Contents lists available at ScienceDirect



Computers and Education: Artificial Intelligence

journal homepage: www.sciencedirect.com/journal/computers-and-education-artificial-intelligence



Understanding the perception of design students towards ChatGPT



Vigneshkumar Chellappa^{*}, Yan Luximon

School of Design, The Hong Kong Polytechnic University, Hong Kong

ARTICLE INFO

Keywords: ChatGPT Design education Students' perceptions Artificial intelligence

ABSTRACT

The benefits of artificial intelligence (AI)-enabled language models, such as ChatGPT, have contributed to their growing popularity in education. However, there is currently a lack of evidence regarding the perception of ChatGPT, specifically among design students. This study aimed to understand the product design (PD) and user experience design (UXD) students' views on ChatGPT and focused on an Indian university. The study employed a survey research design, utilizing questionnaires as the primary data collection method. The collected data (n =149) was analyzed using descriptive statistics (i.e., frequency, percentage, average, and standard deviation (SD). Inferential statistics (i.e., one-way ANOVA) was used to understand the significant differences between the programs of study, gender, and academic level. The findings indicate that the students expressed admiration for the capabilities of ChatGPT and found it to be an interesting and helpful tool for their studies. In addition, the students' motivation towards using ChatGPT was moderate. Furthermore, the study observed significant differences between PD and UXD students and differences based on gender and academic level on certain variables. Notably, UXD students reported that ChatGPT does not understand their questions well, and formulating effective prompts for the tool was more challenging than for PD students. Based on the findings, the study recommends how educators should consider integrating ChatGPT into design education curricula and pedagogical practices. The insights aim to contribute to refining the use of ChatGPT in educational settings and exploring avenues for improving its effectiveness, ultimately advancing the field of AI in design education.

1. Background

Artificial intelligence (AI) has grown substantially in recent decades and transferred to numerous facets of society. AI is the technology in designing systems capable of executing tasks attributed to intelligent entities, including decision-making, judgment, and learning (Xue et al., 2023). AI has effectively addressed complex challenges across diverse domains, including education (Ouyang et al., 2022). The integration of AI into education has made a substantial impact, as illustrated by enhancements in educational process efficiency (Javaid et al., 2023), the facilitation of global learning (Rahman & Watanobe, 2023), the customization of learning experiences (Ahmed & Miller, 2023), the development of more intelligent educational content (Filippi, 2023), and the optimization of academic administration for improved effectiveness and efficiency (Urquiza-Yllescas et al., 2022).

One of the formidable AI-driven chatbots is the 'Chat Generative Pre-Trained Transformer,' commonly referred to as ChatGPT. A chatbot is a software application that emulates a discussion with individuals using text or natural language, creating the impression of interacting with a human (Adamopoulou & Moussiades, 2020). ChatGPT is a chatbot capable of generating sophisticated text and participating in persuasive conversations with individuals. It is a revolutionary tool that can respond to queries about virtually any topic within the scope of the dataset it has been trained on in the modern digital landscape (Javaid et al., 2023). ChatGPT can assist in various tasks, including essay writing, research idea brainstorming, literature reviews, and computer code generation (Owens, 2023). ChatGPT's capabilities are anticipated to expand swiftly as it continually accumulates new data from user interactions (van Dis, 2023).

Educators can incorporate ChatGPT into their courses to customize the students' learning experience. Conversely, students can improve their writing skills by using tools for text completion, translation, and text summarization (Javaid et al., 2023). ChatGPT is an efficient tool for educators to enhance teaching methods and facilitate students' learning (Javaid et al., 2023). Teachers can assist their students in achieving more effective learning outcomes by employing ChatGPT to stimulate discussions, offer personalized feedback, and enhance their language and literacy skills. The application can offer comprehensive feedback on

* Corresponding author. *E-mail address:* vkumar.chellappa@polyu.edu.hk (V. Chellappa).

https://doi.org/10.1016/j.caeai.2024.100281

Received 20 February 2024; Received in revised form 1 August 2024; Accepted 17 August 2024 Available online 22 August 2024

2666-920X/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

a student's project, providing suggestions for improvement and motivation. Students may experience increased confidence and motivation to continue their studies and personal development.

