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# MULTIDISCIPLINARY PRODUCT DESIGN AS A TOOL FOR REFLECTING AND PRESERVING KAZAKH CULTURAL HERITAGE

*L.T. NURKUSHEVA , A.M. ASHIMOVA*

**(International Educational Corporation (Kazakh Head Architectural and Construction Academy), Kazakhstan, 050043, Almaty, Ryskulbekov str., 28)**
Corresponding author e-mail: nur_lyazzat@inbox.ru, ay.ashimova@mail.ru

***The article is devoted to the development of a methodology for integrating cultural codes of the Kazakh heritage into educational programs on industrial design with an emphasis on the principles of sustainable development. The article explores the importance of integrating traditional materials such as felt, wood, and ornaments, along with traditional crafting techniques, into modern practices that align with contemporary environmental and technological standards. The study provides a qualitative analysis of existing works on sustainable design and cultural heritage, including the works of R. Dorri and A.H. Margulan. Special attention is paid to an interdisciplinary approach that combines knowledge in the field of ecology, history and modern technologies, which allows students to create environmentally friendly products reflecting the cultural characteristics of Kazakhstan. Examples of successful project assignments completed by students demonstrate how traditional Kazakh elements can be reinterpreted and adapted to modern needs. The article emphasizes the importance of preserving national heritage through education and its connection with sustainable design. Nevertheless, despite the progress made, the study highlights the need for further experiments and the development of deeper techniques that will allow graduates to be competitive in the global market, combining cultural identity and environmental responsibility. Kazakhstan due to its rich cultural heritage and environmental resources, has a unique potential for creating sustainable products, but additional research is needed to unlock the full potential of this integration.***

**Keywords: sustainable design, Kazakh culture, eco-friendly products, traditional ecological knowledge, green economy.**

# ҚАЗАҚТЫҢ МӘДЕНИ МҰРАСЫН КӨРСЕТУ ЖӘНЕ САҚТАУ ҚҰРАЛЫ РЕТІНДЕ КӨПСАЛАЛЫ ӨНІМДЕРДІҢ ДИЗАЙНЫН ҚОЛДАНУ

*Л.Т. НҰРКУШЕВА, А.М. ӘШІМОВА*

**(Халықаралық білім беру корпорациясы (Қазақ бас сәулет-құрылыс академиясы), Қазақстан, 050043, Алматы, Рысқұлбеков көш., 28)**
Автор-корреспонденттің электрондық поштасы: nur_lyazzat@inbox.ru, ay.ashimova@mail.ru

***Мақалада қазақ мұрасының мәдени кодтарын тұрақты даму принциптеріне баса назар аудара отырып, өнеркәсіптік дизайн бойынша білім беру бағдарламаларына интеграциялау әдістемесін әзірлеу мәселесі қарастырылады. Онда киіз, ағаш, ою-өрнектер сияқты дәстүрлі материалдар мен қолөнер техникасын қазіргі экологиялық және технологиялық стандарттарға сәйкес келетін заманауи тәжірибелерге енгізудің маңыздылығы атап өтілген. Зерттеу тұрақты дизайн мен мәдени мұраға қатысты Р. Дорри мен А.Х. Марғұланның еңбектері сияқты бұрыннан бар жұмыстардың сапалық талдауын қамтиды. Экология, тарих және қазіргі технологиялар саласындағы білімді біріктіретін пәнаралық тәсілге ерекше назар аударылады, бұл студенттерге Қазақстанның мәдени ерекшеліктерін көрсететін экологиялық таза өнімдер жасауға мүмкіндік береді. Студенттердің орындаған табысты жобалық тапсырмаларының мысалдары дәстүрлі қазақ элементтерін қайта қарастырып, қазіргі қажеттіліктерге бейімдеуге болатынын көрсетеді. Мақалада ұлттық мұраны сақтау ісіндегі білімнің рөлі және оның тұрақты дизайнмен байланысы атап өтіледі. Дегенмен, қол жеткізілген жетістіктерге қарамастан, зерттеуде түлектердің жаһандық нарықта бәсекеге қабілетті болуы үшін мәдени бірегейлік пен экологиялық жауапкершілікті біріктіретін терең әдістерді әрі қарай әзірлеу және тәжірибелер жүргізу қажеттілігі атап өтілген. Қазақстан бай мәдени мұрасы мен экологиялық ресурстарының арқасында тұрақты өнімдер жасауға ерекше әлеуетке ие, бірақ осы интеграцияның толық мүмкіндіктерін ашу үшін қосымша зерттеулер қажет.***

**Негізгі сөздер: тұрақты дизайн, қазақ мәдениеті, экологиялық таза өнімдер, дәстүрлі экологиялық білім, жасыл экономика.**

# МУЛЬТИДИСЦИПЛИНАРНЫЙ ПРОДУКТОВЫЙ ДИЗАЙН КАК ИНСТРУМЕНТ ОТРАЖЕНИЯ И СОХРАНЕНИЯ КАЗАХСКОГО КУЛЬТУРНОГО НАСЛЕДИЯ

*Л.Т. НУРКУШЕВА, А.М. АШИМОВА*

**(Международная образовательная корпорация**
**(Казахская головная архитектурно-строительная академия),**
**Казахстан, 050043, Алматы, ул. Рыскулбекова, 28)**
Электронная почта автора-корреспондента: nur_lyazzat@inbox.ru, ay.ashimova@mail.ru

