

PERCEPTIONS OF LECTURERS OF ARTIFICIAL INTELLIGENCE ON INDUSTRIAL DESIGN STUDENTS

Yang ZHANG¹, Yun FAN² and Erik BOHEMIA^{2,3}

¹Nanjing University of the Arts, China

²Shandong University of Art & Design, China

³Western Norway University of Applied Sciences, Norway

ABSTRACT

The industrial design process consisting of activities discovering, defining and solving problems represents the designer's thinking cognition and innovation ability. However, with the emergence of artificial intelligence (AI) technology, there is a potential for designers to incorporate unintended problems into their design solution. For example, a false information, or bias error and ethical imbalance can infinitely amplified through computer coding incorrect design solutions. If the teachers have poor understanding of the AI limitations this may have devastating impact on the development of future industrial designers. This paper surveyed Industrial Design teachers in China. The survey aimed to explore the Industrial Design teachers' understanding of AI role in the design process. The following questions guided this study: How do teachers envisage the use of AI by their students? Do they think that the AI may affect students' creative behaviour? First, we reviewed literature to understand the AI potential to inform industrial design activities. Then we examined the feasibility of AI intervention in the design innovation process. The results indicate that teachers believe that AI, as a design tool, can facilitate industrial design students to generate design solutions faster. Nevertheless, the data also indicate that AI does not provided students with learning opportunities and development related to creativity skills.

Key words: Creative behaviour, AI, curriculum, design process, design education

1 INTRODUCTION

Wang points out that the emergence of generative AI is challenging the systematic knowledge of teaching in higher education [1] and according to Edwards and Cheok [2] the emergence of AI may directly change the development of the education industry as it is expected that AI will play the role of teachers and support students to answer questions at any given time. However, Kaudi et al. mentioned that there is still a big gap between AI educational technologies and how they are actually implemented [3]. Assuming that AI can participate in or replace a certain role in the design process, may also indirectly affect how teachers engage in cultivation of students' creativity skills. Therefore, in the facing this new situation, we are interested to understand how design teachers view use of AI by design students.

2 RESEARCH OBJECTIVES AND METHODS

In order to understand Industrial design teachers' perspectives how may AI impact on design students' creative behaviour, this study conducted a questionnaire survey on the teachers of industrial design major, the research consists of four parts:

- (1) Review the role of teachers in the design process of students in different teaching situations, and summarize the influence of teachers on students' creative behaviour.
- (2) Analyse the possibility of AI assuming a certain role in the design process.
- (3) Survey questionnaire's design and distribution.
- (4) Analyse the questionnaire data and draw conclusions.

This study aims to analyse the potential of AI in industrial design student activities through teachers' perspectives towards students' use of AI, so as to further provide more reference suggestions for optimizing teaching activities and cultivating the creativity of industrial design students.

3 LITERATURE REVIEW

3.1 The role of the teacher in the student design process

Ababio mentioned that teachers, as guides in the teaching process, play a very important role in teaching knowledge, organizing and planning teaching activities, and evaluating students' creativity development [4]. Kuok et al. advocated that project-based learning (PJBL) and problem-based learning (PBL), can promote student-centred teaching strategies also help students to better understand design problems [5]. Although both PBL and PJBL are defined as student centred difference is that PBL may not incorporate actual project, whereas according to Sofie et al. PJBL core feature is the project, driven by the problem. They suggest that in this mode of teaching the teachers assume the role of mentors or "consultants" [6]. Nevertheless, Lehman et al. suggested that the core relevance of PJBL and PBL is to solve real-world problems [7]. Based on the above content, this paper summarizes the roles of teachers in two different teaching situations as illustrated in Figure 1.

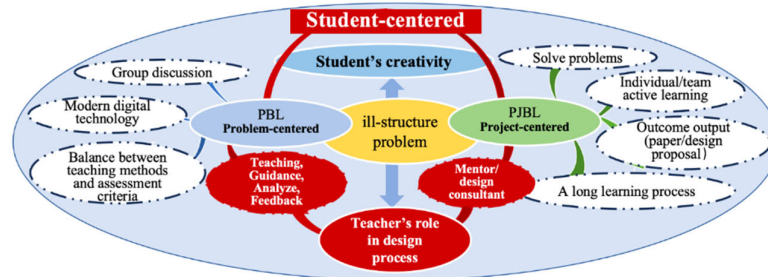


Figure 1. Teacher's role in design process

As the subject of imparts knowledge, teachers need to assume the roles of guiding, motivating, analysing, giving feedback and improving students' design schemes during the design process. Students can decide what design knowledge to apply according to the design problems to be solved through generating creative ideas. Yun et al. pointed out that students' creative behaviour runs through the process of finding problems and using knowledge to solve problems, and knowledge plays a very important role in the production of creative behaviour [8]. Therefore, we argue that the role of the teachers in the student design process is dynamic, and the core of the teachers role is to guide students through the design process to facilitate students to identify, solve problems and to implement new solutions, and ultimately to promote the creative ideas generated by the design students.

