse of materials without compromising the environment[19]. In marketing, there is such a concept - to observe the principle

of ecological balance 3R (reduce, reuse, recycle - reduce, reuse, recycle). The idea of reducing production and expanding the sale of things, the transition to recyclable technologies. An example is the work of modern industrial designer Vadim Kibardin, who makes his original chairs from waste paper[20]. Design objects designed in compliance with environmental principles (recycling and sorting of household waste) (Figure 4).

Figure 4. Development of equipment for the systematization and sorting of household waste; innovative design equipment for household waste sorting at home

In modern design, a whole direction is currently defined as: sustainable design, green design, and so on. But along with this, no matter how this most important component of the design activity is called, the most important factor is to see in the final product the maximum degree of the required quality of the subject design object. In the system of design functions, cognitive, value-oriented, communicative, adaptive, educational functions are singled out[3]. The socio-cultural essence of design is manifested in the influence of the subject-spatial environment on the social behavior of a person, in the communicative nature of the form, in the sign-symbolic reading of design objects. The designer must comply with environmental principles in his design activities and foresee how his implemented objects will affect people, form worldview and aesthetic ideals, and value attitude to the environment.

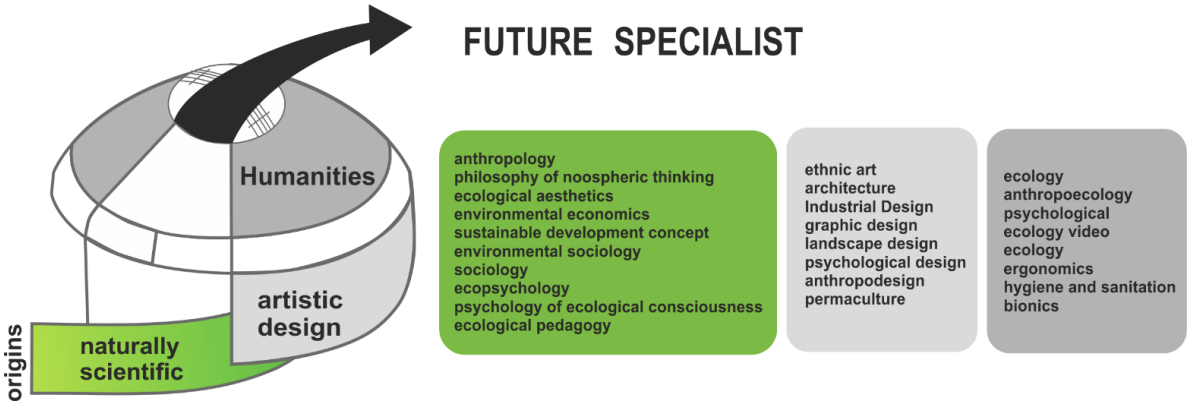
Today, there are no more people who would doubt that the propaedeutics of environmental design and environmental thinking in various areas of the designer's design activity is becoming the most important factor and this imposes moral and ethical responsibility on designers[21].

Representatives of art, architecture and design are directly related to the possibility in their design activities to create conditions for the creation of sustainable design and a positive ecological environment for human interaction with the object-spatial environment. The working curriculum of the industrial design specialty is formed in such a way that as students move from course to course, students are oriented precisely to the fact that when designing a subject-spatial environment for internal and external spaces for life, the main target factor remains an environmentally oriented concept when creating a project idea. If we turn to history, we can see the following pattern: the subject-spatial environment was formed in accordance with the ideologies of society, with its social and political foundations. Housing, household items, arts and crafts reflect a person's worldview and the level of technology development. A person's attitude to the environment was formed depending on natural phenomena and natural life cycles. Therefore, when shaping the dwelling, interior details, furniture, household items, and decor, natural elements resembling natural forms were used. For example, patterns of ornamentation are directly related to patterns of natural phenomena.

The genesis of the civilization of each society includes spiritual, cultural and technological indicators. If we talk about the processes of the emergence and progress of civilization in the steppes of Eurasia in antiquity, innovations in material culture, methods of production, then the nomads made a huge contribution to the creation of material and spiritual culture, inventing new technologies and means of communication that mankind uses to this day.