***Статья посвящена разработке методологии интеграции культурных кодов казахского наследия в образовательные программы по промышленному дизайну с акцентом на принципы устойчивого развития. В статье рассматривается важность интеграции традиционных материалов, таких как войлок, дерево и орнамент, а также традиционных техник ремесла в современные практики, соответствующие современным экологическим и технологическим стандартам. В исследовании проводится качественный анализ существующих работ по устойчивому дизайну и культурному наследию, включая труды Р. Дорри и А.Х. Маргулана. Особое внимание уделяется междисциплинарному подходу, объединяющему знания в области экологии, истории и современных технологий, что позволяет студентам создавать экологически чистые продукты, отражающие культурные особенности Казахстана. Примеры успешных проектных заданий, выполненных студентами, демонстрируют, как традиционные казахские элементы могут быть переосмыслены и адаптированы к современным потребностям. В статье подчеркивается важность сохранения национального наследия через образование и его связь с устойчивым дизайном. Тем не менее, несмотря на достигнутый прогресс, исследование подчеркивает необходимость дальнейших экспериментов и разработки более глубоких методик, которые позволят выпускникам быть конкурентоспособными на мировом рынке, сочетая культурную самобытность и экологическую ответственность. Казахстан, благодаря своему богатому культурному наследию и экологическим ресурсам, обладает уникальным потенциалом для создания устойчивых продуктов, но для раскрытия всего потенциала этой интеграции необходимы дополнительные исследования.***

**Ключевые слова: устойчивое проектирование, казахская культура, экологически чистые продукты, традиционные экологические знания, зеленая экономика.**

## *Introduction*

Sustainable development has become a global priority, driven by urgent environmental challenges such as climate change, resource depletion, and pollution. This necessitates fundamental shifts in production and consumption patterns, with sustainable product design playing a crucial role in minimizing environmental impact. While meeting environmental standards is essential, it is equally important to preserve cultural identity, especially in nations with rich heritage like Kazakhstan [1].

Kazakhstan's unique cultural landscape, shaped by centuries of nomadic traditions, presents a valuable opportunity to integrate traditional knowledge into modern sustainable design. Traditional crafts like felt carpet making, wood carving, and weaving exemplify sustainable practices adaptable to contemporary needs, highlighting the significance of developing a methodology to integrate cultural codes into industrial design education [2].

Despite global attention on sustainable design, integrating traditional cultural heritage into Kazakh industrial design education remains underdeveloped. Existing methodologies often lack focus on the region's cultural nuances and rarely leverage the potential of ethnic art for innovative and ecological design. This hinders the creation of unique products that reflect Kazakh cultural identity while adhering to sustainability principles. A key challenge is the lack of an interdisciplinary approach that bridges traditional craftsmanship, ecological principles, and modern design technologies. This necessitates a comprehensive methodology that equips students not only with technical skills but also with the creative capacity to incorporate cultural heritage elements into contemporary design.

This paper aims to develop such a methodology, merging Kazakh applied art traditions with sustainable development principles. This involves analyzing existing research on sustainable design and cultural heritage, identifying key cultural elements (traditional materials, ornaments, craft techniques) for modern product application, and developing design projects that encourage students to create environmentally sound, culturally reflective products. A crucial aspect is implementing an interdisciplinary approach, encompassing history, ecology, and modern design technologies, to ensure comprehensive learning.

This research contributes to the advancement of industrial design education by proposing a unique approach to integrating cultural codes. This methodology not only preserves Kazakhstan's cultural heritage but also enhances the nation's capacity for sustainable production. In the context of growing interest in eco-design and the green economy, creating products that blend cultural tradition with environmental responsibility is crucial for developing local markets and strengthening national identity. The novelty of this research lies in its approach, which integrates Kazakhstan's cultural heritage into modern design with a focus on sustainability. Unlike existing programs emphasizing technical skills, this approach ensures a deep understanding of cultural traditions, enabling the creation of innovative products with high added value [3].

The paper is organized into four main sections. The first section delves into the core concepts of cultural heritage and sustainable design, providing a foundational understanding of their significance. Next, the theoretical underpinnings of interdisciplinary approaches in education are examined, highlighting their relevance to modern design practices. The methodology section details the step-by-step process for developing student design projects, offering a clear framework for practical implementation. Finally, the results of applying this methodology are presented, along with actionable recommendations for its future adaptation and broader application.

***Materials and research methods***

To achieve the research objectives and address the stated tasks, a series of methodological approaches were employed, based on the analysis of scientific articles and books. First and foremost, a qualitative analysis of existing research in the field of sustainable design and cultural heritage was conducted. The analysis was based on the works of R. Dorri (Developing Critical Reflection: Role of Sustainability in Modern Design and Cultural Heritage), which emphasizes the importance of cultural heritage in modern design, and the research of Setlhatlhanyo, K.N., Marope, O., Moalosi, R., Sealetsa, O.J. (Developing Creative Product Designs Inspired by Ethnic Cultural Heritage), demonstrating examples of using ethnic codes in educational projects [1, 2]. Additionally, the works of A.A. Bakanov and A.R. Tenchurina (2020) (Formation of Universal Design Competencies in the Training of Engineering Personnel: An Interdisciplinary Approach) were analyzed, which helped to develop design tasks using an interdisciplinary approach [5].

