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Comparative analysis of neural networks Midjourney, Stable Diffusion, and DALL-E and ways of their implementation in the educational process of students of design specialities

Abstract. The implementation of neural networks in the creative design process enables original and innovative results and increased efficiency in creating a visual art product, and therefore it is important to explore how various interactive tools can contribute to the development of the creative abilities of future design professionals. The purpose of this study was to investigate the capabilities and characteristics of Midjourney, Stable Diffusion, and DALL-E neural networks in the context of their use in teaching design students. The study used the analytical method, comparison, generalisation, and systematisation methods. The study found that the neural networks Midjourney, Stable Diffusion and DALL-E have prospects for implementation in the educational process for students of design specialities. The authors of this paper revealed the significant potential of artificial intelligence, namely neural networks, in design, namely for creating fonts, typographic elements, posters, banners, graphics, and illustrations. By comparing the capabilities of the Midjourney, Stable Diffusion, and DALL-E neural networks, it was found that each of them has a specific purpose and architecture that is effective for performing various design tasks. The findings of the study demonstrate the potential of neural networks to improve the education of students of design-related specialities. It was substantiated that the introduction of suitable methods and techniques can help expand the creative spectrum, ensure stability and control in generating images, and lead to a more effective implementation of ideas in visual realities. The results of this study can be useful as tools for developing educational approaches in the field of design and introducing modern technologies into the educational process

Keywords: visual image; idea generation; software; modern education; artificial intelligence

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INTRODUCTION

Amid the rapid development of technology, the role of neural networks and artificial intelligence in various spheres of life is growing significantly. This trend is not lost on design, an industry where aesthetics, functionality, and innovation combine to create unique visual solutions. Today, information technology is being actively implemented in the educational process around the world, and artificial intelligence is one of the key areas. Therefore, the study of the use of neural networks, namely Stable Diffusion, Midjourney, and DALL-E in the training of designers will help to confirm the potential of these technologies in the creative educational process. This study aims to determine how the use of neural networks can improve the effectiveness of teaching design students. It is important to establish whether these technologies can contribute to better learning and the development of creative skills.

Neural networks, namely Stable Diffusion, Midjourney, and DALL-E 2, have been investigated by A. Borji (2022), who draws attention to their ability to generate face images in real-world conditions. The scientist emphasises that each of these networks has unique characteristics and approaches to image creation. Stable Diffusion, according to the scientist, is noted for its high stability and visual accuracy in generating faces, while Midjourney stands out for its ability to create images that match text descriptions, adding style and design elements to images. The scientist also notes that the DALL-E 2 is distinguished by its creativity in generating new images by combining different elements and concepts, which expands the possibilities for visual expression. The researcher is convinced that each of these networks has its advantages and limitations, but they can be effectively used for various tasks in the field of visual design and creativity. Therefore, it is worth exploring the potential of neural networks in education.

Ukrainian researchers M. Marienko and V. Kovalenko (2023) focus on the role of artificial intelligence in modern education. Scientists note that artificial intelligence can influence the learning process, providing students and teachers with new opportunities to improve productivity and learning efficiency. The researchers are convinced that artificial intelligence can be used in educational technologies such as individualised learning, data analysis, and student performance forecasting. Furthermore, M. Marienko and V. Kovalenko (2023) emphasise the importance of integrating artificial intelligence and open science into the educational process, which contributes to the development of students, improves the quality of education and ensures the availability of scientific information for all stakeholders. It is necessary to investigate these innovative approaches in greater detail, specifically the introduction of neural networks in the educational process to help students prepare for modern reality and develop their scientific potential.

O. Romaniuk and V. Naidiuk (2021) note the use of neural networks as an effective tool for image processing and analysis. Scientists emphasise that neural networks allow achieving exceptional results in pattern recognition and detecting patterns in images. The authors suggest that this technology has a wide range of applications. It is worthwhile to study this topic more thoroughly, including the analysis of specific neural networks, namely Midjourney, Stable Diffusion and DALL-E, as tools in modern art education.

