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COMBINATORIAL METHOD AS A WAY TO CREATE MULTIVARIATE PRODUCTS

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In the conditions of global competition, the development and realization of original solutions in the process of artistic design, contributing to the creation of products with unique properties, is a promising prospect. On this basis, it is relevant to turn to the combinatorial method in order to obtain multivariant, universal and durable clothing. The methodological basis of the research was formed by general scientific methods of cognition, as well as system and structural-functional approach, art-composition analysis. Based on world practice, the article discusses the combination techniques used by designers. Modern constructive solutions of the structure of clothing models are analyzed, which are based on a module that allows to change the object variably. The task is set to develop the design of the product in the ethno-style based on the application of the investigated method of creative shaping. In this case, the issues of preserving national identity by rethinking traditions as a condition of self-identification in the multipolar world of culture are taken into account. As a result of the research, we came to the conclusion that the combinatorial method offers a range of possibilities for individualization of the image, which is characterized by multifunctionality, variability, and aesthetics. This, in turn, can contribute to the development of ecological thinking, i.e. a meaningful approach to resource consumption. Of particular interest is the formation of the method's interrelation with the philosophy of cut of the traditional Kazakh costume.

Keywords: combinatorial method, module, constructive principle, variability, multifunctionality, traditional costume.

КОМБИНАТОРЛЫҚ ӘДІС КӨП НҰСҚАЛЫ ӨНІМДЕРДІ ЖАСАУ ТӘСІЛІ РЕТІНДЕ

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Жаһандық бәсекелестік жағдайында бірегей қасиеттері бар өнімдерді жасауға ықпал ететін көркемдік жобалау процесінде түпнұсқа шешімдерді әзірлеу және іске асыру перспективті болып табылады. Осыған сүйене отырып, көп вариантты, әмбебап және берік киім жасау үшін комбинаторлық

әдіске жүгіну өзекті болып табылады. Зерттеудің әдіснамалық негізі танымның жалпы ғылыми әдістері, сонымен қатар жүйелік және құрылымдық-функционалдық тәсіл, көркемдік-композициялық талдау болды. Әлемдік тәжірибеге сүйеніп, мақалада дизайнерлер жұмыс істейтін құрамдастыру әдістері қарастырылады. Нысанды өзгермелі түрде өзгертуге мүмкіндік беретін модульге негізделген киім модельдерінің құрылымының заманауи конструктивті шешімдері талданады. Креативті қалыптастырудың зерттелетін әдісін қолдану негізінде этно-стильдегі бұйымның құрылысын жасау міндеті қойылды. Сонымен дәстүрлерді мәдениеттің көпполярлы әлемінде өзін-өзі сәйкестендірудің шарты ретінде қайта қарау арқылы ұлттық бірегейлікті сақтау мәселелері ескеріледі. Зерттеу нәтижесінде біз комбинаторлық әдіс көпфункционалдылықпен, өзгергіштікпен және эстетикамен сипатталатын кескінді даралау мүмкіндіктерінің спектрін ұсынады деген қорытындыға келдік. Бұл өз кезегінде экологиялық ойлауды, яғни ресурстарды тұтынуға мағыналы көзқарасты дамытуға ықпал етуі мүмкін. Әдістің дәстүрлі қазақ костюмінің пішім философиясымен өзара байланысын қалыптастыру ерекше қызығушылық тудырады.

Негізгі сөздер: комбинаторлық әдіс, модуль, конструкторлық принципі, түрленгіштік, көпфункциялылық, дәстүрлі костюм.

КОМБИНАТОРНЫЙ МЕТОД КАК СПОСОБ СОЗДАНИЯ МНОГОВАРИАНТНЫХ ИЗДЕЛИЙ

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В условиях глобальной конкуренции перспективу представляет разработка и реализация оригинальных решений в процессе художественного проектирования, способствующих созданию изделий с уникальными свойствами. Исходя из этого актуально обращение к комбинаторному методу с целью получения многовариантной, универсальной и долговечной одежды. Методологическую основу исследования составили общенаучные методы познания, а также системный и структурно-функциональный подход, художественно-композиционный анализ. Основываясь на мировой практике, в статье рассмотрены приемы комбинирования, которыми оперируют дизайнеры. Проанализированы современные конструктивные решения структуры моделей одежды, в основе которых лежит модуль, позволяющий вариативно изменять объект. Поставлена задача: разработать конструкцию изделия в этно-стиле на основе применения исследуемого метода креативного формообразования. При этом учитываются вопросы сохранения национальной идентичности путем переосмысления традиций как условие самоидентификации в многополярном мире культуры. В результате исследования мы пришли к выводу, что комбинаторный метод предлагает спектр возможностей по индивидуализации образа, для которого характерны многофункциональность, вариабельность и эстетичность. Это, в свою очередь, может способствовать выработке экологического мышления, т.е. осмысленного подхода к потреблению ресурсов. Особый интерес представляет формирование взаимосвязи метода с философией кроя традиционного казахского костюма.