The second stage involved a comparative analysis of traditional Kazakh crafts based on the works of A.Kh. Margulan (1950-1970), which detail elements such as felt carpets (syrmaks, tekemets), wood carving, and their historical and cultural significance. This allowed us to identify key elements of Kazakh art that can be adapted for modern products, taking into account the principles of sustainable design.

The third stage of the study was project modeling, aimed at developing educational tasks for students. These tasks were based on the integration of knowledge from various disciplines (history, design, ecology, and technology), utilizing the research findings of the aforementioned authors [6].

**Material description**

This research drew upon a diverse range of materials, encompassing both cultural elements of Kazakh applied art and relevant academic sources. Primary materials included traditional materials and techniques such as felt, wool, wood, ornamentation (e.g., "ram's horn", astral circles), and techniques of weaving and wood carving. These elements were analyzed based on the works of A.Kh. Margulan (1950-1970), providing a deeper understanding of Kazakhstan's cultural heritage.

In addition to these tangible cultural elements, the research incorporated contemporary studies on sustainable design and interdisciplinary approaches. This was reflected in the inclusion of works by R. Dorri and Setlhatlhanyo et al., which explore the integration of ethnic art into modern design practices [1, 2, 7].

***Results and discussion***

**The Challenge of Integrating Cultural Codes into Industrial Design Education.** The lack of integration of cultural codes into industrial design education presents a critical challenge in

preparing future design professionals. Contemporary industrial design programs often prioritize the technical aspects of product creation, relegating the cultural heritage of a region, especially in countries with rich histories and traditions, to a secondary role. This issue becomes even more pressing in the context of growing global interest in sustainable development and eco-design.

For Kazakhstan, where cultural heritage is a vital component of national identity, integrating cultural codes into educational programs is not merely desirable but essential for preserving and adapting traditions within modern design [8].

Research in sustainable design, such as the works of R. Dorri, emphasizes the significance of cultural heritage as a source of innovative solutions in contemporary design [1]. However, despite this theoretical recognition, the practical application of cultural elements in educational programs remains underdeveloped. The core problem lies in the absence of a methodological framework that not only imparts knowledge about cultural elements to students but also enables them to practically apply these elements in the creation of modern products.

Consequently, graduates of industrial design programs often lack the skills and confidence to effectively work with cultural codes. As a result, the products they develop often lack the uniqueness and cultural relevance that incorporating such elements could provide. The scarcity of methodologies and interdisciplinary approaches that seamlessly integrate cultural codes, sustainable development, and modern technologies into a cohesive educational process poses a significant obstacle.

While many programs are actively incorporating ecological approaches into design, cultural aspects remain largely absent from most curricula. This leads to a situation where students become proficient in designing environmentally sound products but miss the opportunity to harness cultural elements as a wellspring of creativity and innovation [9].

Industrial design programs require a paradigm shift towards incorporating interdisciplinary approaches that consider both environmental aspects and cultural traditions. The works of A.Kh. Margulan (1950-1970) on Kazakh applied art serve as an example of successful integration of cultural elements into sustainable design. These studies demonstrate that traditional materials like felt, wool, and wood, used in Kazakh yurts, textiles, and furniture, are not only eco-friendly but also carry significant symbolic value. For instance, elements such as "tekemet" and "syrmak" - traditional Kazakh felt carpets with unique ornamentation - can be adapted for contemporary textile design, preserving cultural identity while adhering to sustainable development principles. Similarly, Kazakh wood carving traditions can be applied to create furniture and decorative interior elements, showcasing a fusion of tradition and innovation in design [9].

Despite the immense potential for incorporating cultural elements into modern design, educational programs still fail to equip students with the tools and knowledge to effectively work with these elements. This highlights the need to develop methodologies that move beyond simply familiarizing students with cultural heritage and empower them to actively utilize it in contemporary product design, meeting both cultural and ecological imperatives.

**Synthesis of Existing Research on Sustainable Design and Cultural Heritage.** Research in the field of sustainable design and cultural heritage has become an integral part of modern approaches to creating innovative products that can meet the challenges of environmental and cultural identity. One of the key studies in this area is the work of R. Dorri, which focuses on the importance of integrating cultural values into modern products in order not only to preserve cultural heritage, but also to improve environmental sustainability [1]. Dorri points out that cultural elements such as traditional materials and techniques can significantly enrich modern design, providing the designer with unlimited opportunities for a creative approach to designing products that combine cultural identity and environmental responsibility. However, the author also emphasizes that in order to effectively implement these ideas, it is necessary to develop appropriate educational programs that can teach students how to integrate these aspects into their projects [10].

Similar ideas are reflected in a study by Setlhatlhanyo et al., which focuses on ethnic cultures and their influence on creative design decisions [2]. The authors consider examples of the introduction of ethnic codes into educational programs to create innovative products. One of the key aspects of their work is to show how traditional materials and cultural symbols can be used in modern projects aimed at meeting the needs of the modern market. Successful projects in countries such as Botswana and South Africa show how ethnic elements can be adapted to create unique

products that combine cultural traditions and modern trends in sustainable design.

A.A. Bakanov and A.R. Tenchurina in their work explore the problem of the formation of design competencies among engineering students using an interdisciplinary approach [4]. Their research highlights the importance of introducing interdisciplinary methods into educational programs, where students will be able to combine technical, cultural and environmental aspects when creating products. They also point to the need to develop project assignments that will help students practice integrating cultural elements into real products.