Using text and image queries, N. Dehouche and K. Dehouche (2023) explore the potential of the Stable Diffusion neural network for visual arts learning. Scientists argue that the use of this network can positively affect the learning process, as a response to text queries that will initiate the creation of visual works. The researchers emphasise the possibility of using this tool to create experimental works, allowing students to unleash their creativity and use innovative approaches in visual art. It is worth comparing the capabilities of Stable Diffusion with other similar neural networks to highlight the differences from other methods of using artificial intelligence in visual arts education, including image generation tools.

I. Lugova and D. Panchenko (2023) address the importance and prospects of using artificial intelligence in the field of architectural drawing. They emphasise that artificial intelligence can significantly expand the capabilities of architects and designers in the creative process, facilitating the rapid creation and optimisation of drawings. The authors consider the possibilities of using machine learning algorithms to generate innovative ideas, analyse and improve architectural forms and compositions. It is necessary to study in greater detail the prospects for introducing neural networks into education, which can lead to new opportunities and expand the horizons of creativity.

The purpose of this study was to investigate the use of Midjourney, Stable Diffusion, and DALL-E neural networks in teaching design students.

MATERIALS AND METHODS

The study uses the methods of analysis, comparison, generalisation, and systematisation to conduct a thorough research of ways to implement neural networks such as Midjourney, Stable Diffusion, and DALL-E in the educational process of students of design specialities. The application of the analytical method in the study contributed to the investigation of the sphere of influence of Midjourney, Stable Diffusion, and DALL-E neural networks in the modern digital world. The analytical method of allowed investigating the functional characteristics, strengths, and weaknesses, as well as potential areas of implementation in the educational process. This method helped to analyse in greater detail the various properties of each network, their ability to generate images, and use them to improve students' practical design skills. Additionally, this method helped to find the optimal strategies for implementing neural networks in education, considering the specifics of design specialities and the needs of students.

The comparison method made it possible to compare the capabilities of Midjourney, DALL-E, and Stable Diffusion neural networks, their functionality and efficiency in

the context of design education. The comparison helped to show the areas where each network was most effective, including visual content creation and image generation and image processing. The advantages and disadvantages of each network were shown through a comparison method, which helped to understand how they can be used in the educational process for future designers. The comparison also revealed which aspects of each network could be integrated into the curriculum to enrich students' knowledge and skills. This method helped find potential applications for each network, such as creating interactive visuals, generating design concepts, or implementing creative projects.

Using the method of generalisation, the researchers managed to achieve an in-depth understanding of the essence of each of the neural networks under study. This method made it possible to identify general trends and define the main principles of their operation. The method of generalisation helped to find the key characteristics of each neural network, their role in the educational process and their potential for improving design education. This method has helped to identify general strategies for implementing neural networks in education, namely, to identify the benefits of using them to improve students' creativity, increase productivity, and improve the quality of design products. The method of generalisation helped to build a holistic picture of the impact of neural networks on the educational process and find ways to optimally use their potential to improve the learning of students of design-related specialities.

The use of the systematisation method facilitated the organisation of information in the scientific study about each of the neural networks under study. This method made it possible to divide the key aspects and characteristics of each network into logical groups, creating a comparison system. The systematisation helped to find the common and distinctive features of networks, their advantages and disadvantages in terms of their use in education. Through systematic analysis and comparison, it was possible to set priorities for the implementation of networks, develop strategies for their use, and identify key aspects that should be considered when teaching design students. This method helped to structure the knowledge gained to improve the effectiveness of training and ensure optimal use of the potential of neural networks in the training of future designers.

RESULTS

The modern world is undergoing changes due to the rapid development of digital technologies, among which artificial intelligence occupies a prominent place. This innovative tool has long since gone beyond science fiction, becoming an integral part of everyday and professional life, particularly for artists. The integration of artificial intelligence into design opens unlimited potential for creative experimentation, innovative approaches and revolutionary solutions.

