

Application of Upcycling Technology in the Project Activity of Future Teachers of Labor Education and Technology

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Abstract.–The aim of this article is to justify the potential of technologies for processing secondary raw materials and to investigate the effectiveness of developing professional competences in future teachers of labor education and technology through the utilization of upcycling technology in the design of eco-bags.

Project activity focuses on fostering critical thinking and portrays the pedagogical process as a system based on the theory of universal human values, humanization, a person-oriented approach, and the priority of subject-subject relations. It proves to be effective in shaping the personality of future teachers. The main features of the process of designing eco-bags using upcycling technology are determined to be interdisciplinary, communicative, and dynamic, facilitated by the use of information services of social networks. The process emphasizes environmental friendliness under the conditions of recycling secondary raw materials and involves creative project and practical activities.

Pedagogical conditions for project activity in eco-bag upcycling are defined through provisions such as structuring the project and its stages, setting educational goals and tasks, implementing an integrated program of technological activity, developing a criterion basis for determining the levels of educational achievements, and creating information-subject and material-technical support

for the educational process. Collaboration among teachers of general and professional training cycles is highlighted for content coordination, organization of training, and improvement of educational, methodological, and software training for processing secondary raw materials.

The work employs methods of theoretical and empirical research, including analysis and synthesis to clarify main concepts and categories of learning technologies for processing secondary raw materials for future teachers of labor education and technology. It also involves the study of psychological-pedagogical and scientific-methodical literature and advanced pedagogical experiences related to learning technologies in higher education institutions, enabling the identification of regularities and formulation of conclusions on the investigated problem.

Keywords: pedagogical conditions of professional training for teachers of labor education and technology, Pinterest social network, project activity, upcycling.

I. INTRODUCTION

Social development puts on the agenda the requirement of forming a creative personality that orients itself, chooses a path, and acts using new approaches,

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ideas, and solutions. The individual realizes oneself and adapts to society, utilizing one's own potential on the basis of effective, productive knowledge, and creative opportunities.

The problem of training a teacher in labor education and technology, capable of shaping the creative personality of a student in a general secondary education institution (GSEI), is currently being emphasized. Future teachers should be knowledgeable and practically prepared for project-based learning, utilizing innovative techniques and materials processing technologies that are engaging for students.

In the concept of "New Ukrainian School" [1] it is emphasized that the development and formation of a creative, comprehensively developed personality is a strategic task of GSEI. The educational process should be dynamic and aimed at improving existing methods and developing new, effective approaches to foster the creative personality through the use of innovative technologies.

The process of forming professional competences and developing the creative personality of a future teacher of labor education and technology utilizing cloud services for mastering original processing technologies is effective, as evidenced by certain of our studies [2]. We view the learning of upcycling technology through the implementation of eco-bag projects with the involvement of social network services as an innovative pedagogical approach for shaping the technological competences of future teachers capable of creative activity [3]. This approach necessitates an interdisciplinary approach [4].

II. MATERIALS AND METHODS

A number of works by researchers and practicing teachers are devoted to the problem of professional training for teachers in labor education and technology, emphasizing the increasing role of innovative learning systems using cloud services and the necessity for their development, advancement, and implementation in the educational field. For example, V. Steshenko and D. Kilderov propose a systematic approach to the formation of professional competencies of a teacher of labor training and technology [5]. The authors of the collective monograph (A. Gedzik, et al.) noted that competence reflects the practical orientation of the educational process, implying effective activity and a high final result [6]. V. Sydorenko substantiated the concept of "competence" as the ability to effectively use knowledge and skills, the presence of personal qualities to achieve results at a specific workplace [7].

We agree with S. Tkachuk's interpretation regarding the peculiarity of forming the professional and pedagogical competence of a teacher in labor training and technology. This involves mastery of technological culture, with components such as project competence (subject knowledge and skills related to the design of educational activities) and technological competence (cognitive, emotional, valuable, and creative aspects reflected in a humanistic attitude towards professional activity) [8].