Examples of successful integration of cultural elements into educational programs can be found in international practice. For example, in the countries of Scandinavia and Japan, approaches focused on cultural heritage and sustainable development are widely used. In these countries, educational design programs include the study of local crafts and materials, which allows students to create products that reflect national identity and at the same time meet modern market requirements. In Finland, for example, projects focused on the use of wood and natural materials show how local resources can be integrated into the design of environmentally friendly products while preserving traditions.

The application of these ideas in Kazakhstan requires taking into account the specific cultural and environmental conditions of the region. Unlike other countries, Kazakhstan has a unique nomadic heritage that has been formed over the centuries. This heritage includes the use of natural materials such as felt, wool and wood, making it particularly relevant for sustainable design. Research by A.H. Margulan (1950-1970) shows that Kazakh traditions are not only environmentally sustainable, but also deeply symbolic. Adapting these cultural elements into modern design can significantly enrich educational programs in Kazakhstan, allowing students to use unique cultural resources to create innovative and environmentally friendly products [11].

Thus, the key aspects that should be adopted from existing research and integration projects are: an emphasis on traditional materials and techniques, an interdisciplinary approach, as well as the creation of educational tasks aimed at developing products that reflect cultural heritage and comply with the principles of sustainable design.

**Identification of cultural elements of the Kazakh heritage that can be used in educational programs.** The cultural codes of the Kazakh heritage can be interpreted as deep symbolic, material and technological elements that convey the philosophy of a nomadic lifestyle, harmony with nature and a utilitarian approach to everyday life. These codes consist not only in visual aspects such as ornaments and patterns, but also in the shape, color palette, material and the very idea of objects that served the needs of nomadic life.

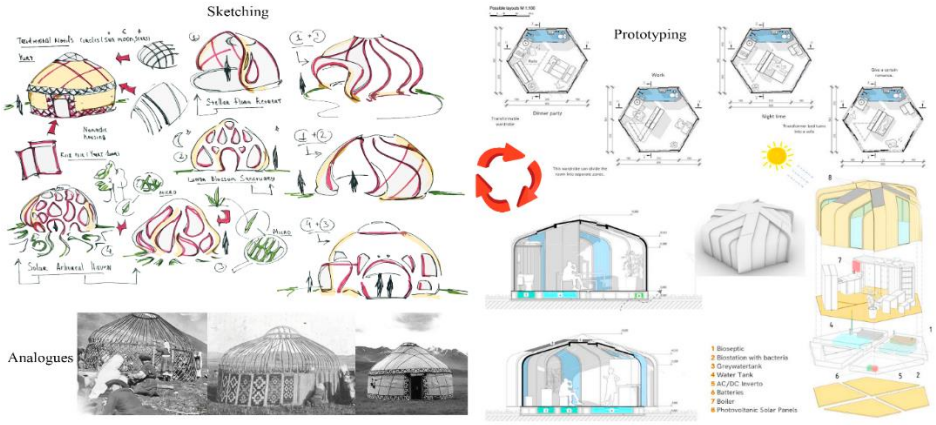


Figure 1 Left: Original sketches for the yurt development, Right: project awarded the ICONIC AWARDS 2024 for Innovative Architecture

One of the key cultural codes of the Kazakh heritage is the mobility and functionality of household items, which is directly related to the nomadic lifestyle. The shape of many Kazakh objects was created with the expectation that they could be easily assembled, disassembled and moved. An example is a yurt, a unique structure that combines lightness, strength and ease of assembly. This element can be used as a cultural code for the development of modern modular

systems — for example, furniture that is assembled and disassembled without the use of fasteners. In project assignments, students can explore the principles of adaptive yurt-inspired designs and create modern interior items that are also easily transported and change shape depending on conditions [12].

Kazakh tableware and utensils also follow the principle of versatility and compactness. Leather skins for storing koumiss were not just utilitarian, but also reflected the idea of reusable use and durability of the material. This idea can be transformed into modern projects for the development of environmentally friendly containers for storing or transporting liquids, where the emphasis will be on the use of natural materials and minimizing waste.

The color palette of the Kazakh heritage also carries an important symbolic load. The use of natural shades — brown, beige, dark red and green - is associated with materials of natural origin, such as leather, wool and wood. These colors can be used not just as decorative elements, but as symbols of sustainability and naturalness. In modern educational tasks, you can focus on the development of color solutions based on natural materials, which will convey the idea of environmental friendliness of the product. For example, students can explore the possibilities of creating biomaterials with a natural color scheme that do not require additional coloring.

The cultural code of the Kazakh heritage also includes unique craft techniques such as wool felting and the manufacture of wooden elements. It is not so much the visual form that becomes important here, as the technology itself. Modern training tasks can be based on the principles of transformation of these techniques in the context of modern technologies. For example, the wool felting technique — the process of gradual compaction and joining of fibers — can be adapted for the development of modern composite materials, where a pressing or sintering process is used to create dense environmentally friendly structures [13].

Another example is wood carving, where the process itself can be interpreted within the framework of digital technologies. Modern manufacturing processes such as milling or 3D printing can replace traditional manual methods while maintaining the philosophy of working with the material. In project assignments, students can create products based on the traditional philosophy of caring for the material, but using digital tools to minimize waste.