Artists and designers appreciate the considerable progress in the use of artificial intelligence. These neural networks allow concepts and ideas to be instantly transformed into visual representations, providing a ready-made raster product for use or further work (Cetinic & She, 2022). Artificial intelligence and neural networks are opening new opportunities for artists and designers, simplifying, and accelerating the creative process. Thanks to them, concepts and ideas can be transformed into visual embodiments in a truly brief time, making the creative process more dynamic and efficient. This is especially useful for creating visual materials such as graphic design or artwork. Furthermore, the use of neural networks in the creative process allows artists to experiment with stylistic solutions and visual effects. They can create unique images with their own style using a variety of neural network settings and parameters, which is especially important for training future design professionals. Artificial intelligence is used in many areas of design, which requires young design professionals to be proficient in these technologies (Fig. 1).

It is worth considering the most common neural networks used to create a design product. The Midjourney neural network, which appeared in 2022, is of relatively high quality, which makes it attractive to designers and artists who find inspiration in fantasy or science fiction. This neural network creates exceptional works of art by visualising images with a surreal touch. The features of Midjourney reflect the rapid progress of new technical capabilities of artificial intelligence and its widespread use in creative practices. This trend supports the need for scientific research into this phenomenon. According to Wired, back in 2018, the Benjamin neural network created its first sci-fi short film without direct human involvement. The neural network has scripting skills, processing hundreds of real-life scenarios. In 2020, artificial intelligence was used in the creative work of the artist Roman Lipskyi (Kolisnyk *et al.*, 2023).

Midjourney, as a neural network, demonstrates the ability to perform deep analysis and generate visual images. This software was used to visualise Ambergris as an organism in the novel Perfume by P. Süskind. Midjourney depicted Ambergris, which in the novel symbolises Constantinople, a city with a long history and cultural significance (Alışık, 2022). Using Midjourney, Ambergris was portrayed as an essential element of historical and cultural heritage, which adds to the versatility and depth of understanding of the text. Midjourney can play a leading role in visualising literary images and concepts, helping to recreate the visual context and emotional depth of a text. It can be a valuable tool for analysing and interpreting texts that contain a visual component and allows opening new ways of understanding literary works through the lens of images and emotions (Byrne, 2023).

In the education of future designers, Midjourney technology can help develop creative and design skills, as well as increase efficiency in the creative process. With Midjourney, students can quickly turn their ideas into visuals, which helps them better understand what their concepts look like in practice. Furthermore, Midjourney can stimulate students' creativity. It helps experiment with assorted styles, shapes, and colours, opening new avenues for creative expression. Midjourney also helps to thoroughly

analyse designs, their details and relationships, which contributes to a better understanding of design principles and its impact on perception. Students can work with realistic designs and scenarios, which helps prepare them for practical tasks in a real design environment. In general,

