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Investigating The Effects of Using Artificial Intelligence in The Conceptual Design Phase of the Industrial Design Process

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Abstract

This article offers a perspective on the use of artificial intelligence software as an auxiliary tool in the design process and the positive and negative effects of its application. For this purpose, the potential of the MidJourney tool based on artificial intelligence to support creativity and motivation in the product design process was tested with design students. In the workshop with design students, it was determined that artificial intelligence can support the creative thinking process in terms of form and aesthetics by creating the outlines of design concepts and supporting the creative thinking process in terms of form and aesthetics and can also contribute positively to the student's time management. As a result of the analysis and interpretation of the workshop, positive results were obtained, like other studies that refute the existing negative prejudice against artificial intelligence. However, it is understood that there is a need to explain to the students how such platforms should be used and that the current concerns should be eliminated by raising students' awareness about the future of artificial intelligence. On the one hand, it will negatively affect unconscious student profiles or people who are accustomed to the ready-made design process and their creativity.

1. INTRODUCTION

Product design has been labelled with different definitions throughout its history, new definitions are emerging today [28, 64]. After the Industrial Revolution, many different design approaches have been developed, and the product design process has moved to a new dimension with the more effective use of productive design [60]. In this process, it has been observed that by creating design alternatives, designers increase their creativity and save time. Generative design facilitated by algorithms, enables the generation of multiple product designs. This capability has been the subject of extensive discussion in numerous articles (Figure 1). Generative design can be used very effectively in the design process [3, 55]. However, in addition to creativity, the designer's knowledge and instincts are also very important in the design process [3, 60].

Studies aiming to reflect the brand identity in different product ranges have been carried out. For example, McCormack, Çağan, and Vogel [42] conducted studies on Buick vehicles; Pugliese and Çağan [48] on Harley motorcycles; and McKay, Ang, Chau, and Pennington [43] on Coca-Cola bottles. In addition, Alcaide Marzal et al. [3] conducted studies using generative design on different products such as office chairs, rings, and coffee machine wheels. As illustrated in Figure 1, the application of algorithmic rules has led to the development of initial product designs or the creation of diverse designs through the amalgamation of features from various products [3].

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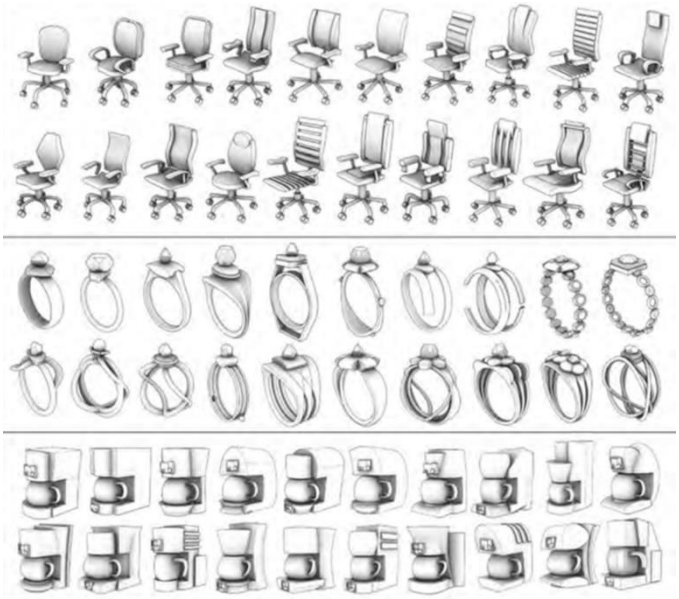

Figure 1: *Productive design solutions for office chairs, rings, and coffee machines [3].*

Research on machine learning has increased over time and a new method has been created in the design process [8]. Machine learning is defined by Şapçı and Bektaş [58] as "Machine learning, which is one of the sub-headings of artificial intelligence developed to perceive, learn and imitate human intelligence, is defined as the process used to program artificial intelligence algorithms in the form of continuous learning and to enable these algorithms to make informed decisions according to what they learn from these data by separating the data." [58]. Among the programs implemented with machine learning are systems capable of editing photographs, and software trained on diverse visuals and models to generate a model specific to a particular word (Figure 2) [14, 61].

Figure 2: *3D modelling of a chair inspired by four different 3D options (cyan) from a photograph. New models (yellow) are created as geometric variations of the candidates to match the target product in the photo while maintaining the 3D structure of the options [61].*

Machine learning-based artificial intelligence studies are not limited to product design. They can be applied in graphic design, fashion, interior architecture, architecture, art, and many other fields. Especially since 2021, many platforms with text-to-image features have emerged. Applications such as Dall-E 2, MidJourney and Stable Diffusion, which can be accessed via internet browsers, are among these applications. These online systems, using data trained by machine learning, allow users to edit images generated by the system with the words or sentences they type. These features are used by designers in many fields such as design, graphics, fashion, and architecture. In a study conducted in the field of graphics, users of the preferred artificial intelligence-based application showed that they were twice as creative compared to non-users [40]. Recently, the clothing brand Koton launched its clothing collection designed with MidJourney [66].