One of the fundamental cultural codes of Kazakh culture is sustainability, the understanding that each item must serve for a long time and be adaptive to changing conditions. This can be interpreted in modern design through the creation of products that are easy to repair, modify or recycle. An example is the concept of reusable containers or modular furniture, which can change its shape and functionality, adapting to different life situations. In the study tasks, students can create structures that adapt to different conditions, as nomads did, creating yurts that could be quickly assembled and disassembled, while remaining strong and durable [13].

**Development of project assignments for students.** Project assignments aimed at integrating cultural codes of the Kazakh heritage into modern design play a key role in developing students' skills to work with traditional elements within the framework of sustainable design. One of such tasks may be the development of a modular dwelling based on the principles of a traditional Kazakh yurt. The yurt is a symbol of mobility and harmony with nature, which makes it an ideal cultural code for modern sustainable design. As part of this assignment, students will study the design features of the yurt, its collapsible and mobile structure made of environmentally friendly and renewable materials such as wood and felt. The main task will be to adapt these principles to develop modern modular residential structures that can be used in urbanisation or natural parks. An important element of this project is the integration of modern technologies such as renewable energy sources, energy efficiency systems and autonomous ecological systems, which allows not only to preserve cultural codes, but also to implement them into innovative and sustainable solutions for modern housing construction. Students will have to submit mock-ups or prototypes demonstrating how the principles of mobility, environmental friendliness and sustainability of a yurt can be reinterpreted in a new context to create modern, eco-friendly modular homes. Another important project task may be related to the creation of modern accessories based on traditional crafts. Kazakh culture is rich in craft techniques such as wool felting and leather processing, which were used to create functional and durable household items such as wineskins, backpacks and belts. As part of the assignment, students can design modern accessories that are both functional and aesthetically appealing,

combining the principles of traditional crafts with modern needs. For example, you can create multifunctional backpacks, bags or travel organizers that preserve the principles of mobility and durability characteristic of a nomadic lifestyle. It is important not just to copy traditional forms, but to adapt them to modern conditions, for example, by introducing technologies for processing materials or focusing on the versatility of accessories that can be used both for storage and for transporting various things. Students must demonstrate how cultural codes such as durability, reusability and adaptability can be reinterpreted to create modern accessories using natural and environmentally friendly materials [14].

The third task may concern the development of textiles such as eco-carpets, plaids or capes that combine the use of traditional materials such as wool and felt with innovative eco-friendly technologies. The students' task is not just to reproduce traditional carpets such as flamethrowers or syrmaks, but to create modern interior items that will meet the requirements of environmental friendliness and minimization of waste during production. As part of this assignment, students can explore the principles of wool processing or the integration of traditional felting techniques into modern methods of creating textiles. It is important that these products reflect not only cultural symbols, but also modern design trends such as minimalism, environmental responsibility and functionality. Students can offer innovative solutions for the use of natural materials and minimizing environmental impacts, including reuse and recycling of industrial waste. At the same time, the emphasis will be on adapting cultural codes — such as natural materials, connection with nature and environmental friendliness — to modern requirements of sustainable design.

Thus, the proposed design tasks cover several key aspects of the Kazakh cultural heritage — from mobile homes and accessories to textiles — and focus on their adaptation to modern conditions. By completing these tasks, students will be able not only to study the cultural codes of the Kazakh people, but also to offer innovative solutions for their integration into sustainable product design.

**The introduction of an interdisciplinary approach.** The interdisciplinary approach in industrial design educational programs is becoming an important tool that allows future designers to combine cultural, environmental and technological aspects in their projects. In the modern world, where environmental problems require complex solutions, the ability to use knowledge from different fields plays a key role in training specialists. The program, which combines courses in ecology, the history of crafts and modern technologies, forms students' deeper understanding of design as a process aimed not only at creating aesthetic and functional products, but also at their compliance with cultural and environmental standards.

One of the most important components of the interdisciplinary approach is the ecodesign course, which helps students understand the importance of sustainable design. The use of software such as SimaPro, GaBi and Tally makes it possible to analyze the entire life cycle of a product, starting from the extraction of raw materials and ending with its disposal. Students learn to assess the environmental impact of various materials and technologies, which allows them to make informed decisions in favor of more environmentally friendly solutions. These programs make it possible to simulate production and optimize the use of resources, which is important for creating products with a minimum carbon footprint and maximum efficiency in terms of using materials. In parallel with the ecodesign course, it is necessary to include a course on the history of Kazakh handicrafts and cultural heritage in the program. Studying traditional craft techniques such as wool felting, wood carving and the use of felt allows students to understand the cultural codes that underlie Kazakh culture. Special attention is paid not only to the form and materials, but also to the philosophy that accompanied the creation of these objects. For example, a yurt is not just a dwelling, but a symbol of mobility and harmony with nature. This understanding allows students to rethink cultural elements and use them in modern design solutions, adapting traditional symbols and materials to the needs of today [15].

A course on modern technologies such as 3D modeling and digital manufacturing also plays an important role in the interdisciplinary program. Using programs such as Autodesk Fusion 360, Rhinoceros 3D and Blender, students can create digital product models based on cultural elements and then implement them using technologies such as 3D printing and digital carving. This makes it possible not only to maintain the accuracy in reproducing traditional elements, but also to adapt them to modern conditions, minimizing waste and increasing production efficiency. Such technologies make it possible to integrate cultural heritage into mass production, while maintaining the uniqueness of each product.