the use of Midjourney in design education can help students develop creativity, analytical and practical skills, improve their preparation for the challenges of the modern design industry and contribute to their personal and professional growth.
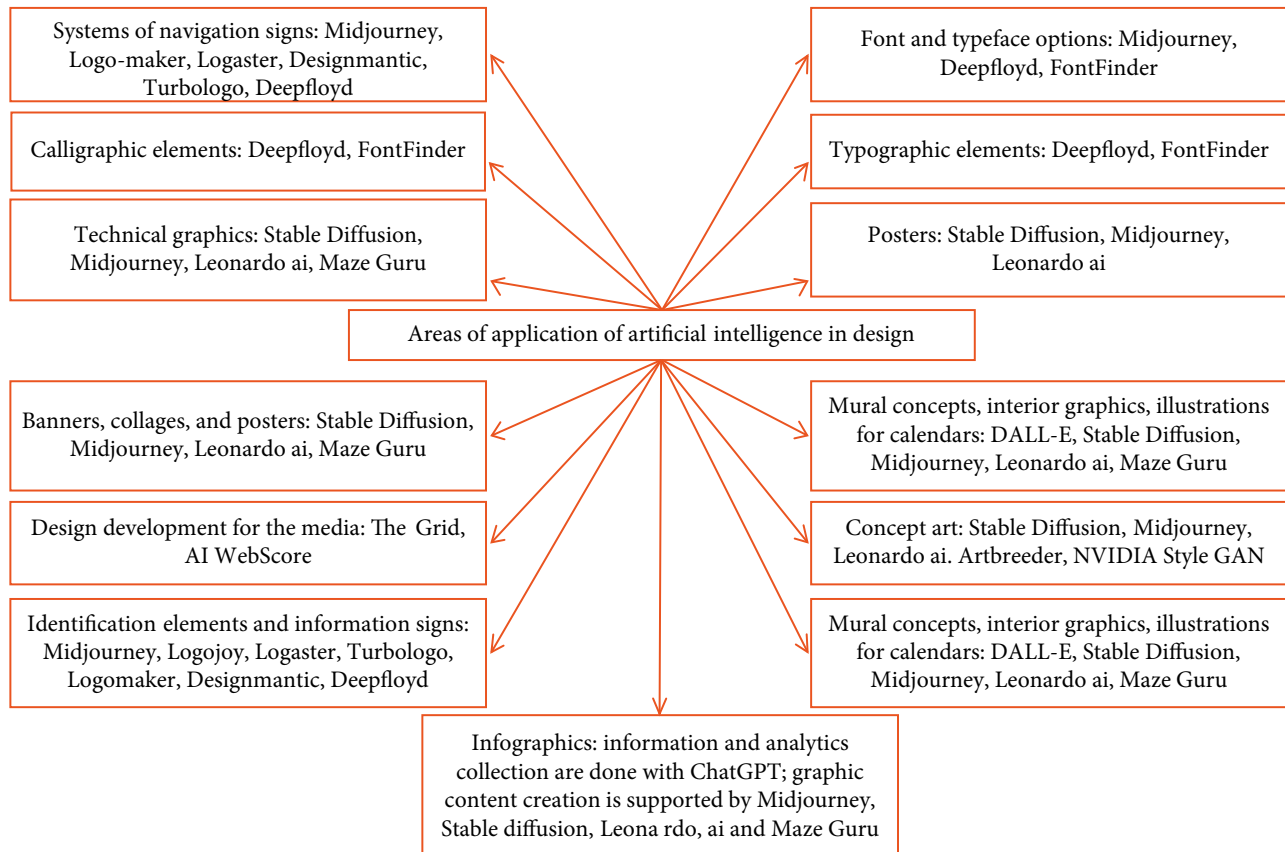

Figure 1. Areas of application of artificial intelligence in design
Source: compiled by the authors of this study based on T. Bozhko and V. Arefiev (2023)

The Stable Diffusion neural network has a considerable potential in design. Stable Diffusion technology is a method of generating visual images based on a text description. Its main principle is to transform textual information into concrete graphical images using neural networks and computer visual modelling (Lee *et al.*, 2023). This technology helps to create visual content corresponding to a given text, which can be useful in educational processes for students of design specialities.

The network can be useful for solving various tasks in product development, from conceptual design to optimisation and improvement of finished designs. Stable Diffusion helps automate the process of generating and refining designs, making it more efficient and convenient for designers. This approach can increase the creative potential of industrial designers, as well as speed up the development of new products and improve the quality of the results (Liu & Hu, 2023). Technology can help students unleash their creativity and take their design skills to a new level. Applications include concept and prototyping,

design improvement, creative process support, workflow optimisation, and active learning.

Thanks to the Stable Diffusion neural network, students can experiment with distinctive designs and ideas effortlessly. It provides the ability to automatically enrich parts, visualise alternatives and introduce innovative elements. It helps to improve the creative process and find the best design solutions. Workflow optimisation is also an important advantage of using a neural network. It reduces the time required to develop concepts and designs, which is important in today's fast-paced work environment. Furthermore, students can learn how to work with artificial intelligence and use its capabilities in design. Using modern tools, students can communicate with artificial intelligence and achieve design goals. Students are given more opportunities to create innovative and creative designs thanks to Stable Diffusion, which also improves their workflow and prepares them for today's design challenges.

Another popular neural network, DALL-E, is a new innovative technology in the field of deep learning and image

generation. DALL-E is an evolutionary development in the field of artificial intelligence that can change the approach to creating visual content. This network can generate unique images by combining concepts and structures that would not have been physically possible before (Marcus *et al.*, 2022). One of the key features of DALL-E is the ability to generate creative images based on text descriptions. This enables designers, artists, and creative professionals to use the network to translate even the most unconventional ideas into visual form. However, along with the immense potential of DALL-E, ethical questions arise regarding the use of the generated images, as the network can affect authorship, authenticity, and the concept of intellectual property.