Ключевые слова: комбинаторный метод, модуль, конструктивный принцип, вариаабельность, многофункциональность, традиционный костюм.

Introduction

With the increasing interest in mass customization, which implies individualization of products [1], there is a need to improve the process of designing the light industry products to achieve originality and polyvariance of the design solution. Heuristic methods of design, and in particular, the combinatorial method, which is characterized by universality and versatility, open up wide opportunities to create unique clothing items while maintaining functionality and usability. In addition, the transformation of products by composing different combinations creates a special form of communication between the developer and the user. The purpose of this article is to confirm the significance and prospective application of the combinatorial method in the development of light industry. For this purpose, an analysis of scientific works, as well as the creativity of modern designers, projects that include the application of the investigated method has been carried out. The research has shown that the ways of implementing

the combinatorial method in design practice have been considered more than once, but this issue remains insufficiently studied.

Materials and research methods

The term "combinatorics" was introduced by Gottfried Wilhelm Leibniz in 1666 in the work "Reflections on combinatorial Art". The scientist sought to invent a universal language of general science, proposing to identify the simplest elements and create rules for combining the symbols of the alphabet of the science language to obtain new truths from already known truths. Great contributions to the systematic development of combinatorial methods were also made by J. Bernoulli and L. Euler [2].

Having passed a long way of development, combinatorics is widely used in mathematics, computer science, statistics, cryptography, economics, physics, chemistry, biology, linguistics, as well as in other fields of science, operating with precisely established rules, principles, and patterns. This method studies the ways of selection and arrangement of objects, the properties of configurations formed from specified elements (points, numbers, segments, clothing details), and also determines optimal solutions to problems taking into account a number of criteria. As a method of costume design, combinatorics is revealed thanks to the Russian avant-garde artists V. Stepanova, L. Popova, A. Rodchenko. According to researches, the combinatorics method is based "on the search, study and application of patterns of variant changes of spatial, constructive, functional and graphic structures, as well as on the ways of designing design-objects from typed elements" [3].

In modern design, variable search is carried out by applying such techniques as permutation, insertion, grouping, inversion, organization of rhythms. The active use of these techniques, playing with geometric shapes and creating products that change shape and structure depending on the way they are worn and moved is characteristic of the brand founded by designer Issey Miyake. The principles of inversion are applied by designers John Galliano, Demna Gvasalia. Complex and unique combinations and chaotic order are inherent in the models of the Sacai brand, founded by designer Chitose Abe. The studies of F.M. Parmon, T.P. Petushkova, M.I. Alibekova, Y.I. Zelenova, A.G. Arinov, and L.S. Bektemirova are of great interest in the field of costume design. In the work of Y.I. Zelenova, seven principles form the structure of combinatorial methodology: combinatorics of costume design methods, materials, color combinations, style image, decoration, costume shaping, and combinatorics of modules [4]. At the same time, each of the above-mentioned principles relates to the combinatorics of assortment modules.

The combinatorial-modular method of shaping is based on the creation of variability of forms and structure with the help of a module – "an initial unit of measurement, which is repeated and assembled in a holistic form or design object" [5]. Such elements can be either the same or different from each other. The combinatorics of modules is accomplished by designing from both overlay modules and modules that form the construction of a costume. Conditioned by the choice of the designer, as well as the requirements for the product, there are such methods of fastening modules as rigid fixation (Fig. 1), mobile connection (Fig. 2) and their combinations [6]. In the case of rigid fixation, fastening can be carried out by thread, glue, welded methods, using perforation and connection with rings, chains, staples. For mobility, the modules are connected with ribbons, cords, zippers, hooks, buttons, magnets, Velcro. The combined method involves a combination of the first two options.

Figure 1. Options for fastening different modules of various geometric shapes with rigid fixation

Figure 2. Examples of mobile connection of modules

In addition, it is known the connection of modules with slots by threading the elements of one module into the slots of another module. Experiments with this method are presented in the works of researchers E.S. Hur and B.G. Thomas, Chanjuan Chen, Kendra Lapolla [7].