The state standard of secondary education in Ukraine defines the priority goal of the technological field as the realization of the student's creative potential, the formation of critical and technical thinking, readiness to safely alter the natural environment through modern technologies and design, the ability for entrepreneurship and innovative activity, partnership interaction, and the utilization of equipment and technologies for the satisfaction of one's own needs, cultural, and national self-expression [9].

The unfolding of personal potential, the development of abilities, the formation of the ability to independently search for the necessary information to solve the tasks, to creatively approach the creation and manufacture of an aesthetic and technically complete occur through the involvement of GSEI students in creative technological activities during labor training and extracurricular time.

Modern educators are convinced that the educational space of the New Ukrainian School (NUS) should evolve into a comfortable learning environment characterized by trust and valuable discussions. Within this space, students are shaped as competent, creative personalities, and conscious, responsible citizens. Notably, V. Sukhomlynskyi regarded creativity as an activity that reveals the spiritual world of the individual, referring to creativity as the essence of life in the world of knowledge and beauty [10]. In light of this, the educational and cognitive activity of students in primary and secondary schools, emphasizing a creative aspect, necessitates their mastery of project technology. From the perspective of the personal-activity approach, scientists believe that abilities are "...individual psychological features of a person that are manifested in activity and will be a condition for its successful performance" [11]. V. Kremen believes that creativity is the apogee of human existence, when a person acquires the ability to transform the reality (relationships, norms, values) in which he performs life activities [12].

An important aspect of developing the creative abilities of secondary school students is creative pedagogical activity, which significantly influences the effectiveness of this process. Thus, S. Sysoeva justifies that the object and result of pedagogical creativity is the creation of a personality, not an image (as in art) or a mechanism (as in technology) [13].

In the integrated scientific interpretation, the creative personality is considered as a complete human individuality, which shows developed creative abilities and motivation, creative skills that provide it with the ability to generate qualitatively new materials, technologies and spiritual values that, to a greater or lesser extent, change a person's life for the better [14]. It is also worth agreeing with Yu. Koptiloi's opinion that the effective formation of the creative personality of a student of secondary school requires the creation of certain pedagogical conditions for the implementation of a personality-oriented approach; ensuring in-depth individualization of the educational process; cooperation between participants of the educational space; pedagogical patronage of the self-development of a creative personality [15].

Currently, project technologies are widely used in various fields of knowledge, in the teaching of various disciplines, increasing educational motivation, developing cognitive interest and creative abilities. Project activity is focused not only on the implementation of the project, but also on personal changes in the subjects of this activity, when the project culture of the learner is formed - a complex, multi-level, dynamic system of technological qualities.

Studying the opinions of scientists gives us reason to consider the process of project activity as a symbiosis of the development of creative potential and creative technological activity of an individual. In view of this, the purpose of our research is to substantiate the possibilities of upcycling technology and to study the effectiveness of the formation of professional competences and creative abilities of future teachers of labor education and technology in the design of eco-bags.

Note that upcycling is a method of transforming used things into new products in order to reduce the negative man-made and social impact on the environment. It's a process sometimes interpreted as "upcycling", defined by upcyclethat.com as: "The act of taking something that's no longer used and giving it a second life and a new function. At the same time, the finished product often becomes more practical, more valuable and more beautiful than the one that was before" [16].

The rapid development of technology has turned humanity into consumers of natural resources, which has caused an ecological crisis. It is known that the light industry produces billions of units of clothing annually, a large part of which never reaches the consumer. At the same time, fast fashion giants throw away defective or unsold clothes, warehouses are filled with clothes without final use.

Unlike traditional recycling technologies, in which materials such as plastic and paper gradually break down and can only be recycled to a limited extent, upcycling transforms unwanted items into products of greater value. Proponents call this "closing the loop". In particular, Jamie Burdett, co-owner of the London company Worn Again, sees used material as a resource worth saving. A practical embodiment of this approach is the emergence of branded bags made from Royal Mail jackets and Virgin Group balloons [17].