The process of product design, from the students' perspective, has a certain modus operandi. After the project topics are determined, the initial step involves consulting Pinterest and similar channels. By analysing various images on these channels, existing and conceptual products are researched, and boards are created. Afterwards, students put their findings into words and sketches. However, the choice of

words may not be compatible with the sketches. In this case, problems such as the inability to express ideas correctly and the inability to manage time correctly on the way to inspiration and synthesis may be encountered [59]. This article examines the experiences of artificial intelligence in students' design education processes.

Within the scope of this study, a long-term workshop was conducted with third-year Industrial Design students. A mixed-method approach was utilized to examine the effects of artificial intelligence usage on the design process [16, 27, 39]. Data were analysed using thematic analysis and the Analytical Hierarchy Process (AHP). Thematic analysis involved coding the qualitative data obtained from semi-structured interviews and associating it with conceptual themes [11, 12]. The AHP analysis facilitated the acquisition of quantitative data through the decision-making and prioritization processes in complex systems. Consequently, it enabled the calculation of the weights for criteria such as motivation, creativity, and time management in the Likert-scale questionnaires administered to the students [29, 45, 52].

1.1. Creativity, Association, Analogy, and Fixation in the Design Process

Design activity is a problem-solving process that aims to transform existing conditions into desired conditions. The process aims to produce new knowledge by utilising existing knowledge [5, 54]. The design process progresses with studies that are not within a rigid framework [26]. The process starts with the analysis of the problem arising from a need and continues with conceptual, concrete, and detailed design stages [28, 37, 46, 63]. In this process, auxiliary tools such as hand drawing, sketch models, and computer-aided modelling can be used [64].

The creative process includes cognitive and sensory activities such as perception, thinking, learning, motivation, and communication [23]. Amabile [4] argues that individual creativity has three main components: expertise, creative thinking skills, and motivation (Figure 3).

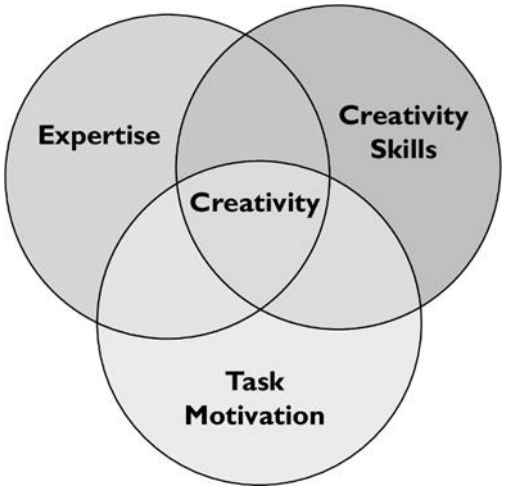

Figure 3: *Components of Creativity [4].*

The creative design process requires a high level of creativity and involves the use of various methods to encourage creativity [9]. Methods such as combination, mutation, analogy, and basic principles can be used to achieve creative design. According to this model, the designer can develop creative design by using combination, mutation, analogy, or basic principles methods to create appropriate forms by combining the features of existing designs in a synthesis (Figure 4) [17].

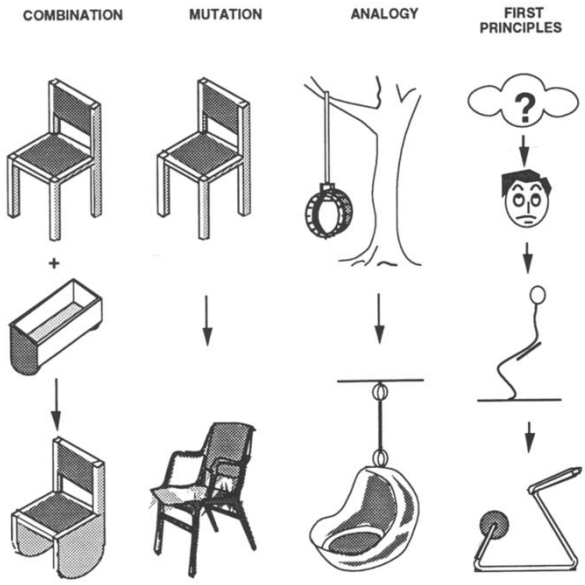

Figure 4: *Illustration of combination, mutation, analogy, and basic principles [51].*

Associations connect emotional and conceptual representations from experience [59]. According to the research conducted by Bar et al. for example, the sound of a train can activate the related image and help develop thoughts [7]. The association process proposed by Bar consists of three main items: associations, analogies, and predictions. Firstly, 'associations' are formed by storing repetitive models in the individual's memory. Secondly, with 'analogy', similarities between the information in memory and the new information are sought and questioned with the question, 'What does the new information look like in memory?

It can be difficult to think beyond the current use of objects [49], and this can lead to fixation [20]. Fixation refers to the fact that individuals get stuck on the same information during the idea generation phase, and this leads to the emergence of unoriginal ideas. This can also lead to biased judgements by design evaluators [10]. Design educators and professionals often have difficulty with early commitment to design solutions and deviation from similar designs [49]. Research has shown that providing a wide range of examples can lead to more original solutions than limited and unoriginal solutions due to fixation [2].