The prospects for using DALL-E in education, particularly in design programmes, are significant, as it can serve as a tool for learning concepts, styles, and visual expressions through the creation of visual artefacts, giving students the opportunity not only to observe but also to experiment with various design options on their own. DALL-E is not only a technology, but also a powerful tool for creativity, education, and the expression of ideas in visual form, but it also requires attention to the ethical and legal aspects of its use.

The use of artificial intelligence in education has considerable potential to transform conventional teaching methods and improve the efficiency of the learning process. There are significant opportunities to use intelligent systems to individualise learning, adapt to students' needs and ensure deeper learning. This approach can help create a more encouraging and dynamic learning environment where students can develop the skills needed for future challenges in design and other fields (Wang *et al.*, 2019). Based on the results of the study, a comparative analysis of the Midjourney, Stable Diffusion, and DALL-E neural networks was performed (Table 1).

Table 1. Comparison of the potential of using Midjourney, Stable Diffusion, and DALL-E neural networks in training

Aspects	Midjourney	Stable Diffusion	DALL-E
Purpose	Generate images from text descriptions and reproduce picture styles.	Generating content for design and visualising ideas.	Creative generation of new images based on text descriptions.
Architecture and features	Uses transformative architecture for text and image processing.	Based on variational autoencoders to generate stable images.	Uses deep convolutional and transformational networks for images and text.
Training and datasets	Uses datasets with text descriptions and corresponding images.	Uses datasets of design and visual concepts.	Trained on a large dataset of text descriptions and images.
Use in education	Can be used to illustrate concepts and stylised visual expression.	Helps students create visualisations for projects and work with images.	Helps to expand the creative potential of students through the generation of innovative ideas.
Main differences	Focuses on generating images from a text description regarding styles.	Focuses on generating stable images for design.	Specialises in creative combination of images and text.

Source: compiled by the authors of this study

The mentioned neural networks, namely Midjourney, Stable Diffusion, and DALL-E, have excellent characteristics that can be used in the educational process of students of design specialities. Each of these networks has a specific purpose and architecture that allows them to perform different tasks in the field of image generation and visualisation. Midjourney focuses on creating images based on textual descriptions with a style guide, which can be useful for illustrating concepts and thematic expressions. Stable Diffusion is aimed at generating stable images for design, which can help work with visual concepts and projects. DALL-E offers a creative approach that allows generating new ideas and combining text and images in unusual ways. The use of these networks can have a positive impact on students' learning, expanding their capabilities in the field of design and visual creativity.

Using Stable Diffusion, Midjourney, and DALL-E, an image with the same description was generated – a highly detailed surrealistic photograph of a ninja fighting a fire-spitting dragon (Fig. 2).

The images show that despite the same query for each neural network, the result is different. Looking at each picture, one can see a clear reflection of the individuality and uniqueness of each network. Colour schemes vary from one image to the next, creating a palette that expresses different moods and emotions. Not only the shades differ, but also the position of the objects in each painting. This helps to understand that each neural network makes a unique contribution to the creation of visual content, giving it a distinctive character and expressiveness. This demonstrates the powerful potential of neural networks in the creative process, opening endless possibilities for the implementation of creative ideas and individual approaches to design.