ChatGPT can influence various facets of education, encompassing writing, instructional techniques, and teaching methodologies. Writing has been pivotal for generations in nurturing creative and critical thinking by structuring information and crafting narratives. Even in the AI era, writing maintains a pivotal role in education. Integrating ChatGPT into higher education could lead to a transition towards greater reliance on AI, reducing the demand for professors and potentially diminishing opportunities for interpersonal relationships and human engagement. ChatGPT can review their work for grammatical and structural issues to support students in enhancing their writing skills, offering valuable feedback. Computers can emulate human conversations using ChatGPT (Kasneci et al., 2023). It can respond accurately to user inquiries and personalize interactions by understanding user intent and context (Gilson, 2023).

According to Shoufan (2023), ChatGPT has been met with both acclaim and controversy in education—for instance, Appleby (2023) surveyed to understand college students' views on using ChatGPT. The findings revealed that over 50% of students use ChatGPT for their assignments and exams as cheating. Kasneci et al. (2023) stated that integrating ChatGPT in learning and teaching can help students develop problem-solving skills, critical thinking, information analysis, and writing. Additionally, it can potentially empower learners with disabilities, offering them new opportunities for engagement and participation. ChatGPT has also demonstrated remarkable performance across various application domains. It excels in assisting with programming code, answering questions, deciphering languages, providing interactive responses, and generating coherent content and essays. This could benefit students' learning process and academic and research teachers (Rahman & Watanobe, 2023). According to Appleby (2023), one of the biggest challenges ChatGPT poses in education is preserving academic integrity. Susnjak (2022) stated that ChatGPT poses a potential threat to the integrity of online exams, especially in tertiary education settings where online exams are increasingly common. Kooli (2023) highlights a potential risk associated with AI systems, wherein they can be manipulated or tampered with, resulting in unreliable or biased outcomes. Some authors (Ahmed & Miller, 2023; Filippi, 2023) investigated the effect of ChatGPT on product design education and found that using ChatGPT can enhance users' creativity. Along the same line, Meron and Araci (2023) investigate the potential of ChatGPT to serve as a virtual colleague, assisting design students in creating educational materials for higher education.

While these studies offer valuable initial insights into the potentials and challenges of ChatGPT, it is important to note that most of the studies mainly focus on the educator's perspective rather than that of the students. In addition, only limited studies (e.g., Dempere et al., 2023; Shoufan, 2023; Zou et al., 2023) focused on understanding students' views on ChatGPT in various domains but not on design education. Design is a discipline rooted in practice, evident in its educational methodology, which revolves around project development. While design critique, theory, and history also play a role, the emphasis remains on practical application and hands-on project work (Filippi, 2023). Design involves purposeful actions and behaviors to attain specific objectives and generate solutions (Wastiels et al., 2013). Design students can greatly benefit from engaging with specific complex knowledge. While visual thinking and representation are integral to the design process, incorporating in-depth knowledge from various domains can enhance their understanding and problem-solving abilities. This multidisciplinary approach allows students to bring deeper insight and innovation to their design projects. As an AI language model, ChatGPT has the potential to impact how design students approach and execute various tasks. However, there is no answer to how design students perceive ChatGPT in learning. According to Muenks et al. (2020), students' perceptions hold great significance in education, as they can

profoundly influence their academic achievement, engagement, and motivation. Gaining insights into the students' perceptions can help educators adjust the curriculum, teaching methods, and assessment strategies to prepare students for the evolving technological landscape effectively. Therefore, this study examined the design student's perceptions of ChatGPT. Thus, this research is structured into distinct sections. The first section of this research offered an introduction that provides an overview of the study's context and presents the problem statement. It also identifies and narrows down the gaps in existing literature and outlines the study's specific aims. The second section focuses on discussing the chosen methodological approaches that have been deemed most suitable for the study. It outlines and explains the specific methods, techniques, or frameworks utilized to gather and analyze data to address the research aim effectively. The third section discusses data analysis and interpretation of the data. The findings, limitations, and implications are discussed in the last section.