An example of a successful combination of these disciplines can be a project related to the development of a modular dwelling based on a yurt. Designers can use modern modeling tools to create architectural solutions that preserve the principles of the yurt, but will be adapted to modern living conditions. Environmentalists, using SimaPro and GaBi programs, can assess the carbon footprint of materials and offer environmentally friendly alternatives such as recycled materials or renewable energy sources. Historians and ethnographers, in turn, will help preserve the cultural identity of the project, providing a deep understanding of how the elements of the yurt can be reinterpreted in modern architectural solutions. Such a project demonstrates how students can work together, using knowledge from different fields to create sustainable and culturally relevant solutions.

Another successful example of an interdisciplinary approach is the creation of modern accessories based on Kazakh crafts. In this project, designers can work on the development of multifunctional accessories, such as backpacks or bags, using natural materials and traditional processing techniques, such as felting wool or working with leather. Environmentalists can offer materials with minimal environmental impact, and historians can help adapt cultural elements such as color palettes or symbols to modern needs. The use of digital technologies, such as 3D printing, will not only speed up the production process, but also minimize the amount of waste, which will make the project completely sustainable.

Thus, an interdisciplinary approach provides a deeper understanding of all aspects of design and production. Students learn not only to combine cultural and environmental elements in their projects, but also to realize the importance of each of these elements to create a complete product. The joint work of students from different disciplines allows them to find innovative solutions to old problems and create products that combine modernity and cultural identity, high technology and respect for nature.

**Examples from the tables of cultural codes.** Examples from the tables of cultural codes of the Kazakh heritage provide a unique opportunity to develop project assignments that will help students integrate traditional elements into modern design solutions. These tasks should be aimed at adapting cultural symbols, forms and ideas embedded in the everyday objects of the Kazakh nomadic people to create modern products. The main categories of cultural codes, such as housing, furniture, textiles and tableware, allow us to unlock the potential of sustainable design inspired by historical crafts and give students the opportunity to consciously use traditional elements in innovative projects.

Table 1. Cultural Codes Overview: Housing, Textiles, and Furniture

| Category | Item | Materials | Traditional Motifs | Traditional Use | Modern Interpretation |
|---|---|---|---|---|---|
| Housing | Yurt | Wood, wool, felt, fabric, metal | Circles (sun, moon, stars) | Nomadic housing | Eco-oriented modular homes using renewable energy sources |
| | Kiiz esik (Yurt door) | Felt, wood, metal | Geometric shapes | Entrance to yurt | Smart doors incorporating traditional forms for modern homes |
| Textiles | Tekemet | Wool, felt | Circles, spirals | Floor covering | Eco-friendly textile products blending tradition and modern technology |
| | Syrmaq | Felt, fabric, threads, cords | Circles, crosses | Wall carpet | Interior textile products combining heritage with innovative materials |
| Furniture | Bed (Tөsek ayagy) | Wood | Cosmogonic motifs: sun, moon, stars | Sleeping space | Modular beds with integrated storage and ergonomic design |
| | Storage Chest (Kebizhe) | Wood | Protective symbols | Storing clothes | Decorative storage with integrated security systems |

The Kazakh traditional dwelling, the yurt, is not only a utilitarian structure, but also a symbol of a nomadic lifestyle, harmony with nature and adaptability. The yurt was easy to assemble and disassemble, which made it ideal for life in the steppe. This principle of mobility can become the basis for a project assignment where students develop modular homes adapted to modern needs.

These houses can retain the characteristic features of the yurt, such as the dome shape, but at the same time use modern materials and technologies. For example, the use of recycled wood or eco-friendly polymers can be a key element of the project. Students can work on the integration of modern energy conservation and renewable energy systems, which will create modern homes that continue to follow cultural codes, but meet the requirements of sustainable development. It is important that they preserve the symbolism of naturalness and use forms and structures associated with traditional architecture [15].

Traditional Kazakh furniture also carries unique cultural meanings that can be adapted to modern design. For example, chests and tables decorated with carved ornaments symbolized not only utilitarianism, but also decorativeness associated with natural motifs. In project assignments, students can work on creating modular furniture that retains the multitasking and ease of use characteristic of Kazakh everyday life. At the same time, decorative elements such as ornaments based on natural symbols can be adapted in a modern minimalist style. For example, carved elements can be interpreted through digital technologies such as 3D printing, which will allow traditional patterns to be transferred into a modern context while preserving their aesthetic and cultural value. It is important not just to repeat traditional forms, but to rethink them, taking into account the requirements of functionality, waste minimization and the use of environmentally friendly materials.

Textiles played an important role in Kazakh culture, both in a decorative and utilitarian sense. Felt carpets, such as tekemets and syrmaks, not only decorated yurts, but also served to insulate and create comfort. Students can work on creating modern textiles, such as eco-carpets or decorative elements for the interior, which will be based on traditional wool felting technologies, but adapted to modern standards of sustainable design. For example, they may explore ways to use recycled materials or waste minimization technologies in textile production. Ornaments such as the ram's horn, which traditionally symbolized protection and prosperity, can be reinterpreted as modern graphic elements integrated into textile design. This allows us to preserve cultural symbols, while meeting modern aesthetic requirements and requirements for environmental responsibility.