Innovation-oriented neural networks, including Midjourney, Stable Diffusion, and DALL-E, stand out as powerful tools that can change design education. Their potential opportunities intersect with the needs of students and professionals in this field, helping them to acquire new skills and expand their creative horizons. Capable of

generating exceptional and surreal images, Midjourney can be an excellent tool for visualising ideas and concepts, giving students the opportunity to explore a variety of styles and expressions. Stable Diffusion, based on stable diffusion, can help students analyse and understand the complexity of processes and structures in design. Specialising in generating images from textual descriptions, DALL-E paves the way for creative expression and experimentation.
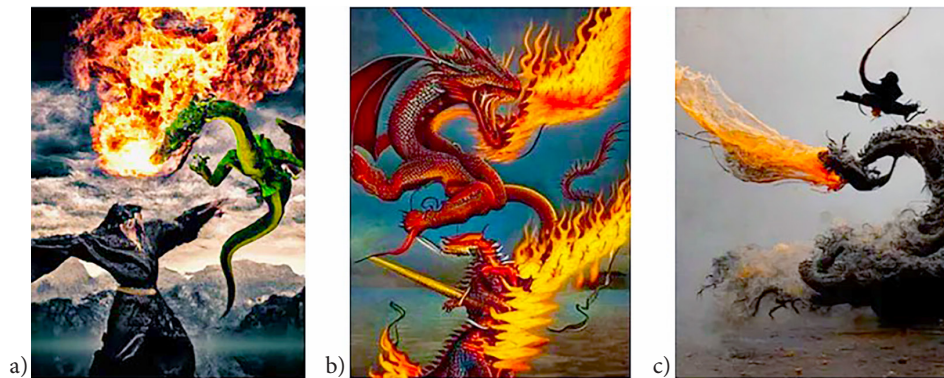

Figure 2. Generated images
Note: created with a) DALL-E 2; b) Midjourney; c) Stable Diffusion
Source: A.S. Perera (2022)

There are several ways to effectively implement neural networks in the educational process of design students:

1. Interactive workshops and projects. Students can take part in hands-on activities where they will interact with neural networks to create their works. This can include image generation, designing stylish or unique fonts, creating graphic concepts, etc.

2. Virtual workshops and platforms. Online platforms or software tools that allow students to try their hand at creating designs using neural networks. They can offer tasks of varying complexity and direction, which will help develop creative and technical skills.

3. Integration into design courses. Neural networks can be integrated into the curriculum as an integral part of certain courses. Students can explore the power of networks in particular aspects of design, such as infographics, mock-ups, animations, etc.

4. Cooperation with specialised platforms. Collaborating with platforms that specialise in neural network design and development can give students access to powerful tools and resources for learning and creativity.

5. Training resources and materials. Teachers can create educational materials that explain how neural networks work and teach students how to use them for design. This can be educational material in the form of video tutorials, manuals, etc.

6. Research projects. Students can take part in research projects related to the development and application of neural networks in design. This will allow them to delve deeper into the topic and discover new opportunities.

In general, the introduction of neural networks into the educational process can make learning more engaging and relevant, helping students develop the necessary skills for the modern design industry. The latest technologies can provide students with the opportunity to apply learning material in a practical way, enhancing their ability to think innovatively and solve real-world problems. At the same time, they are designed to expand the boundaries of learning, allowing students to immerse themselves in the world of future technologies and create images that previously seemed impossible. However, along with the advantages, it is important to consider the ethical aspects of using these technologies, as well as to explore their possible limitations and impact on the creative process. Overall, Midjourney, Stable Diffusion, and DALL-E neural networks can substantially enrich the learning experience of design students by introducing them to the world of modern technology and creative improvement.

DISCUSSION

The development of artificial intelligence, namely neural networks, opens new opportunities for modern education. These technologies can have a considerable impact on the educational environment and expand the knowledge of design students. Neural networks, including Midjourney, Stable Diffusion, and DALL-E, are recognised as promising tools for educational purposes. Their image analysis and generation capabilities help to individualise learning, develop creative skills and provide access to virtual workshops. The interactivity of the learning process, thanks to these technologies, increases student engagement and allows them to learn complex concepts more effectively. It is worth considering the views of researchers from different countries on the introduction of neural networks in the educational process, which will help to understand how this technology affects various aspects of learning, cultural identity, and other aspects of the modern world.

