створюють передумови для підвищення ефективності формування графічної грамотності майбутніх педагогів професійного навчання.

Отже, узагальнення наукових підходів дає підстави стверджувати, що використання штучного інтелекту як педагогічної технології відкриває нові можливості для модернізації графічної підготовки, розвитку просторового мислення та формування професійно значущих умінь майбутніх педагогів у умовах цифровізації освіти.

Отже, штучний інтелект як педагогічна технологія відіграє важливу роль у формуванні графічної грамотності майбутніх педагогів професійного навчання, розширюючи можливості освітнього процесу та підвищуючи його ефективність. Використання інструментів штучного інтелекту сприяє розвитку просторового мислення, формуванню навичок роботи з графічною інформацією та забезпечує індивідуалізацію навчання.

Впровадження адаптивних систем, інтерактивних платформ і цифрових середовищ дозволяє створювати умови для активної навчальної діяльності здобувачів освіти та наближення освітнього процесу до реальних професійних завдань. Разом із тим, ефективна інтеграція технологій штучного інтелекту потребує комплексного підходу, що включає підготовку педагогів до їх використання, оновлення змісту навчання та удосконалення матеріально-технічного забезпечення.

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EDUCATIONAL FUNCTIONS IN THE PROCESS OF STUDYING MACRAMÉ TECHNOLOGY

In the modern educational space, the development of creative abilities and the formation of students' value orientations is a priority task. Macramé is an ancient art of knot weaving that is currently experiencing a new wave of popularity, transforming from a utilitarian craft into a means of artistic self-expression. The relevance of studying macramé lies in its ability to combine historical heritage, mathematical logic, and ecological consciousness. This art form allows for the creation of products in the

popular eco-style using natural materials such as jute or cotton. Furthermore, the variety of modern macramé applications - ranging from small accessories to interior decor and clothing - opens up vast opportunities for student creativity and design.

The educational impact of macramé is based on its deep historical roots, allowing the realization of a number of strategic educational functions through immersion in the history of the technique. The origins of the technique date back to primitive times, when the first knot was tied to secure a stone hammer or axe. Familiarity with the experiences of Ancient Egypt, Iran, Peru, China, and Greece enables students to recognize macramé as part of the global anthropological heritage and the continuous development of human culture [2]. This contributes to national-patriotic education by comparing global traditions with domestic ones. Of particular interest is the knot writing of the Incas (quipu), where knots were used to store numerical information and mathematical calculations [2]. This demonstrates the logical component of the art to students: since an error in a knot meant an error in the data, the learning process fosters personal responsibility, accuracy, and respect for the intellectual labor of ancestors.

The term "macramé" has Arabic origins and means "lace" (migramah) [3]; it reached Europe in the 8th–9th centuries from the East, with the sailing fleet playing a key role in its spread. Sailors, who knew thousands of nautical knots, used weaving to decorate ships [2]. This fact helps broaden the horizons of adolescents, dismantling gender stereotypes regarding needlework and fostering respect for any craftsmanship. The Victorian era in England is considered the "golden age of macramé", when the technique was widely used to create complex tablecloths and lampshades [3]. Studying this period teaches 5th-9th grade students to distinguish interior styles, understand the value of handmade artisanal products in contrast to mass consumption, and forms individual artistic taste.

The study of macramé in middle school holds special importance due to the psychophysiological and emotional needs of students during this period. Adolescence (ages 10–15) is characterized by heightened emotional sensitivity and frequent mood swings. In this context, macramé serves as an effective tool for psycho-emotional self-regulation: the rhythmic repetition of knots and tactile contact with natural materials help adolescents reduce anxiety levels, fostering inner calm and the ability to concentrate. This allows the educational process to become a space for emotional relief, which is critically important for the harmonious development of an individual amidst modern educational workloads.

The purpose of this work is the theoretical and practical substantiation of the educational potential of macramé technology as a means of shaping a holistic student personality, developing their volitional qualities, aesthetic taste, and ecological consciousness. To achieve this goal, a comprehensive approach was applied, which includes three primary methods for implementing educational functions.

First, through historical and culturological analysis, the evolution of the technique is traced from ancient functional knots and the Inca "quipu" writing system to the refined art of "migramah". This approach allows the realization of the cultural education function: students perceive macramé not merely as a craft, but as the living intellectual heritage of humanity. Exploring the transformation of terms—from the nautical "square knotting" to Victorian decor and the Cavandoli technique—builds

students' respect for historical continuity and lays the groundwork for a national-patriotic worldview through cultural dialogue.