The harmonious interaction of modules with a number of characteristics including shape and size of parts, configuration, proportional relationships, rhythm, color, texture of materials should provide a balance in terms of aesthetics, ergonomics and technology. Experimenting with the modular method by changing these characteristics provides an opportunity to be creative and obtain new design solutions of products that maximally meet the needs of consumers [8].

In addition, key features of modular design include:

- multifunctionality;
- diversity, interactivity, flexibility and continuity of use [9];
- interchangeability of parts;
- scalability by adding new modular components;
- personalization, i.e., the reflection of personal style through the uniqueness of the product;
- economy, based on the principle of obtaining a variety of combinations with the least number of parts;
- visual illusion, which can be achieved through the use of contrasting and multi-textured pieces of material, complex cut, and multiple divisions in a multi-detail construction [10];
- eco-formation, which implies "the creation of a form in harmony with an artistic image and an eco-friendly cut with minimal damage to the environment and human health" [11].

For the development of new modular designs, the Kazakh women's national costume, in particular the kamzol, is of considerable interest. Let's take a closer look at the features of this type of product.

The kamzol (Fig. 3) refers to the upper shoulder garment, which was worn over the dress. In the period from the nineteenth to the beginning of the twentieth century, it was widely used as a casual and elegant product, but since the second half of the twentieth century it has fallen out of use, becoming mainly part of the festive image. The kamzol was characterized by a semi-fitting silhouette with an extension downwards. Over time, there are changes in the cut. The initially tunic-shaped kamzol acquires the shape of an "hourglass", which is associated with mowing the shoulder line and cutting out the back from 2 halves. The neck of the product could be open or with a stand–up collar. Based on the characteristics of the regions, there were models without sleeves, as well as options with long, short (south, east) sleeves. For girls and young women, the length of the product reached the waistline or the middle of the hips. In addition, there were longer kamzols.

Figure 3. Kamzol (Kyzylorda region, mid-twentieth century, Mangystau region, 60s of the twentieth century, North Kazakhstan region, early XIX century, Pavlodar region, early XX century, Almaty region, early XIX century)

The function of fastening the sides of the kamzol was performed by kapsyrma (buckles) made of silver with a hook and a loop, silver coins, the front side of which was polished and ornamented, and a hook /loop was soldered to the underside. In addition, buttons (made of faceted glass, mother–of-pearl - in East Kazakhstan, Semirechye), stones set with silver were used. Performing a decorative function, the fasteners also served as a kind of protection for the abdominal area.

Dense cotton fabrics, velvet, and silk were used as materials, in most cases plain and bright. The lining of the kamzol was insulated with a layer of wool, and for the cold period it could be quilted with longitudinal seams along with the top. It should be noted that in the world of traditional Kazakh culture, each age had its own semantic meaning [12], which could be expressed in the color scheme. So, for older women, a more restrained palette was typical, including yellow, blue, and green colors.

The location of decorative elements were mainly corners, edges of the sides, hem, armhole, and there were also completely embroidered kamzols. The mobile lifestyle of Kazakh nomads was characterized by the use of such an unpretentious art form as embroidery in decoration, which is more dynamic and changeable compared to the cut. Additionally, sewn decorations were used: lace, coins, ribbons, fringe, shytra, the number and location of which differed in regions.

In general, the traditional female kamzol corresponded to the difficult living conditions of nomadic life, organically combining utilitarian, aesthetic, semantic functions and gradually changing according to the requirements of the time.