1.2. Examples of the Uses of Artificial Intelligence

With the development of technology, computer-aided studies have become a supportive tool in art, design, architecture, law, and other fields [53]. However, Sezer [53] argues that while technology serves as a tool, human creativity and diverse perspectives are paramount. In the literature, there are studies about the use of artificial intelligence in fields, such as architecture, interior architecture, graphic design, visual arts, fashion, and product design. For example, Chaillou thinks that artificial intelligence is an opportunity for architecture and achieves rich results by addressing the blind spots of the discipline [13]. Many similar artificial intelligence applications are used in the field of interior architecture. Platforms such as Interior AI, Room GPT, AI Room Planner, Visualize AI, and Spacely AI transform the space photos uploaded by users into their preferred styles (Scandinavian, Art Deco, modern, etc.).

In his study titled "Is MidJourney-AI the New Anti-Hero of Architectural Imagination and Creativity?" published in 2023, Radhakrishnan aims to reveal whether technologies such as artificial intelligence are beneficial or harmful. Radhakrishnan suggests that channels such as MidJourney are not inherently detrimental to the field of architecture but could potentially become so if they are misused or their influence is not properly managed. Citing Panicker [47] to support his argument, Radhakrishnan suggests that MidJourney can be useful for architecture students who struggle to visualise possibilities and need creative support. In conclusion, Radhakrishnan [50] tools outside of teaching still require personal interpretation and do not automate creativity now or in the future.

Artificial intelligence accelerates graphic design processes, increasing design efficiency and reducing costs–[21]. In addition, it is also used in different areas, such as logo-making, web design, news illustration, and photo editing [33]. For example, Opal is an algorithm for creating multiple images from texts for news illustrations. It analyses the given articles or texts and presents visuals. In the study, it was found that Opal users produced twice as many usable results as non-users [40].

Software in the fields of visual arts and fashion is used in many different fields, such as the production, analysis, and restoration of artefacts [62]. The artificial intelligence application called FashionQ provides creative designs by combining different styles and encouraging the creative processes of fashion designers. The application was tested by 10 fashion designers and was found to support their creative processes as it encourages different thinking [32].

1.2.1 Generative Design and Artificial Intelligence in Product Design

The origins of generative design date back to the 1970s. The initial aim of generative design was to focus on the solution of complex structures, and with the advances made, it has developed to create design alternatives, develop options, and facilitate design research [6, 55]. In this process, alternatives emerge that cannot be achieved through traditional design methods. These ~~are~~ alternatives include;

- Reduced weight
- Sustained or improved performance
- Reducing development time
- Increased creativity
- Increased efficiency
- Customised product development [44].

There are products designed and manufactured using a generative design approach. In 2019, a chair designed by Philippe Starck in collaboration with Autodesk is among these products. In this chair design, the relationship between design and artificial intelligence was analysed. Similarly, programs such as SolidWorks Simulation, xDesign, CATIA, Siemens NX, and Autodesk Fusion were used for other chair designs [60].

As stated by Stones and Cassidy [56], digital design helps designers complement their skills by offering solutions beyond their imaginable limits. Instead of replacing the designer, the computer helps the designer develop his or her ideas by offering a wider perspective on the design process. Alcaide et al. [3] argue that generative design should be viewed as a design object, not as a design tool. Generative design can be used as a system that can support designers in finding the most appropriate structure [3].

1.2.2. Examples of Artificial Intelligence Studies in Product Design

In the literature, there are artificial intelligence-based human-computer studies in which creativity-supporting tools are used in the design process [40]. Suh et al. [57] believe that content produced with the help of artificial intelligence can facilitate collaborative groups to meet on common ground. It is argued that creativity is invoked in the design and modelling process, and the user should be the source of inspiration [14]. While the source of inspiration comes from pure imagination, it can often be a variation and composition of one or more existing models [14, 22, 34, 38]. Chaudhuri and Koltun [14] carried out a study in which designers can get different suggestions or ask for uncontrolled suggestions to improve their initial rough models through the Inspire Me software. This study enables a prototype to be created by visually emulating and then refined with a high-level 3D modelling package (Figure 5) [14].

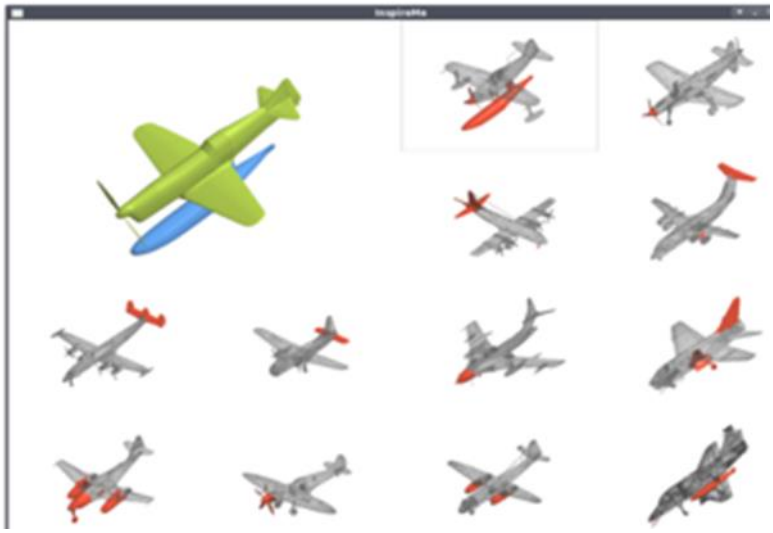

Figure 5: *The Inspire Me interface displays a query form (in green) and corresponding suggestions (in red). Once a suggestion is selected, it is added to the model (in blue) [14].*

Within the scope of the Inspire Me project, designers are asked to design futuristic military aircraft and creatures for science fiction films. As shown in Figure 6, after the concept of the project was explained in detail, the designers realised the designs using Maya, 3Ds Max, or ZBrush programmes.