3.2 AI and the design process

Bellman understood AI as the automation of computer activities associated with human thought processes, decision-making, problem solving, and learning [9]. Sony, Pat and GPT-3 pointed that generative AI has advantages in editing text, code development, and video and renderings production, which can increase the efficiency or creativity of designers engaged in knowledge and creative work by at least 10%. This makes the design output of designers not only faster and more efficient, but also more capable than ever before [10]. However, Miao pointed out that the ability of AI to communicate and solve problems with the language understood by human beings is far from that of human beings. From the generation of design knowledge to the communication and interaction of design teams, design problems are redefined, understood and handled by people in a "real" environment. The generative model constructed by the neural network model cannot, like the human brain, select appropriate concepts to process information correctly according to the language environment and information text [11]. Combining the above advantages and challenges brought by AI and human collaboration, it also further highlights the necessity of in-depth research on whether AI will affect students' creative behaviour. This study attempts to re-examine how students may use AI in the design process from the perspective of the teachers, aiming to investigate the impact of AI on the cultivation of students' creativity in design process.

4 QUESTIONNAIRE DESIGN AND DISTRIBUTION

4.1 Questionnaire content

The questionnaire was compiled, with a total of 15 questions. The questionnaire was divided into two parts. The first part consisted of 3 questions to investigate the level of design skills the teachers think students majoring in industrial design should possess; the second part consisted of 12 questions,

specifically investigated teachers' attitudes toward students' use of AI, the fields in which students may use AI and the perceived ethical standards for students' using AI.

The second part of the survey contained two scale questions. Cronbach's coefficient was 0.804, which indicates high reliability, and the KMO value was 0.5, which met the to the standard values of the two scale items. The P value was less than 0.01, which reached a significant level, indicating that the reliability and validity of the two scale questions were good. Secondly, in order to ensure the validity of the overall questionnaire, two experts were invited to adjust the dimensions and contents of the questionnaire and complete the pre-test of the sample survey. The survey factory was used to construct questionnaire which was distributed online through WeChat and other online apps. To supplement the survey data, 6 teachers with long term teaching experience were interviewed. All interviewed teachers work in the top 20 universities of industrial design as indicated by the Soft Science Ranking 2023. The questionnaire was made available online for about 5 weeks. A total of 170 questionnaires were collected, of which 168 were valid. Excel 2010 was used for data entry and screening, and SPSS.29 was used to undertake the statistical data analysis.

4.2 Survey data analysis

4.2.1 Teachers' evaluation criteria for industrial design students

In the first part of the questionnaire, questions in 1st and 2nd parts consisted of multiple-choice questions, and the 3rd part of the survey included an open textbox to allow the survey participants to provide textual data. The first two parts of the survey investigated design skills that teachers thought industrial design students should have by end of their graduation, and 3rd part of the survey asked the participants to describe 5 criteria for evaluating industrial design talents. The Figures 2 and 3 provide sorted results according to the frequency each of the items was selected).

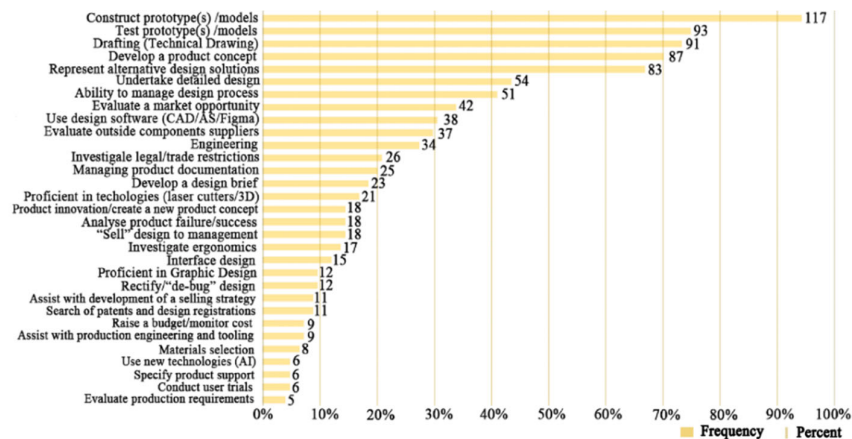


Figure 2. Evaluation criteria for industrial design students' skills

As indicated in the Figure 2, the most teachers perceived that the professional skills required by industrial design students are more reflected by the prototyping process of products, from developing product concepts (ranked 4th), drafting (ranked 3rd), building product models (ranked 1st) and testing product models (ranked 2nd), only a few teachers focused on products cost budget (ranked 25th), product support (ranked 29th), user trials (ranked 30th) and the use of new technologies (ranked 28th), such as AI.