Researchers P. Fortuna and A. Modliński (2021) note that the public perceives art created by artificial intelligence as less valuable than art created by humans, especially if the author of the work is known. According to scientists, the impact of the information that the painting was created

by artificial intelligence is offset by the level of the author's skill and the overall impression it makes on the viewers. Researchers have found that people use contextual cues when evaluating paintings created by both humans and artificial intelligence. According to researchers, if it is pointed out that the artistic value of a painting created by artificial intelligence is provided as a contextual clue that highlights the difference between art created by humans and machines, the perceived value of this painting increases (Fortuna & Modliński, 2021). Comparing the results of this study, the use of neural networks in design education may prove to be a significant area in the development of education, preventing the devaluation of skills and abilities of future specialists.

L. Justice (2019), and S. Davydova and N. Derevyanko (2022) highlight the importance of digital technologies and artificial intelligence for education. Scientists emphasise that such technologies can considerably improve the learning process by providing an individualised approach to learning, meeting the needs of different students and contributing to more effective knowledge acquisition. Researchers also emphasise that the use of artificial intelligence can help improve the assessment process and provide convenience for teachers in monitoring student progress (Justice, 2019; Davydova & Derevyakno, 2022). Comparing the results of this study, it is worth noting that the use of artificial intelligence in the field of design education has significant potential and is available for implementation in the educational process.

Researchers at UNESCO Education Sector (2019) are convinced that the use of artificial intelligence in education opens both great opportunities and challenges for humanity. The study emphasises that a rational combination of innovative technologies and sustainable development can lead to improved access to education, higher quality of education, and development of individual abilities of students. However, at the same time, challenges arise related to the ethical, social, and technical aspects of introducing intelligent systems into the educational process. The UNESCO Education Sector (2019) is convinced that it is important to ensure a balanced approach that considers both the positive aspects of innovation and its possible consequences for society and the individual. It is worth agreeing with this position, since, if compared with the results of this study, the use of a balanced approach in teaching design students can effectively help integrate neural networks into the educational process. This will facilitate the development of this industry, considering the conventional elements of education in universities and higher education institutions.

M. Kahng *et al.* (2018) concluded that understanding and learning complex deep generative models can be simplified through interactive visual experiments. The researchers believe that GAN Lab, the first interactive visualisation tool designed to help understand and experiment with complex deep learning models such as Generative Adversarial Networks (GANs), enables unknown users to get to know these models. With GAN Lab, users can interactively train generative models and visualise the results of training in real time. This tool combines an overview graph of the GAN model with a multi-level distribution to help understand the interaction between model components. The researchers emphasise that GAN Lab offers interactive opportunities to explore complex deep learning models, including stepwise training at various levels of abstraction to gain a more profound understanding of learning dynamics (Kahng *et al.*, 2019). The tool is implemented using TensorFlow.js and can be accessed via web browsers without the need to install specialised hardware, which helps to overcome practical limitations in the implementation of interactive deep learning tools. In comparison with the results of this study, it is worth noting that more modern neural networks, such as Midjourney, Stable Diffusion, and DALL-E are more promising tools for teaching students design skills and abilities and are more in line with the current requirements of design education.

According to a study by K.Q. Zhou and H. Nabus (2023), the development and use of the DALL-E deep learning system for image generation presents both opportunities and challenges from an ethical perspective. Scientists note that DALL-E can generate realistic images that closely resemble human art. The researchers emphasise that DALL-E's ability to generate realistic images of various kinds opens the door to a variety of applications, including value, artistic, and deceptive, raising questions about the ethics of using such images, including in marketing, social media, and media. At the same time, it can raise controversy about the extent to which creativity based on this type of tool is authentic and original (Zhou & Nabus, 2023). However, when comparing the results of this study, it should be noted that the list of ethical aspects does not include the use of artificial intelligence in the education of future professionals as a tool for developing the creative skills of young design professionals.

Scientists X. Yuan *et al.* (2023) note the effectiveness of computer-based information design education in higher education institutions. Scientists note that this educational method helps to optimise the learning process, provides a more interactive approach to learning and improves the quality of students' learning. This approach also promotes ease of learning and can increase students' motivation to study information design (Yuan *et al.*, 2023). It is worth agreeing with this statement, as computer-assisted learning in today's digital environment is a promising element in the development of the design industry, encouraging young people to engage in an active learning process, namely using artificial intelligence and neural networks.