TABLE 1 ADVANTAGES OF UPCYCLING

Environmental	Socio-economic	Personal
Processing of materials from landfills	Preservation and distribution of the works of ancient and modern masters	Conservation of natural resources
Reducing the volume of landfills	Support of regional industry	Formation of master skills of repair and processing
Economical use of natural resources	Reduction of production costs and losses	Creating unique things

Upcycling is a creative design solution for recycling materials that ensures their ecological use and gives old products a new purpose. Under the conditions of material processing, humanity can save a significant amount of water, slow down the excessive production of textiles and other materials, and reduce the mass of landfills. Design recycling moves waste items forward in the chain of useful consumption [18].

On the other hand, upcycling is a project technology both for beginners (for example, installing a clock mechanism on an old record or restoring a coffee table) and for creating your own brand of recycling clothes or household items, which requires certain experience, tools and creativity.

Upcycling technology is not only focused on environmental benefits. The process of making, refining and recycling products is actually beneficial for many in terms of rehabilitation, mental health issues and motivation for generations to come. Taking into account the research of scientists on the content of environmental training for future teachers [19; 20], we have identified the main advantages of upcycling, which can become decisive in the project activities of future teachers of labor training and technologies (Table 1).

Social networks are an integral part of today, where users have accounts to communicate and share information. Researchers believe that social networks are an effective way to expand one's personal learning network and discover resources. Under conditions of distance learning, participants in the educational process rely on certain social media as part of their daily routine. In teaching the technologies of processing used things, in addition to programs, plans, educational videos, posters, it is possible to publish creative ideas, projects and products that are related to technological activity and the formation of creative abilities.

In the network, future teachers learn not only the content of individual disciplines, but also ways and methods of working on the Internet in order to immerse themselves in the educational process, intensify participation in research projects, develop communication, draw attention to important events, own pages and share experiences.

III. RESULTS AND DISCUSSION

In the organization of project training for future teachers, we determined the search and analysis of social networks, which make it possible to increase the effectiveness of training in processing technologies, in particular, upcycling technologies. This work involved solving the following tasks: searching for popular social networks, analyzing the pages of thematic social networks, studying the possibilities of their use in creating banks of creative projects. The most famous social networks in Ukraine are Facebook, Instagram, Snapchat, etc. Their interface is clear and familiar to today's youth.

We focused our attention on the possibilities of the free social network Pinterest (with more than 200 million monthly visitors), which uses attached diaries and

pictures, reminders as a giant educational board. The feed shows Pins, Follows, and Users based on recent activity on Pinterest. Pins can be searched by keywords. For example, if you enter the word "Handmade" in the search bar (Fig. 1), the system immediately displays a collection of pins for selection. Pins are ideas that Pinterest users create, find and save from the web. Pinning is about saving, organizing, organizing important and useful information on your own and group boards on your Pinterest profile.

The profile contains long-term saved foams, created boards and ideas, topics (Fig. 2). It is possible to create illustrative thematic boards that talk about what network users are currently doing (drawing, designing, manufacturing, etc.).

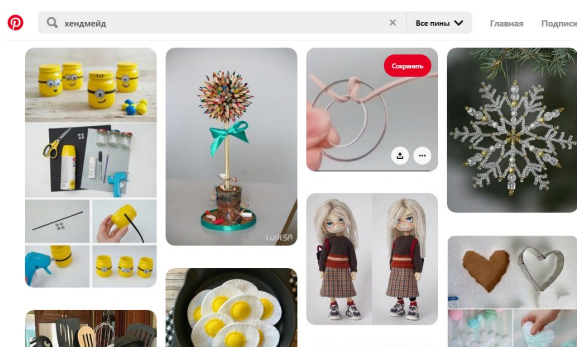


Fig. 1. Suggested pins by keyword.

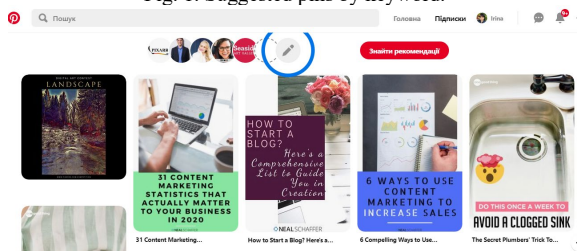


Fig. 2. An example of a subscription in your own Pinterest profile.