Figure 6: *The models designed for the aircraft (top) and creature (bottom) tasks, created by the designers. The initial query shape (top row), the model created with Inspire Me (middle row), and the final textured model created from the model (bottom row) are shown for each model. All new components are derived from data-driven suggestions [14].*

The time required for the completion of the design depends on the decisions of the designers. At the end of the research, the designers expressed their satisfaction with the application and stated that they could use such a tool in the conceptual design phase (Figure 7) [14].

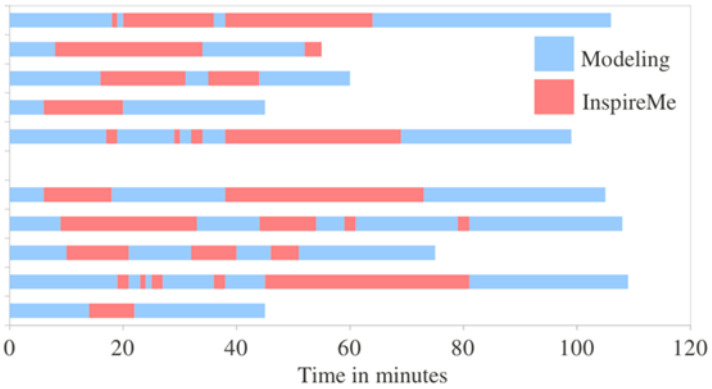

Figure 7: *A comparison of the duration of activities in Modeling Programs (blue) and Inspire Me (red) during the process of model creation [14].*

Xu et al. [61] present an algorithm that guides the creative process inspired by a user-selected photograph. This algorithm works with 3D candidate models to generate new 3D models (Figure 8).

Figure 8: *Matrix of creations inspired by photographs (rows: 3D model candidates; columns: photographic inspirations) [61].*

The input of the system comprises a photograph of the target object, which contains components of the 3D candidate models previously analysed within the program. This uploaded photo is then matched with the 3D models to generate several variations of them.

Hyun and Lee [30] tested alternative design methods with four automotive designers through an application created with the help of artificial intelligence to help make efficient design decisions. The results of the applied questionnaire revealed that the designers using the methodology proposed by Hyun and Lee showed a significant difference compared to the others. This methodology helped to generate new design alternatives and helped to create the proposed designs by allowing a large number of changes and saving time.

Autodesk researchers integrated 3DALL E software into Autodesk Fusion360 in 2022 to test it with designers. The results showed that presenting the text-to-image concept as a 3D model helps to explore the design process. The system has the advantages of facilitating collaboration, providing inspiration, and fully exploring the design process. Moreover, the user-friendly interface, similar to search tools such as Google Images, provided a faster and more efficient research process [41].

2. METHOD

A mixed-methods approach was used to examine the effects of using artificial intelligence in the design process. Mixed-methods research involves analysing and interpreting qualitative and quantitative data in a study [16, 27, 39]. This approach allows research questions to be analysed from different perspectives [16]. The workshop included non-participant observation, survey research, and semi-structured interviews. Since the study was a long-term workshop, third-year students currently studying in the department were selected. Care was taken to ensure the accuracy of the participants and to avoid time constraints, and six volunteer participants from the Yeditepe University Department of Industrial Design who were in their third year were selected.

Thematic Analysis and Analytic Hierarchy Process (AHP) were used to analyse the data. AHP helps to quantify design alternatives and criteria and is used in the literature as a decision-making and prioritisation tool for complex systems [29, 45, 52]. Thematic analysis is a qualitative method used to identify meaningful themes and relate them to conceptual issues [11]. Systematic coding of qualitative data provides support for qualitative research that can be associated with clusters and then broader conceptual themes by analysing the codes [12].

The reliability of thematic analysis can be measured using various methods. Hayes and Krippendorff [25] suggest Krippendorff's Alpha, called KALPHA. The KALPHA macro is a tool used in SPSS software that produces a reliability test that does not negatively affect reliability and can be applied with at least 2 raters [36]. Through this macro, the results of the coders are entered into the system, and the reliability test result is obtained. The KALPHA macro argues that results above .800 have high reliability and results between .667 and .800 have low reliability [35].

2.1 Workshop

The skill levels of the participants in the traditional and AI-assisted design processes were determined by a survey conducted at the beginning and end of the workshop. The questionnaire included seven criteria: proper time management, creativity, concept development, knowledge of form and aesthetics, transforming ideas into products, fixation, and motivation. The students scored the questionnaire between 0-5, considering the process they went through in their designs. The workshop was conducted in 2 separate groups: experimental and control groups, with four sessions of 45 minutes each. Participants were randomly assigned to these 2 groups, the experimental group utilised artificial intelligence in the design process, while the control group followed the traditional design process. In each session, the experimental and control groups were switched to ensure that the participants received an equal amount of AI assistance. In the sessions, participants were tasked with creating a conceptual coffee machine design for four different brands: De'Longhi, Apple, IKEA, and Bang&Olufsen respectively.