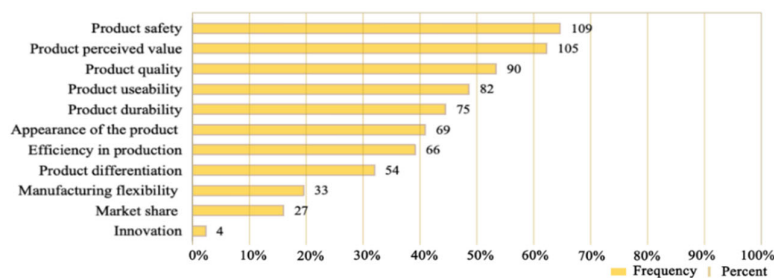


Figure 3. Skills to be improved for industrial design students

As indicated in the Figure 3, the most teachers selected areas that students should focus on to improve when design a product are: (i) product safety, (ii) perceived value, (iii) quality and (iv) product usability. Some teachers mentioned the importance of innovation when choosing other options, but did not mention the impact of new technology on product design. According to the data collected in Q3, 75% (n=126) of teachers mentioned creativity, teamwork, communication and drawing skills as the key indicators of industrial design talent training, and only 9% (n=15) of the teachers stressed the importance of personal moral literacy and new technologies such as AI for industrial design talent training. Nearly a third of the respondents (29%, n=44) have not provided answers to this question. Potentially indicating that they may have no clear idea on the specific skills their industrial design students should be able to demonstrate. To sum up, it was found that most teachers have not perceived the impact of new technologies such as AI on the training of industrial design students. How to optimize the performance of products is still perceived by the teachers a key design skill that industrial design students need to demonstrate, and teamwork is seen as an important way to solve design problems. For students, the ability to collaborate and communicate among teams on the basis of professional drawing skills is also perceived as important ability for students to have demonstrate during the design team cooperation to achieve generation of creative ideas.

4.2.2 Teachers' evaluation of students' use of AI

This section covers these four categories: (a) teachers' attitudes towards students' use of AI, (b) areas in which students use AI, (c) assessing students' use of AI, (d) ethical standards for students' use of AI. The data extracted from (a) indicate that 82% (n=137) of teachers support students' use of AI in design activities, while 18% (n=30) are opposed. This indicates that most of the teachers are optimistic about the development of AI in the field of industrial design teaching especially in the context of big data information.

In category (b), 55% (n=92) of teachers believe that students should know how to use AI, which is necessary for students to rationally use AI technology in the design process. In contrast, 59% (n=99) of teachers believe that students should know more about the operation process of AI technology, but this has no significant impact on students' literacy ability to use AI. Just as when we use a mobile phone developed by a new technology, we don't need to understand how the technology was developed and used in the mobile phone, because it will not help us to use the mobile phone.

More than 55% (n=92) of teachers believed that students frequently used AI in the fields of providing creative ideas, completing renderings, video production, designing questionnaires and writing thesis (as shown in Table 1); Secondly, 70% (n=117) of teachers believed that AI helped students complete design schemes faster, 63% (n=105) believed that AI helped students produce more creative ideas, and 54% (n=90) believed that AI helped students improve their design abilities. From the perspective of teachers, AI can help students save time in processing information, most replacing students' work of thinking about problems and putting forward design ideas in the design process, which is also the most important link for students to generate creative ideas. Amabile mentioned that finding problems is a part of creativity. The process of creations is not a current process (algorithm) with clear goals, but a heuristic [12]. Therefore, AI can't provide students with more opportunities to cultivate creativity in the design process, and even limit the development of students' creativity to a certain extent.

More than 80% (n=136) of teachers indicated that AI may make students overly dependent on technology, thus affecting students' ability to think independently, and 32% (n=53) of teachers mention that AI may leak students' personal information, potentially causing security risks.