Teachers use personal pages for educational purposes, create thematic groups, collect educational videos, interesting information with links, create galleries of works, etc. Teachers create their own boards on Pinterest from various fields of knowledge, technology and pedagogical practice activities. Their boards are filled with lesson plans, activities, and general ideas for classroom improvement.

Users can connect interesting pins, find context boards, add and subtract search terms, orient relevant content. Along with boards for educational activities and ideas for creative development, you can create boards for generating ideas and new projects.

In particular, on the topic of our research, there are more than 1000 pins related to the processing of used jeans into various products: bags, rugs, jewelry, interior items, etc. An important aspect is the dosage and selection of information from social networks. A structural approach, identification of network leaders, contextual search, dosage, processing and generalization of information is effective in this process.

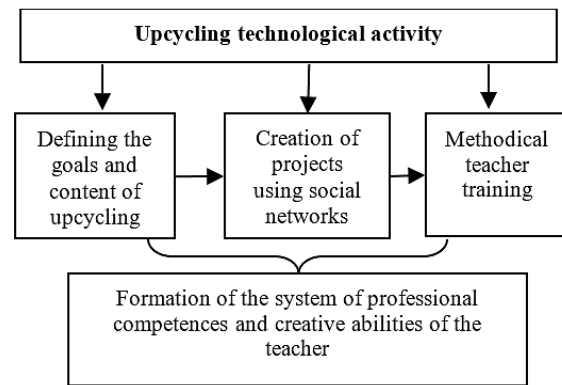


Fig. 3. Priority directions and goals of technological activity for the upcycling of the future teacher of labor education and technologies.

We have determined the priority directions and goals of technological activity on upcycling using the possibilities of social networks of the future teacher of labor education and technologies (Fig. 3).

We have worked out a number of organizational and pedagogical conditions for project activity on the upcycling of future teachers of labor training and technologies, namely: definition of structural elements and stages of the project; determination of educational goals and objectives, implementation of an integrated program of project and technological activities of the participants; determination of the stages of formation of professional competences and development of abilities of future teachers in project activity, which is based on the formation of experience of creative activity; development of a criterion basis for determining the levels of educational achievements of students in the implementation of eco-bag projects; use of opportunities and improvement of information-subject and material-technical support of the educational process; modeling of systems of interdisciplinary connections in technology education; constant cooperation of teachers of various subjects regarding the content, organization of training, development of educational and methodological and software support for teaching technologies.

We assume that the observance of these organizational and pedagogical conditions will ensure the formation of the readiness of the future teacher of labor education and technology to learn upcycling technology and the development of creative abilities of students of primary and secondary schools.

In the implementation and determination of the effectiveness of the organizational and pedagogical conditions of project activities on upcycling with the involvement of information arrays of the Pinterest social network regarding the formation of professional competences and creative abilities of future teachers of labor education and technology, we carried out a pedagogical study of the educational process at the Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, which was carried out in three stages (2020-2023): *ascertaining experiment* - a preliminary slice of knowledge (the levels of formed professional competences of future teachers were determined); *formative experiment* - the organization of learning technologies for making eco-bags by the upcycling

method with the involvement of information arrays of the Pinterest social network and the formulation of organizational and pedagogical conditions of project activity; *control and generalization stage* – analysis, processing of research results using statistical methods, formulation of theoretical-experimental conclusions and recommendations.

Control (K) and experimental (E) groups were selected for the experiment. The average level of previous knowledge was almost the same in the groups. The one in which the established level of knowledge was higher was chosen as the control group.

In order to establish the effectiveness of the organizational and pedagogical conditions of project activities on upcycling with the involvement of information arrays of the Pinterest social network, control measures were carried out in 2 groups of higher education institutions: implementation and protection of eco-bag projects.

The K-group students worked according to the method of individual execution of products for various purposes, the E-group students worked in small groups on the production of eco-bag projects using the upcycling method with the involvement of social network services aimed at developing the system of professional competences and creative abilities.