Semi-structured Interview Questions

1- Can you describe your design process through screen recordings and your works respectively?
2- At which stages of your design process did you use artificial intelligence?
3- What was different from your usual design process?
4- Did artificial intelligence contribute to your creative process? How would you evaluate this issue? Did it inspire you, or did it lead to a fixation on the results?
5- Did artificial intelligence help you generate ideas or your design approach? If so, in what way?
6- How do you think you would get results if you did not use artificial intelligence?
7- Can artificial intelligence be used in design processes?
8- How does it affect students?

2.2. Investigation of the MidJourney System as an Auxiliary Tool for the Conceptual Product Design Process

MidJourney, an artificial intelligence software, enables the creation of variations of visuals through text.

The impact of the MidJourney platform on art, fashion, and graphic design has been investigated. It has been observed that the platform can help fashion designers in the process of creating initial ideas and can significantly speed up the process. In the field of art, it has been argued that it motivates the designer more in his or her work and supports creativity. It was also mentioned that it encourages creativity in graphic design and develops more alternatives by utilising the power of artificial intelligence [18, 24, 65].

MidJourney, which incorporates many different features, can produce the user's drawing, rendering images, or 3D visuals with typed words. The application generates four different alternatives according to the typed text. The user can choose to recreate or save and enlarge the image of his or her choice among these alternatives (Figure 9).

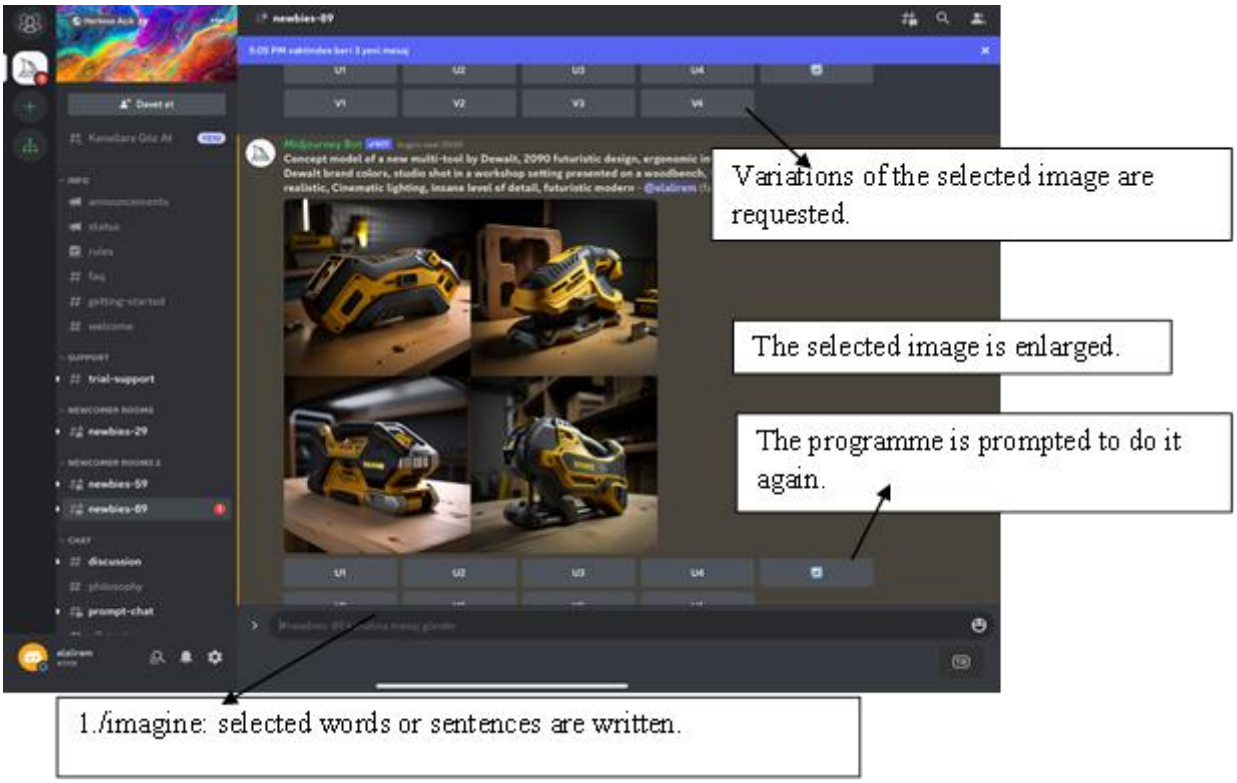

Figure 9: *Interface screenshot of the MidJourney platform (MidJourney).*

In addition to the feature of creating text-specific images, the platform has many features such as editing the uploaded photographs with the typed words (Figure 10), stylising the images, and adjusting the quality and size of the output. In the student studies, 'blend, describe and upload images' features were used.