Among the countries of Central Asia, Kazakhstan has distinctive features when it comes to the cultural heritage of the past and creativity, which directly depend on the conditions of life associated with nomadism. Historical roots in the past[22] formed the concept of the mobility of the housing structure – the yurt, and also formed the object-spatial life support system, and as a result, the way of life, which in turn dictated certain requirements for housing and household items of the ethnic group (Figure. 5).

Figure 5. Propaedeutics of ecological design

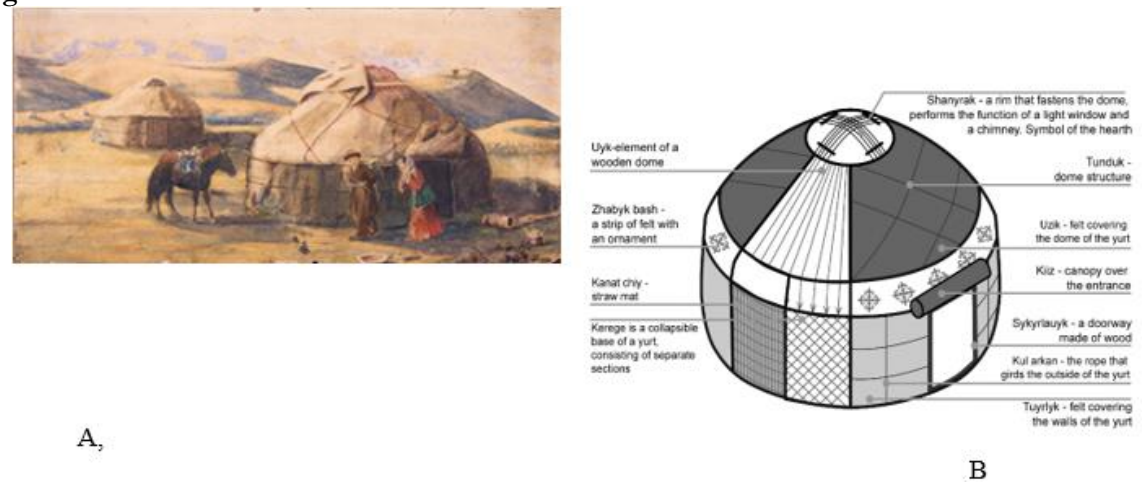


The Kazakh yurt reflects the traditional idea of the formation of a transformable living space, and the design itself reflected its correspondence with the semantics of the concept: the structure of the world[11]. A yurt is like a small universe of a nomad that meets all the requirements of ecological design. Products from felt, leather, tapestry, Kazakh ornament are used in handicraft practices. These everyday works of art instilled many iconographic and mythological images that expressed their cultural identity, social values, history and beliefs.

The exemplary creative qualities and skills of the craftsmen were effectively combined to produce highly functional items[23] that exhibit an exceptional aesthetic aura that satisfied everyday household needs. It is this knowledge that students receive, who are directed to the area of the basics of ecological design, inspired by the ethno-culture of the historical past, which should develop the skills of students. Thus, this article reflects the importance of the educational process of industrial design students in the field of environmental design, inspired by the ethnic culture of the historical past.

The model of living space of a nomadic civilization is also characteristic of a portable mobile dwelling[19]. "The special way of thinking of a "nomadic person" is a special work of thought, its own philosophy, its own outlook on life. Under the influence of the way of life associated with nomadism, a new kind of culture was accordingly formed. This newly formed culture reflects empirical knowledge, originality of thought and poetic expression, in many ways more complex than our contemporaries believe". An illustration of the above can serve - the student's thesis - a mobile rescue station (Figure 6).

Figure 6. a – A. Kasteev "At the yurt". 1937 (photo from the museum fund), b – Design of a yurt – a mobile dwelling for a nomad



The Kazakh yurt consists of a systemic set of elements of load-bearing and enclosing structures. At the same time, the universal design of the yurt is considered as an object of art that has a semantic image of the universe. This design correlates with the structure of the dual system, which is embodied in a single concept as: a microcosm of real, as well as material existence[12].