Kazakh tableware can also become a source of inspiration for creating modern household items. Traditional tableware made of wood, leather and metal was durable and reusable, which is an important principle of sustainable consumption. Students can design modern items such as kitchen accessories or tableware that would preserve these principles of durability and functionality. It is important to maintain the philosophy of using natural materials and versatility — qualities that were important for the nomadic lifestyle. In the design tasks, it is possible to explore the possibilities of using modern eco-friendly materials, such as biodegradable polymers or recycled wood, to create modern tableware that retains traditional shapes, but is adapted to the needs of modern users. This will allow students to rethink cultural elements through the lens of sustainable design.

The integration of cultural codes into modern design projects allows students not only to preserve cultural heritage, but also to adapt it to new conditions. The adaptation of traditional forms, such as a yurt, chest or felt carpet, into modern products allows you to connect the past and the future, creating products that preserve the symbols and philosophy of the Kazakh people, but at the same time meet the requirements of the modern market. Students can use the symbols of natural cycles, such as astral circles, in interior design or textiles, which will create unique products that combine tradition and innovation. This opens up new possibilities for design, where cultural elements become an important part of the product without losing their functionality and environmental friendliness.

Thus, the tables of cultural codes provide rich material for creating project assignments that will help students understand and adapt the cultural codes of the Kazakh heritage into modern design. Each category, whether it is housing, furniture, textiles or tableware, provides unique opportunities to rethink traditions and adapt them to modern requirements. These assignments not only contribute to the preservation of cultural heritage, but also help to develop students' skills in sustainable design, which meets the challenges of modernity, without losing a deep connection with traditions.

As a result of completing design projects for the development of modern modular housing, students successfully interpreted key elements of the traditional Kazakh yurt and adapted them to modern architectural solutions. First of all, the philosophy of mobility and adaptability of the yurt was taken into account, which allowed students to create residential structures that can be easily

assembled and disassembled, as well as transported. These principles became the basis for the creation of modular houses suitable for use in a variety of conditions - from urban areas to nature reserves. An important element of the projects was the use of environmentally friendly materials, such as recycled wood and biodegradable polymers, which meets the requirements of sustainable development. Students also integrated renewable energy sources, such as solar panels, and energy-saving technologies, which made their projects not only functional but also environmentally friendly.

Of particular note are examples where the cultural elements of the yurt have been implemented in contemporary design. In most projects, the dome shape and frame structures of the yurt were rethought to create modular systems that can be transformed depending on the needs of the user. One successful project involved the development of a living space for eco-tours, where mobile homes based on the yurt can be quickly deployed in recreation areas in natural areas, minimizing environmental impact. The students demonstrated how the principles of traditional Kazakh dwelling, such as harmony with nature and functional adaptability, can be integrated into modern architectural solutions aimed at solving environmental and social problems.

The design tasks aimed at developing furniture allowed students to explore and rethink traditional Kazakh furniture, such as chests, low tables, and folding structures, adapting them to a modern interior. The main focus was on the versatility and durability of the furniture, which has always been an important part of Kazakh life. Students successfully used traditional shapes, such as chests with ornamental carvings, and incorporated them into modern storage systems. The principles of modularity and ease of assembly were especially relevant in the context of modern living spaces, where furniture needs to be adaptable. In addition, students actively used digital technologies, such as 3D modeling, to create furniture prototypes, which allowed them to reproduce elements of traditional carving in a minimalist style, preserving cultural identity but giving the furniture a modern look.

One of the most successful examples was the creation of a multifunctional modular storage system that could be transformed depending on the needs of the user - from a chest to a table or bench. This project used elements of Kazakh ornamental carving interpreted using 3D printing, which made the furniture not only visually appealing but also culturally significant. Also, students experimented with natural materials, such as recycled wood and textiles made from organic fibers, which supported the principles of sustainable design. These projects have shown that the traditional principles of durability and functionality of Kazakh furniture can be easily adapted to modern conditions, creating unique and environmentally friendly solutions for modern living spaces.

As part of the design tasks for textile products, students were able to successfully integrate traditional Kazakh techniques and materials into the creation of modern environmentally friendly products. One of the key areas was the use of traditional wool felting technologies, which were rethought and adapted to create textile products such as eco-rugs, blankets, and decorative elements for the interior. Students explored the possibilities of using recycled wool and other natural materials, which was consistent with the principles of sustainable development. Particular attention was paid to the symbolism of traditional ornaments, such as the "ram's horn" and "astral circles", which were interpreted in the form of modern graphic motifs, preserving their cultural significance, but at the same time meeting the requirements of modern design.

Examples of successful projects included the creation of carpets with minimalist patterns inspired by Kazakh symbolism, where students used both traditional and new felting methods. Such products not only met modern aesthetic requirements but also demonstrated adherence to the principles of environmental friendliness: minimizing waste, using natural and recycled materials, as well as the durability of products. The students demonstrated that traditional techniques can be successfully adapted to new production conditions without losing their cultural significance. Textile projects have shown that cultural elements can be transformed and applied in sustainable design, creating unique products that combine tradition and modern technology.

Design tasks focused on creating tableware and household items enabled students to explore the rich traditions of Kazakh applied art, emphasizing the use of natural materials like wood, leather, and metal. In the process of completing the tasks, the students sought to rethink the traditional forms of Kazakh dishes, such as leather wineskins for storing koumiss and wooden bowls, adapting them to modern standards and needs. The principles of durability and reusability inherent in traditional products formed the basis for the

development of modern items such as multifunctional kitchen utensils and eco-friendly tableware. Students experimented with recycled materials and environmentally friendly alternatives, such as biodegradable polymers and natural wood, to create products that preserve the spirit of tradition, but at the same time meet the requirements of sustainable consumption.