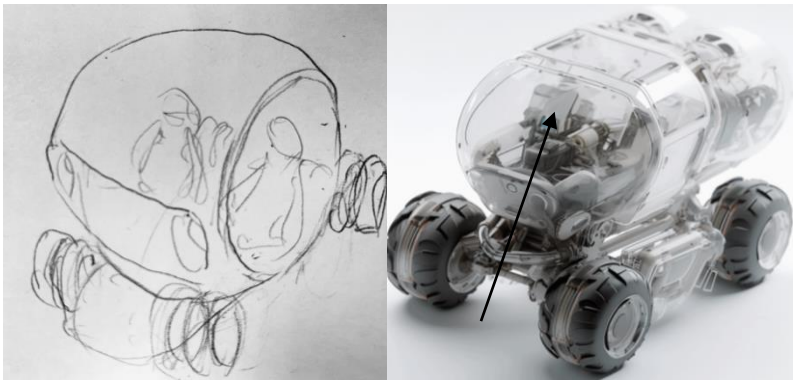

Figure 10: *Recreating the sketch image uploaded to the MidJourney application with typed words (MidJourney).*

As shown in Figure 11, 4 different variations can be created by blending 2 different images using the 'blend' feature.

Figure 11: *MidJourney, creating new coffee machines from Saeco and Nespresso coffee machines using the 'blend' feature (MidJourney).*

3. FINDINGS

3.1. Workshop Outputs

The analysis of the questionnaire data collected from both the control and experimental groups shows a significant improvement, especially in terms of motivation. While the motivation criterion was given scores between 1 and 3 in traditional design processes, the answers for the design phase with AI resulted in scores of 4 or 5. We will examine the outputs of 2 students, which were analysed by reviewing screen recordings to illustrate the paths followed by the participants during the workshop. The first example is the concept design of a coffee machine created by participant A for IKEA. To understand the design identity, the student first visited IKEA's website and analysed the company's products. This led to the creation of the first image in AI. Then, he asked ChatGPT to explain IKEA's design style and created the second output by using the resulting keywords in the MidJourney application (Figure 12).

Figure 12: *Design phases of participant A for IKEA concept coffee machine on the MidJourney platform.*

1- Prompt for image 1: Ikea espresso machine.
2- Prompt for image 2: Espresso machine simple, functional, minimalist, Scandinavian, influence, innovative, democratic design made Ikea.
3- The 3rd image is a variation of the one on the top right in the 2nd image.

ChatGPT was asked, "If Ikea produced a coffee machine, what would they pay attention to? What kind of design language would it use? Which colours would it use?" and created the prompt of the 4th visual in line with the answers received.

Prompt of the 4th image: Espresso machine simple, functional, minimalist, Scandinavian, influence, innovative, democratic design made Ikea, add natural material like wood and space efficiency

Finally, it reached its goal for the final design by creating variations of the upper left from the 4th output (Figure 13).

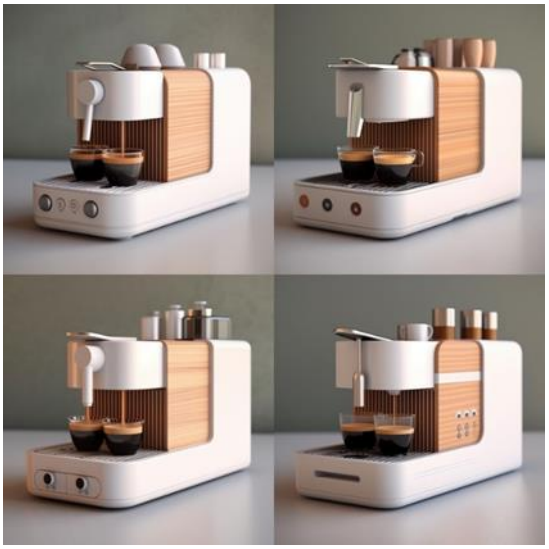

Figure 13: *Final design by participant A for the IKEA concept coffee machine*.

Our second example is the work of participant, C who designs for Bang & Olufsen. The participant initially visited the brand's website, analysed its products, and researched the design identity and the target audience. Then, using artificial intelligence, he added one of the sites where the user segment of the brand lives to his keywords (Figure 14).

Figure 14: *The first four design phases of participant C for the Bang&Olufsen concept coffee machine on the MidJourney platform.*

1. Prompt for the 1st image: bang olufsen, luxury, house in çubuklu vadi house, bang olufsen coffee machine
2. Prompt for image 2: Bang olufsen coffee machine, luxury, rich
3. The 3rd image is the result of the variation of the bottom left one in the 2nd image.
4. Image 4 is the result of the variation of the upper left in image 2.

Figure 15: *Visuals obtained by participant C by applying the 'blend' command to the 3rd and 4th outputs for the Bang&Olufsen concept coffee machine.*

5. The 5th image was obtained by applying the 'blend' command to the 3rd and 4th outputs.

Figure 16: *Steps 6, 7 and 8 of the Bang&Olufsen concept coffee machine design phases of participant C.*

6. The 6th image is the result of the variation of the bottom left output of the 1st image.
7. Prompt for 7th image: bang olufsen, luxury, house in çubuklu vadi house, bang olufsen coffee machine
8. The 8th image is a variation of the upper left output of the 7th image.