At the same time, the universal mobile design of the yurt is a symbol that reflects the basic empirical concepts of the culture of society. In the functional-spatial solution, there are clearly defined connections and specially designated places as a clearly organized system that reflects the place of each of the living people, the designated places for men and women, including their age and social status within the family[24].

The main factors of the constructive basis were such concepts as: lightness, multi-modularity of the elements filled in the structure[21]; The most important factor in the formation of the dome shell itself is: the thermal insulation of specially hand-crafted materials such as felt. On the territory of Central Asia, during the period of the coldest climatic manifestations, it was the design of the yurt that was appreciated[10]. Along with this, and at the present time, architects often turn to the image and formation of this type of mobile structure when creating a new vision and creating their own concepts, correlating their creativity with the period of the past (Figure 7).

Figure 7. A mobile rescue station, formed from elements based on the principle of a traditional Kazakh dwelling

The modern interpretation of a mobile multifunctional mobile object is like a nomadic village. On the territory of the steppe and forest-steppe spaces in the central and southeastern territories of Asia, for almost three millennia, nomadic pastoralism has always been the main and main economic base of the tribes that inhabited this area[25]. In the course of their evolution, a need arose to create an extremely versatile form of housing that could be easily transported in space[26]. When moving, the structure of the yurt was solemnly dismantled, and all its individual structural components were transported on camels and horses[27].

In the published scientific studies of Kazakh scientists, it was proved that it was on the territory of the forest-steppe zone of Kazakhstan during the period of the Botai culture that the horse was first tamed in the time period of the Neolithic and Eneolithic 5-4.5 thousand years ago. And it was during this time period that the community of tribes that inhabited the vast territory of Eurasia was manifested for a long time[22]. The modern image of movement of nomads is a car, the possibility of transformation of which is reflected in the thesis work of T. Altuev (Figure 8).

Figure 8. Modern image of movement of nomads is a car, the possibility of transformation

The endless space of the Kazakh steppe has always been open to the sharp gaze of the nomad. Wide open spaces, sandy hills and mountains have unique natural forms and colors that can awaken creative imagination and create original visual images when designing objects of design[28]. The idea of a vertical connection with the cosmos, the use of the "mountain" archetype is reflected in the competition project of a lighting device by R. Petrov, a student studying industrial design. This project was implemented jointly with the Italian manufacturers Aidozhi, who, according to the design concept, manufactured a grandiose chandelier from Murano glass and metal in an industrial way.

CONCLUSIONS

The main goal of the educational process is to improve techniques that reflect the principles of ecological ethno-regional design. In the propaedeutic course of the specialty industrial design (16), it is necessary not only to gain knowledge in ecology, but also in-depth knowledge in the direction of regional ethnoculture. This is a link in the formation of the concepts of object design objects based on traditional culture and life with a targeted emphasis in the direction of environmental policy at all stages of creating an artificial object-spatial environment.

In the educational process, the most important step is direct contact with the production base. In this context, it is necessary to intensify the practice of the workshop. Student seminars, which contribute not only to the system of performing project tasks on a competitive basis, but also to see the fact of selecting the best project idea and task that the organizer selects from the customers. The manufacturer, the customer and the party to the actual implementation of the selected project evaluate the student's project from the position of the functional task of the production process. Therefore, the triadic connection science-education-production in the dual process is the main target link leading to the release of students ready to solve specific problems in modern production. An example is the work done as a result of an international student workshop held at the Faculty of Design, IEC (KazGASA Campus) with the IDOGI Murano factory in Venice.

One of the main target principles of the educational process is a structural immersion in the historical regional origins of traditional culture, and through the prism of modern industry, the goals and objectives of environmental design are formed as an actual direction of innovative design practice. The sociocultural role of design, as one of the main ecological paradigms that is being formed in the conditions of modernity, is the main basic component that forms the self-awareness of future industrial designers.

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