Table 1. The range categories as perceived by teacher of students using AI

Multiple questions	Category	Frequency	Percentage
(Teachers' viewpoints) How will students use AI?	Provide creative ideas	111	66%
	Complete renderings or video production	108	64%
	Design questionnaire	96	57%
	Literary creation (thesis)	93	55%
	Write and debug computer programs	66	39%
	Derive data	63	38%
	Others	0	0%
	Category	Frequency	Percentage
	Quickly complete the design scheme	117	70%

(Teachers' viewpoints) In what ways can AI help students'?	Generate more creative ideas	105	63%
	Improve students' design ability	90	54%
	Improve student learning effect	54	32%
	Discover the nature of design problems	51	30%
	Others	0	0%

In category (c) of the survey, 73% (n=122) of teachers indicated that they can independently distinguish the works completed by AI from those completed by students. They stated that compared with the works completed by students, teachers believed that the works completed by AI lack the emotional of human integration. Secondly, they stated that the works completed by AI are more perfect in terms of integrity and professional skills. In addition, in the teaching process, teachers are familiar with students' design ability to a certain extent, and teachers can independently identify whether the works submitted by students can meet students' design skills. However, 27% (n=45) of teachers believe that students will independently modify the work of AI participation, which will make it impossible for teachers to distinguish the authenticity of students' work, and it also involves whether students adhere to moral and ethical standards when using AI.

In category (d), the data for setting ethical standards showed that 64% (n=107) of teachers believed that students would not conduct ethical reviews of information collected by AI, because when students use AI in the design process, students will not mark the role and function of AI in their completed design works. This also indirectly showed that there is a lack of laws and regulations in the regulatory system for the development of AI in China. The imperfect supervision policy and system of AI also indirectly affect the norms of students in the use of AI, and students lack the cognitive norms and standards of ownership of knowledge output.

In addition, 93% (n=156) of teachers believed that universities should include "AI Literacy" in the evaluation criteria for training industrial design talents. However, the top 5 design skills indicated by the teachers (see Figure 2) are building product models, testing product models, drawing (technical drawings), developing product concepts, and proposing different design schemes, rather skills supporting use of AI during the design process. Plus, the use of new technology (AI) for students is only mentioned 6 times. In summary, most of the surveyed teachers believed that industrial designer students need to focus on optimizing products, and that the AI technology can only play an auxiliary role in the design process, and it cannot replace a certain role of design students in the design process.

5 CONCLUSIONS

Based on the above data, the surveyed industrial design teachers (n=168) indicates that AI can't directly affect students' creative behaviour in the design process, and may even hinder to some extent students' ability to reflect on their design practice. Although, AI can greatly improve the speed of students to solve design solutions, the reason is that the AI can quickly complete information collection through input instructions and codes, thus replacing part of the process of students thinking about design problems. When describing the impact of AI on students, some teachers mentioned that along with the instructions and codes input by students, there is a cognitive deviation between AI and human brain's understanding of information, which indirectly leads to students spending more time on how to accurately describe the problems that AI can understand to complete the task instructions. This means that the teachers believe that AI can't completely replace the designer's thinking to complete the design process. As a design tool that plays an auxiliary role, AI has more advantages in completing design performance, video production and text processing. However, AI can't replace students' role of collaboration and communication in team cooperation, because designers' unique design thinking and cognitive mode are difficult to simulate by computers, such as: The ability to relate things, the personal quality to achieve innovation and creativity, the ability to make judgments and choices in a variety of complex situations, these are difficult to do through algorithms and coding, which is precisely the characteristics of designers. Designers have design experience and design cognition is an important part to promote and realize the creation of creative ideas. Finally, based on literature review and data, it shows that at present, AI cannot replace the role of teachers. Teachers still play an irreplaceable role in the design studio education environment. As Saris pointed out, three attributes of designers may be associated with the creative design process: implicit knowledge, reflective practice, and designer-like knowledge [13]. As an intermediary between students and design tools, teachers can create a space for students to meet the development of creativity at the right time, and encourage students to independently

discover knowledge that cannot be taught (tacit knowledge) in design practice. Students need continuous experience and reflection in action to generate new ideas. At the same time, teachers also need to supervise students to complete their own original design, and help students distinguish and deal with the information with cognitive bias and bias provided by AI.

In the face of the popular application of AI, this study explores Chinese industrial design teachers' perception of students' use of. Although, the data samples obtained in this paper cannot represent the attitudes of all industrial design major teachers, it presents the potential limitations of the current use of AI in the design process. So, further research on how students assign teachers and the role of AI in the design process is still a topic worth exploring. In general, we must re-examine the role of AI in design activities.

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