3.2. Application of AHP and Thematic Analysis

Weight calculations were made for the criteria in the questionnaire applied to the students. AHP analysis was used as a decision-making and priority-setting tool, and Super Decisions programme was used. In the questionnaire, 6 different criteria were determined: correct time management, creativity, concept development, transforming ideas into products, knowledge of form and aesthetic, and motivation. The weighting criteria of the criteria were calculated as follows;

- Correct Time Management: 0,26116
- Creativity: 0,18417
- Concept Development: 0,06191
- Converting Ideas into Products: 0,09724
- Form and Aesthetic Knowledge: 0,03281
- Motivation: 0,36271

An AHP analysis was performed on the questionnaires completed by the experimental and control groups according to predetermined criteria. The results revealed that the average of the traditional design process scored 2 points and the average of the design process using artificial intelligence scored 4 points. Thus, it

was determined that the use of artificial intelligence in the design process led to twice the effectiveness of the traditional method in terms of time management, creativity, concept development, idea implementation, knowledge of form and aesthetics, and motivation criteria. During the workshop, it was observed that artificial intelligence had a positive effect on students' design processes and contributed significantly to their motivation levels.

Thematic analysis was applied to the interviews, and as a result, 128 codes, 5 clusters, and 2 themes were obtained. After the reduction stage following the coding stage, five clusters were determined: Implementation Characteristics, Time Management, Creativity, Motivation, and Awareness. Finally, 2 themes named 'Impact' and 'Use' were identified.

The features of the MidJourney app were part of the "Use" theme, and the cluster of this theme, the "App Features" category, consisted of 38 codes. For example, Providing Various Alternatives, Having More Information About the Brand, Reaching Different Results by Blending...

The 2nd theme is the "Influence" theme. It includes the clusters of Creativity, Motivation, Time Management, and Awareness. Research shows that these clusters are interconnected and play an important role. Darini et al. [19] revealed that there is an important link between creativity and time management. Jackson [31] stated that the correct implementation of time management increases productivity and quality of life. Agnoli et al. [1] also emphasised in their study that motivation and creativity success are interactive.

According to Krippendorff [36], a reliability test requires at least 2 coders, and the output should be clearly presented to them. In this study, the coders were given an Excel file containing 128 codes corresponding to the themes. Both coders are Industrial Design graduates; one of them is an Expert Industrial Designer and the other one is studying for a master’s degree in industrial design abroad. The data were processed using the SPSS programme and a reliability test was obtained using the KALPHA macro with a result of 0.8070, which is considered highly reliable according to Krippendorff [35].

3.3. Interpretation of the Workshop

Users who were not used to using computers were able to adapt to the platform quickly. Users were positively influenced at every stage and were able to focus on the project for a longer period of time. This enabled them to manage their time and develop more efficient ideas. These interactions increased their motivation towards the project [1, 19, 31].

The time spent on Pinterest and similar channels for existing product or brand research, which is the first stage of the design process, was minimised. With the coffee machine images uploaded using the Describe feature, information about the brand's design identity and keywords were obtained. By accessing the image with keywords, time-savings were achieved. In addition, students who were freed during the design process improved their knowledge by getting support from ChatGPT, Google, and Pinterest.

"I didn't know the De'Longhi brand. It took me minutes to do the research that I would normally spend hours on. In the IKEA study, even though I knew it very well, it offered me the keyword that I could not think of." P1.

As a result of the capacity of artificial intelligence, and self-training helped designers gain a wider perspective and increase their creativity by presenting four different visuals. The visuals created with different variations allowed new ideas to be discovered in each new output and the problems in the students' stereotyped ideas to be eliminated. Artificial intelligence increased the motivation of the students, increased their working efficiency, and triggered their desire to produce better work. In addition, thanks to its speed and capacity, artificial intelligence gave students the advantage of conceptualising, making decisions, and reaching the starting point of the project earlier, allowing them to improve in time management and get the opportunity to test their thoughts concretely.

"My time has become very short; I spend most of my time on research because I usually think that I will find a way after researching. But since I was able to confirm what they found out with this; I stopped searching on the internet when I realised that there were really completely accurate results that I would have found if I really tried. It saved me a lot of time." P1

"I'm a very demoralised person; if I can't do something I'm thinking about or if I get stuck on an idea, I try to run away from the project. However, the fact that the visuals were of such high quality and reflected what was on my mind motivated me a lot. Maybe I realised that I could work more continuously when I got up from the table in half an hour." P6

The quality and realism of the visuals were used as an aesthetically effective tool. The students not only looked at the form and shape of the products but also interpreted their outputs, enabling them to gain ideas about their functions and properties. These gained ideas enabled them to make progress in their design process by using the 'blend' feature and manipulating the images they found appropriate to achieve different results. They also realised that they could use these features on images they obtained from other platforms or on their drawings. In this manner, they expressed that these features can assist them when they encounter difficulties in advancing their ideas, and they can also utilize them for presentation purposes.

The students likened the platform they used to the support of their lecturers, who provide counselling in their courses. In this way, they realised that they could advance their design processes more easily and accurately. They stated that the ideas offered by the platform were as stimulating as the ideas given by their lecturers and that they were almost like a design coach. In addition, thanks to the flexible use of the platform, students can reach the ideas they have created more quickly and get support.