One successful example was the creation of a series of multifunctional cutlery and tableware that could be transformed for different tasks while remaining durable and environmentally friendly. For example, students have designed wooden bowls and spoons that could be used for both storing and serving food, reflecting a traditional approach to utility. Ornamental elements inspired by Kazakh patterns have been minimized to meet modern aesthetic perceptions, but retain their cultural symbolism, conveying important cultural codes through form and material. These projects have demonstrated that the principles of functionality and environmental sustainability inherent in traditional Kazakh tableware can be successfully adapted in modern design solutions, giving products a unique cultural context.

The application of an interdisciplinary approach in design assignments has shown its high effectiveness in developing students' deep understanding of the interaction between cultural traditions, sustainable practices, and modern technologies. All stages of product development were carried out by student designers who used a variety of online tools and software to evaluate the environmental sustainability and cultural adaptation of their projects. This allowed them to independently analyze the environmental aspects of their projects, relying on tools such as SimaPro, GaBi, and OpenLCA, which helped them assess the life cycle of materials and their impact on the environment. Thanks to these resources, students were able to take into account the principles of environmental responsibility, which became a key factor in the development of their projects.

Integrating cultural codes into modern design through an interdisciplinary approach has allowed students to not only adapt traditional forms and materials but also do so in the context of sustainable development. In the modular housing project, students, using online sources to assess the environmental impact of materials, were able to select recycled wood and biodegradable polymers that met sustainable design requirements. At the same time, they explored the cultural aspects of the yurt using historical data and ethnographic research to preserve the symbolism and traditional elements such as the dome shape and ornamental motifs. Thus, the interdisciplinary approach allowed designers to effectively work with cultural and environmental factors, using modern digital tools to create projects that reflect a deep connection with cultural heritage and meet the requirements of modern sustainable design.

The integration of cultural codes of Kazakh heritage into modern design projects has demonstrated successful results both in terms of preserving the cultural context and achieving the goals of sustainable design. The design tasks showed that traditional forms, materials and techniques, such as felt, wood, ornaments, and the principles of modularity, can be adapted to modern needs, while retaining their cultural significance. Student designers, using an interdisciplinary approach and modern technologies, were able to offer innovative solutions that combined elements of Kazakh applied art with environmentally responsible materials and production methods.

Evaluation of the projects revealed that the students mastered not only the skills of adapting cultural codes but also successfully integrated the principles of sustainable development into their work. The use of software tools to assess the environmental footprint, such as SimaPro and GaBi, enabled students to develop projects that meet modern standards of environmental friendliness and waste minimization. At the same time, cultural aspects, such as the symbolism of ornaments and the philosophy of mobility, were reflected in modern products, which made it possible to create unique products that have both practical and cultural value. The conclusions based on the results of the design tasks demonstrate that cultural elements can not only be preserved but also transformed in the context of sustainable design, creating innovative products with high cultural and environmental potential.

***Conclusion***

The integration of Kazakh heritage cultural codes into modern industrial design educational programs has shown its first results, but this process is just beginning. In the course of completing design projects, students have successfully demonstrated that elements of traditional culture can be used not only to preserve historical and cultural identity but also to create innovative solutions that meet the requirements of the modern market and ecological design. However, the challenges and difficulties

encountered during the work indicate that this area requires further development and improvement.

The interdisciplinary approach, which combined knowledge of culture, ecology, and modern technologies, has proven effective, but it has also revealed the need for deeper and more thoughtful interaction between different disciplines. Students have learned to use tools such as environmental sustainability assessment software and 3D modeling, but the full potential of these technologies is far from exhausted. At this point, it is clear that further research and experimentation will significantly expand the boundaries of what is possible in the field of sustainable design based on cultural traditions.

The difficulty is that cultural codes are not always easily adaptable to the demands of modern industry and mass production. Rethinking traditional forms and materials requires a careful balance between preserving their symbolic meaning and the need to meet today's functional and aesthetic expectations. However, the results showed that students can find unique solutions that connect the past and the future, but this process requires continuous learning and improvement. Opening new horizons is possible only through continued research and experimentation.

Despite the successes achieved, many issues remain unresolved, especially in terms of scalability and bringing these solutions to the real market. Modular houses, furniture, and textiles created as part of design projects have great potential, but their commercial viability still needs to be tested. Uncertainty about how such products will be perceived on the market and how they will fit into existing production chains leaves room for doubt. Nevertheless, this stage can be considered an important step towards a deeper integration of cultural and environmental aspects into industrial design.

The future of integrating cultural codes into design remains uncertain, but it is this that opens up opportunities for further development. Continuous interaction between history, technology, and ecology provides ample opportunities for new projects and ideas. Perhaps the current projects only indicated the direction in which to move on, but it is in this that we see the hope that the cultural heritage of Kazakhstan will become not just a source of inspiration, but also an important part of the sustainable future of design.

Thus, the results of research and design tasks confirm that we are only at the beginning of a long journey. This process of integrating cultural codes and traditions into industrial design is a challenge that requires patience, perseverance, and flexibility. Successful examples already today show the potential of this direction, but it is obvious that much remains to be explored and adapted. It is important to continue to look for solutions that not only preserve cultural heritage but also make it part of innovative and environmentally friendly solutions for the future.

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