In evaluating the results of the participants of both groups, an integral criterion for the development of technological and creative abilities was the determination of harmony, aesthetics, unity, and the quality of artistic, design, and technological solutions. Teachers of professional disciplines evaluated the achievements of students in designing eco-bags on a four-point scale: high (5 points), sufficient (4 points), average (3 points), low (2 points). Students' project activities were observed, collective discussions and individual conversations were held. We evaluated the progress of students according to the degree of formation of professional competences, levels of mastery of project activities; a manifestation of creativity and independence, quality and flexibility in the implementation of projects.

We chose the ecological and technological direction, when students used upcycling technology in the design and manufacture of eco-bags. Important aspects of these projects are as follows:

- interdisciplinary character, when knowledge of natural and mathematical, technical and humanitarian fields is used to solve practical problems.
- involvement of cloud services and social networks with the possibilities of visualization, dynamism, mobility and integration;
- the use of used things, which is important in the use of secondary raw materials and the saving of material resources;
- application of ecological technologies without the generation of harmful waste;
- creative project-technological activity aimed at creating original, beautiful and useful things;

- development of creative and technological abilities and formation of professional competences of students.

In the development of the upcycling application method, we involved students in contextual search, discussion of the accumulated information, its generalization and definition of the content of the project activity on the processing of fibrous materials. Students together with teachers chose the topic of the project "Making an eco-bag from used items".

The possibilities of access to the use of significant volumes of interesting information about eco-bags gave students the opportunity to enrich their worldview, use a certain style of creative activity or choose their own. At the planning stage, an analysis of the types of author's eco-bags made from secondary raw materials, created by designers, craftsmen and displayed on the social network Pinterest, which were liked by the forms, design and availability of production, was carried out.

To develop the idea and its practical implementation, the main requirements for the project were defined, namely: originality and uniqueness of execution; compliance of manufacturing technology with ecological criteria. At this stage, students familiarized themselves with the types of eco-bags with decoration (formation of a bank of ideas) (Fig. 4), the technology of their creation, determined the time and resources needed to complete the project.

To achieve aesthetic goals, special attention in the analysis of prototype models is given to style, distinguishing characteristic features and execution of product sketches. Students noted the elements of shape, size, decoration and additional details of the composition.

The material of the product is used jeans, made of dense fabric, which has good operational properties and good appearance. Equipment and materials are selected for sewing the bag (sewing machine, needles, threads, scissors, etc.), for the artistic decoration of the product - ribbons for embroidery, beads, scraps of fabric, muslin, iris (to choose according to the model).

The technological stage of creating an eco-bag is a creative process from the manufacture of basic parts to decoration, where creative and technological skills are used. We have determined the technological sequence of sewing an eco-bag according to a certain algorithm: cutting off the worn bottom of jeans and cutting out the front and back panels; folding panels face to face and equalizing the width; stitching of all sections, cutting out the lining and its processing; sewing the patch pocket to the lining; sewing the side corners of the bag; making and covering bag handles; artistic decoration of the bag; connection of the lining with the main fabric.

During the defense of creative projects, students emphasized that the eco-bag is an ergonomic, ecological, technologically powerful, and original work. They also highlighted that upcycling is an accessible activity providing an opportunity to showcase and realize oneself as a creative person.



Fig. 4. Creating a bank of ideas.



Fig. 5. Artistic decoration of the product: a – ribbon embroidery, b – patchwork decoration, c – smooth embroidery.

Errors made by students in the design, manufacture, and decoration of products were identified and analyzed. These included issues such as disproportionality and excessive complexity of elements in form and composition, unsuccessful placement of additional and decorative parts, misalignment of the composition center, violation of proportions between main and secondary elements, and oversaturation of the product surface with decorative elements, among others.

Eco-bags of female students of specialty 014.10 Secondary education (Labor training and technologies) using upcycling technology are presented in Fig. 5.

The achievements of project participants were determined in relation to: the use of physical, technological, operational, and aesthetic properties of materials; ecologically responsible consumption of things; precise technological production and artistic design of products; compliance with the decoration of the product to its functional purpose; creative novelty and development of style; use of modern and regional traditions.