"Students, especially me, I am a person who progresses with approval; I get approval from my teacher, and then I continue. When I saw the things I had in mind here, it gave me more morale and confidence, especially for the second one. I think it supported me." P1

"I would say he coaches like a teacher. He already presents the thoughts in my head to me before I draw them. We can see it as a second mentor next to the lecturers." P6

"It was so different from my usual design process that I am now trying very hard not to become a member. It opened a very beautiful window for me. Because in a project, lecturers guide you and open your horizons, and I experienced that in MidJourney." P3

"We can call it a coach rather than an auxiliary tool, so it would be unfair if we didn't because the things, they do change your thinking power incredibly." P3

They reported that their steps in the design process improved, and their creativity was further supported by leveraging various platforms and artificial intelligence channels.

"I started with more motivation in my work without artificial intelligence because I included the features in this programme in my process. I thought of myself as artificial intelligence while doing the other design." P1

All this positive feedback improved their stress and time management and enabled them to focus more on the project. It also provided support for the profiles of students who have little drawing skills and cannot reflect their ideas.

"Definitely, it would have been very nice if I had used it during the 14 weeks. Once I write down whatever comes to mind, I am currently making a barbecue that can make pizza pancakes, but I reached the idea of a drum oven in 2 or 3 weeks; if I had used it, I would have reached it earlier. Naturally, it would also help me manage stress. If I had something at hand, I would work better. Our biggest problem, especially for 3rd and 4th grade students, is that we don't have good hand drawing; if we don't have an expression,

we can't explain what is in our minds well, so we can't come up with good things, but if we had this, I would definitely produce very good things." P3

Participants believe that the use of artificial intelligence in the sector is necessary and that it will enable quick product design in emergencies. Regarding design education, students had different views on the use of AI. Some emphasised the importance of learning the design process before using AI output. On the other hand, some students stated that AI outputs do not sufficiently understand the human-product relationship and may cause problems in ergonomics. However, they said that the positive aspects of artificial intelligence will increase for conscious students who know the design process, and, in this way, students can come to the same level and create a competitive environment where intelligence and creativity power are more important.

"I think it can affect the students much better because there will be a competitive environment; this time it will be very different to use the power of intelligence, not by drawing but by hand. Students who do not know how to use those keywords will be eliminated if they cannot provide the right data at the right time. The idea was already important from the very beginning; people who have an idea but cannot draw, who draw but have no idea will be on a more equal level." P6

A negative effect mentioned by one of the participants is that high-quality visuals can sometimes lead to a "got to have it all" mentality. While time and stress management can increase creativity and inspiration, another participant had a lack of self-confidence with the thought that "I cannot do better than this" for the results they obtained with artificial intelligence, causing them to worry about the future of their profession and professional competence.

4. CONCLUSION

In this article, is aimed at investigating how the increase the number of artificial intelligence users and platforms that create visuals from text in a short time will affect the designs of industrial design students in the conceptual design phase and their criteria, such as creativity and motivation. In the workshop conducted with the students, it was seen that artificial intelligence increases inspiration and creativity [3, 14, 22, 30, 34, 38, 55, 56], which are related to each other [1, 20, 31] as in the studies on creativity in the design process, productive design, and various artificial intelligence platforms in the literature. In particular, it has prevented the problem of not being able to manage time [59] on the way to synthesis with fixation and inspiration that students experience in the traditional design process. Because, as Agogué et al. [2] mentioned, providing too many examples prevents fixation, and the MidJourney platform, with the infinite alternatives it offers, prevents fixation, and supports them to reach unique solutions. In the study, with the AHP analysis, it was concluded that the use of artificial intelligence is two times higher in time management, creativity, form and aesthetic knowledge, concept development, transforming ideas into products, and motivation criteria compared to the traditional design process. As in the literature, it has been observed that the efficiency of the results obtained with the use of artificial intelligence is related to the knowledge and instinct of the user and varies [3, 60]. Because in the first stage of the design process, which is the concept creation and development step, it has been determined that it provides more motivation and creativity to conscious students who have internalised the design process and know how to interpret and use the outputs instead of using them directly. Like generative design, it has enabled the designer to explore wider solutions by complementing the designer's skills without experiencing fixation [56]. Because, as in the literature [32] the combination of different inputs for the discovery of new ideas with artificial intelligence has supported the designer in the adventure of creating innovative and creative ideas. At the same time, Radhakrishnan's study supports the conclusion that artificial intelligence can help students who have difficulty in visualisation and need creativity support but can have negative effects with unconscious use [50]. To increase the accuracy of the results, the mixed method was used as an analysis. Qualitative and quantitative data were obtained, and thematic analysis was applied in addition to AHP. The thematic analysis of the semi-structured interviews and the monitoring of the screen recordings showed that the feature of the software to obtain fast and aesthetic results caused some students to accept the first result and not develop their ideas and that unconscious use of artificial intelligence or students who have not yet internalised the design process may have negative

effects on students. At the same time, the quality of the of the visuals created anxiety in the students about their professional competence. Therefore, it is thought that a new era has started for students with artificial intelligence, and they should be prepared for it. Because in the long run, irrespective of the student profile, the quick and aesthetically pleasing results produced by the software might lead students to become accustomed to the ready-made solutions, potentially hindering their ability to engage in brainstorming and critical thinking as they progress toward becoming designers.

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