Results and discussion

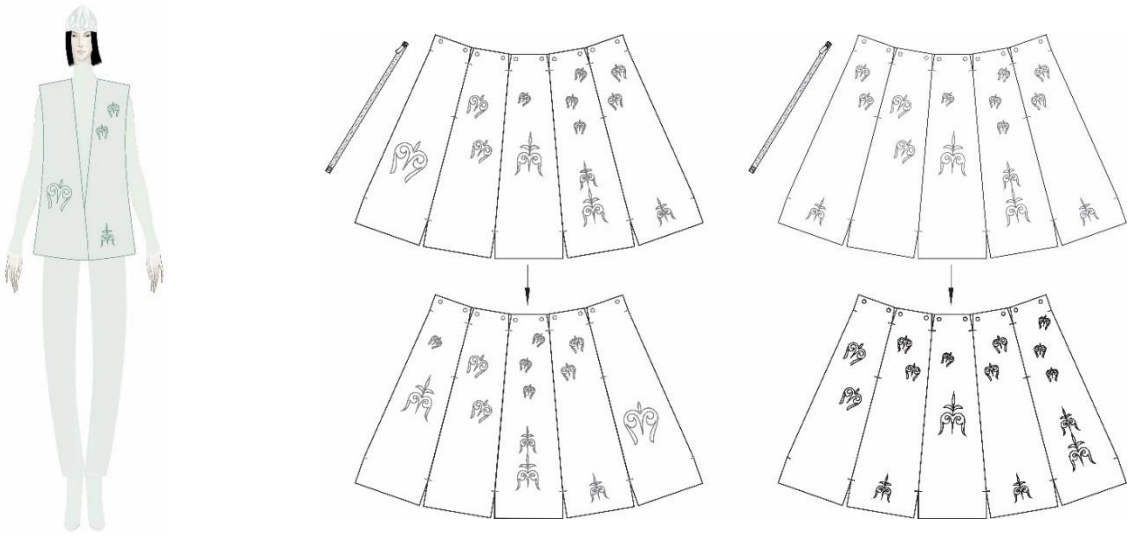
An artistic and constructive solution is new if, on the basis of heuristic techniques, a completely new solution has been created, differing in its set of essential features from similar solutions [13]. For this purpose, based on the analysis of the Kazakh women's national kamzol, the modernization of the traditional cut using the combinatorial-modular design method (Fig. 4, a) is proposed. At the same time, a constructive principle is used, which provides for the development of constructive solutions for the projected object from separate typed modules [14].

A trapezoid is selected as the module. The scheme shows the construction of the kamzol (front and back side together), consisting of 5 modules. A mobile zipper connection is used as a fastening method. The shoulder area is fastened with buttons.

By rearranging the modules, this design allows for modifications such as:

1. Module replacement;

2. Changing the order (Fig. 4, b, c) of modules with different characteristics (color, texture, decor and, in this case, an ornamental solution).



a) b) c)

Figure 4. A modern kamzol consisting of mobile modules: sketch (a), the scheme with modules differing in an ornamental solution (b), the scheme with 2 identical ornamental compositions of modules (c)

The efficiency of the design process increases when using mathematical combinatorics formulas to determine the number of connections between the elements of the system. In this regard,

to determine the possible permutations, which mean combinations consisting of the same n different elements, differing only in the order of their arrangement, the following formula was applied:

$$Pn = n!, \quad (1)$$

where: n – the total number of elements.

$$P(5)=5!=5\times4\times3\times2\times1=120.$$

Thus, from 5 different modules, we can get 120 permutation options. If there are duplicate modules, to calculate the number of acceptable variations, we need to refer to the following formula:

$$Pn\ (n\_1,n\_2,\ldots,n\_k) = n!/(n\_1\ !*n\_2\ !\ldots n\_k\ !,) \quad (2)$$

where:
n_1 – the number of elements of the 1st type;
n_2 – the number of elements of the 2nd type;
n_k – the number of elements of the k-th type.

The calculation results showed that if there are 2 identical modules, 60 permutation options follow, with 3 equal modules, 20 permutations result, and with 4 repetitions, 5 permutations are obtained.

In general, such design transformations make it possible to increase the ways of wearing the product and enhance compatibility with various wardrobe items. At the same time, it is important to maintain the harmony of the costume space on the basis of large–scale, proportional, rhythmic, color-texture relations. Due to the proportionality of the elements of the whole, the object perceived as harmonious not only resists chaos as something ordered, but also evokes special feelings and emotions [15]. It should be noted that the interchangeability of the module elements and the versatility of the design lead to high efficiency of the model. In turn, the "revival" of traditions through the processing of elements of traditional costume contributes to the creation of original clothes with an ethnic flavor, possessing semantic depth, which gives it significance, special meaningfulness.

Conclusion

The combinatorial method, in particular the modular design method, is a synthesis of creativity and rational design techniques, contributing to the development of creativity, personalization and environmental orientation. Its competent application based on a harmonious combination of experimental and associative-figurative shaping methods is considered as an effective way to create promising, comfortable products with a pronounced cultural identity. The reinterpretation of the elements of the traditional costume provides a wide variety of bases for the development of new forms. Therefore, in order to design original, versatile, functional, multi-variant wardrobe items that will resonate with modern consumers, it is necessary to continue exploring the potential of this method.

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