In a world where the role of technology is growing, neural networks can be a key tool for preparing students for the challenges of today. They not only help to develop design skills, but also provide an opportunity to master the latest approaches and technologies, which is important for training competitive specialists. Thus, neural networks are opening new perspectives for design education, changing the way people learn and developing the skills needed to succeed in the modern world.

CONCLUSIONS

The use of neural networks in design has a wide scope of influence on various aspects of the modern world. From creating identification and navigation signs to designing fonts, graphics, posters, animations and infographics, these technologies can help transform the learning experience for design students. The introduction of these innovative tools into the learning process is important as it fosters creativity, a more profound understanding of graphic design and enhances the ability to identify individual approaches.

The use of neural networks in design education is promising and can contribute to improvements and innovations in the industry, as the use of artificial intelligence allows for the development of individual approaches to students, considering their characteristics and needs. Understanding the principles of neural networks can make it easier to learn and create complex designs, speed up the workflow, and make it more efficient. The rapid development of artificial intelligence requires specialists to constantly learn and adapt to new opportunities. Therefore, it is important to take care of the ethical aspects of using artificial intelligence and ensure that the decisions it makes are appropriate. The integration of innovative technologies allows students to devote more time to creativity and improving their design skills. Learning modern technologies such as Midjourney, Stable Diffusion, and DALL-E can improve the quality of graphic design and other skills of students. It is important to make technology accessible and understandable to everyone, so that every student can use it in their learning.

The study revealed that Midjourney, Stable Diffusion and DALL-E neural networks have considerable potential for implementation in the educational process for students of design specialities. An analysis of their characteristics and capabilities has made it clear that these networks can be useful tools for improving the training and creative development of young designers. Integrating neural networks into the learning process can help increase learning efficiency, save time, and improve the quality of projects created. However, the use of artificial intelligence in education requires a certain amount of time to familiarise with and adapt to, as well as to understand the limitations and opportunities of these technologies.

Future researchers should pay attention to the study, development, and optimisation of curricula for design specialities that include the use of neural networks, such as Midjourney, Stable Diffusion, and DALL-E.

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Порівняльний аналіз нейронних мереж Midjourney, Stable Diffusion та DALL-E та способи їх упровадження в навчальний процес студентів дизайнерських спеціальностей

Анотація. Упровадження нейронних мереж у процес творчого проєктування дає змогу отримувати оригінальні новаторські результати та підвищувати ефективність у створенні візуального мистецького продукту, а тому актуально дослідити, як різноманітні інтерактивні інструменти можуть сприяти розвитку творчих здібностей майбутніх спеціалістів у сфері дизайну. Мета статті – дослідити можливості та характеристики нейронних мереж Midjourney, Stable Diffusion та DALL-E в контексті їх використання в навчанні студентів дизайнерських спеціальностей. У науково-дослідній роботі використано аналітичний метод, порівняння, узагальнення та метод систематизації. У результаті дослідження з'ясовано, що нейронні мережі Midjourney, Stable Diffusion та DALL-E мають перспективи впровадження у навчальний процес для студентів дизайнерських спеціальностей. Розкрито значний потенціал застосування штучного інтелекту, а саме нейронних мереж, у дизайні, зокрема для створення шрифтів, типографічних елементів, плакатів, банерів, розробки графіки й ілюстрацій. Шляхом порівняння можливостей нейронних мереж Midjourney, Stable Diffusion та DALL-E виявлено, що кожна з них володіє специфічним призначенням та архітектурою, що ефективно для виконання різних завдань в сфері дизайну. Результати дослідження свідчать про потенціал нейронних мереж для покращення навчання студентів спеціальностей, пов'язаних з дизайном. Обґрунтовано, що впровадження відповідних методик і технік може сприяти розширенню творчого спектру, забезпечити стабільність та контроль у процесі генерації образів та зумовити більш ефективне втілення ідей у візуальні реалії. Результати роботи можуть бути корисними як інструменти розвитку навчальних підходів у сфері дизайну та впровадження сучасних технологій у навчальний процес

Ключові слова: візуальний образ; генерування ідей; програмне забезпечення; сучасна освіта; штучний інтелект