Secondly, through the study of the material and technical base, the stage of forming ecological consciousness and technological discipline is revealed. Working with various materials (natural cotton, jute, synthetic cords) teaches students to value natural resources and understand the properties of objects. The use of auxiliary tools, such as knotting boards and pins, cultivates neatness, organization, and a responsible attitude toward workspace management in adolescents, serving as the foundation for developing a diligent personality.

Thirdly, through practical modeling based on basic knots (lark's head, square knot, half hitch, and tatting knots), the function of creative self-realization and volitional education is realized. Students do not merely copy patterns; they learn to make independent decisions by combining elements to create unique products: from stylish accessories to complex interior items (wall hangings, plant hangers, hammocks) [1]. This combination of traditional algorithms with modern design trends enables students to experience success from their own labor, developing perseverance, self-confidence, and aesthetic taste.

The essence of the research lies in examining the process of studying macramé as a holistic educational system based on three key stages. Each of these stages becomes a tool for shaping the value orientations and volitional qualities of students:

The first stage - preparatory-aesthetic - involves the conscious selection of materials and tools. It is here that the foundations of ecological education and a culture of labor are laid. Through selecting textures (natural cotton for interior wall hangings, eco-friendly jute, or durable polyester) and experimenting with natural hardware (wooden dowels, ceramic beads), students learn to treat natural resources responsibly and develop their individual artistic taste.

The next step is the technological-disciplinary stage, which involves mastering the "language" of knots. The study of lark's head, square, and half-hitch knots, along with tatting techniques, serves as a means of labor education. This process requires high concentration of attention, patience, and perseverance from the student. In addition to technical skills, the function of intellectual education is realized at this stage: through exposure to cultural symbolism (such as the Chinese good luck knot), adolescents learn to more deeply understand the substantive meaning of decorative arts and respect the traditions of various peoples.

The final stage is the creative self-realization stage, where students transform their acquired knowledge into functional, artistic products. The educational function here is evident in the child's ability to see a concept through to completion, creating tangible objects: from small accessories (keychains, bracelets) to complex interior decor (plant hangers, dreamcatchers) or furniture items [1]. The sense of success derived from creating a useful item by hand strengthens self-confidence, cultivates industriousness, and prepares students for active societal participation by integrating a traditional craft into modern design.

Thus, step-by-step immersion into the macramé technique ensures a comprehensive educational impact, shaping not only weaving skills but also the individual's inner culture, discipline, and creative responsibility.

The practical implementation of macramé's educational functions accounts for the gradual increase in task complexity depending on the students' age. For 5th–6th grade students, the priority is building self-confidence through the creation of simple yet functional items, such as keychains or basic bracelets ; a quick result at this stage fosters a positive attitude toward labor. In the 7th–8th grades, focus shifts to cultivating patience and perseverance while making plant hangers or small wall hangings, which require greater concentration and endurance. For 9th-grade students, the creative self-realization stage becomes highly relevant through complex projects, such as shopper bags, dreamcatchers, or interior decor elements, where adolescents learn to integrate traditional techniques into modern fashion, formulating their own artistic and aesthetic stance.

As a result of the research, it can be concluded that macramé emerges as a powerful tool for realizing a complex of educational functions within the technology learning process. This technique uniquely merges the demands of high technological discipline and mathematical precision - from calculating thread lengths to constructing logical knotting patterns - with broad opportunities for moral and aesthetic self-expression. Systematic work with varied-texture natural materials (cotton, jute) in combination with specialized tools actively promotes not only the development of fine motor skills but also the formation of ecological consciousness and a careful attitude toward resources. The process of creating knot compositions cultivates critically important volitional qualities in students: patience, perseverance, and responsibility for the final result. Mastering this ancient technology allows students in grades 5–9 to create unique, original products that hold tangible practical value. This contributes to nurturing a self-confident individual capable of successfully integrating the centuries-old cultural traditions of knot weaving into the context of modern design and fashion, while simultaneously forming respect for labor and a personal artistic and aesthetic stance.

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РОЛЬ ШІ-БОТІВ В СУЧАСНІЙ СИСТЕМІ ОСВІТИ: ПЕРЕВАГИ ТА ВИКЛИКИ

Розвиток комп'ютерних технологій призвів до цифровізації в усіх сферах людського життя. Освіта також не залишається осторонь цього процесу. Актуальність цифровізації освіти в умовах глобальних криз набуває додаткового