The analysis of the results of the implementation of eco-bag projects using the upcycling technology allows us to draw the following conclusions: the quality indicators (QI) of the implementation of control measures were, respectively, in the experimental and control groups: QI = 76%, QI = 56%, which revealed a mostly high and sufficient level of knowledge acquisition and formed competences and creative abilities in the E-group and a sufficient and average level - in the K-group (Table 2). The obtained results are displayed graphically in Fig. 6.

TABLE 2 LEVELS OF STUDENTS' ACHIEVEMENTS IN DESIGNING ECO-BAGS

Groups	Achievement levels in points				QI, %	Overall success, %
	5	4	3	2		
E	44	70	35	1	76	99,3
K	26	58	56	10	56	93,3

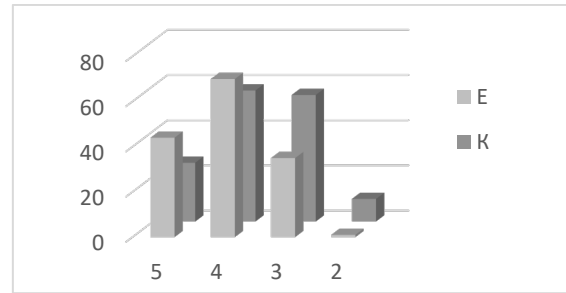


Fig. 6. Frequency diagram of grades received by students during control measures.

To confirm the reliability of the obtained results, the null hypothesis was put forward that the level of professional competences and creative abilities of future teachers formed during the design of eco-bags using the upcycling method in the control and experimental groups is the same or that the discrepancy in success is accidental and not due to the effectiveness of the experimental teaching methods.

TABLE 3 LEVELS OF PROFESSIONAL COMPETENCES AND CREATIVE ABILITIES OF STUDENTS

Groups	Levels of professional competences and creative abilities, %				Qualitative indicator, %	Quantitative indicator, %
	high	sufficient	average	low		
E	36	56	8	0	88	100
K	12	40	40	8	52	100

Students were previously tested to determine the levels of professional competences and creative abilities, the results of which are presented in the Table 3.

The degree of difference in success in two types of groups was assessed by the agreement Pearson χ^2 criterion. We determined the calculated ($\chi^2=22$) and permissible ($\chi_0^2=16.27$) value according to the table given in [21]. Comparison of the table value with the calculated value revealed that it is smaller. Under these conditions, the null hypothesis is rejected.

CONCLUSIONS

The pedagogical result of the effectiveness of the organizational and pedagogical conditions of the project activity on the upcycling of future teachers of labor education and technology is positive. This gives reason to assert that the introduction of eco-product manufacturing projects into the educational process is an important factor in the formation of professional competences and creative abilities of future teachers of labor education and technology, and the technology of upcycling is an effective means of involving future teachers in project activities in the teaching of technologies of students of primary and secondary schools.

We correlated the stages of students' creative activity according to the requirements of project technology (organizational-preparatory, design, technological, final), during which we observed, studied, designed and adjusted the educational process.

It has been established that upcycling as a processing technology is an effective means of forming the personality of future teachers of labor education and technology, when they develop the abilities of creative, technological and ecological thinking and problem solving. An important aspect of increasing the efficiency of this process is the involvement of social network services, which ensures educational mobility, group cooperation of teachers and students, active communication, discussion and teamwork of participants.

A special factor of effective activity using upcycling technology is the combination of information and communication technologies and handmade, which allows students to use the acquired knowledge, demonstrate technological abilities, and demonstrate creative abilities in the manufacture of eco-bags.

The upcycling of eco-bags reflects the idea of the integrity of the pedagogical process as a system of universal values, humanization, a person-oriented approach, and the priority of subject-subject relations. We have determined the main features of the process of designing eco-bags using upcycling technology - interdisciplinary, communicative and dynamism through the use of information services of social networks, environmental friendliness under the conditions of recycling of secondary raw materials; creative and practical activities that can be provided under certain organizational and pedagogical conditions.

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