2. Methodology

A quantitative research approach was employed to comprehensively understand design students' perspectives on ChatGPT version 3.5, specifically through a questionnaire survey. According to previous studies such as Creswell (2014), the survey strategy is considered highly appropriate when researchers aim to obtain a comprehensive and generalized understanding of a phenomenon. Given that the primary objective of this study was to gain a generalized perspective of students regarding ChatGPT, the survey approach was deemed the most suitable methodology.

The questionnaire items were adapted from the previous studies to ensure relevance and alignment with this study's context. Javaid et al. (2023) discuss the features of ChatGPT in the education system based on different themes. Shoufan (2023) further examined the themes regarding using ChatGPT in the educational context. Among these themes, eight were classified as positive, indicating a more favorable perception of ChatGPT, while the remaining six were categorized as negative, indicating a less favorable perception. For instance, the theme "ease of use" reflects a positive perception, suggesting that students find ChatGPT easy to use. Conversely, the theme "misuse for malicious purposes" points to a negative aspect, indicating a concern that ChatGPT can be exploited for harmful or unethical intentions. By examining such themes, Shoufan (2023) developed a range of survey items to gather insights into students' understanding and opinions concerning ChatGPT. These survey items were developed based on the positive and negative themes, indicated by the + and - signs in Table 1, respectively, as derived from Shoufan (2023). Other studies (Farhi et al., 2023; Welding et al., 2023) utilized these survey items by adapting and reframing them to align with their research objectives to perceive the students' views on ChatGPT in various fields, including law, pharmacy, and management sciences. Based on the versatility and applicability of the survey items identified by Shoufan (2023) in investigating students' perceptions of ChatGPT across different disciplines, these survey items were utilized in the current study to understand the perceptions of design students towards ChatGPT.

In this study, certain items were modified to enhance comprehension and relevance within the context of design education. For instance, a previous item stating "ChatGPT is an effective tool for tasks related to engineering tasks" was rephrased as "ChatGPT is an effective tool for tasks about design work." This modification aligns the item with the specific focus of design education and makes it more suitable for the study's objectives. A pilot study involved five individuals with diverse backgrounds, including three faculties and two industry experts, all with more than five years of experience in the design field. The main purpose of this pilot study was to evaluate its effectiveness in terms of clarity and relevance. During the pilot study, participants were requested to review the questionnaire's content and provide feedback. They were asked to assess the items' relevance and suggest any necessary modifications or

Table 1

Questionnaire items.

Theme	Code	Items
-Misuse for malicious	M1	ChatGPT has the potential to create
purposes		opportunities for manipulation and misuse
-Replacement of human	R1	Human intelligence is needed to work with
intelligence		ChatGPT
	R2	Having some background knowledge of your
		question can be beneficial to utilize ChatGPT
		effectively
+Ease of use	E1	ChatGPT is easy to use
+Enthusiasm and	EA1	I am amazed by the capabilities of ChatGPT
appreciation	EA2	ChatGPT offers unique advantages compared to
		search engines like Google
+Provide good	PA1	ChatGPT can provide informative and well-
explanations		explained responses
-	PA2	The responses generated by ChatGPT are well-
		structured and organized
+Helpful for learning	HL1	ChatGPT is regarded as a valuable and efficient
1 0		technology for supporting learning
	HL2	ChatGPT serves as a valuable supplementary
		learning resource
	HL3	ChatGPT can enhance creativity
+Helpful for work	HW1	ChatGPT proves to be a valuable and effective
-		tool for tasks related to design work
	HW2	ChatGPT enables me to study with greater
		efficiency and effectiveness
+Human-like	HC1	Engaging in follow-up questions can assist
conversation		ChatGPT in refining its responses and arriving at
		more accurate answers
	HC2	ChatGPT creates a user-friendly impression and
		enhances human experiences
-Inaccurate answers	IA1	ChatGPT is not perfect and can benefit from
		further improvements
	IA2	The responses provided by ChatGPT are
		generally accurate
+Interesting and	IM1	ChatGPT is interesting
motivation	IM2	I feel motivated to use ChatGPT more
-Negative impact on	N1	The availability of ChatGPT could potentially
education		make academic cheating more accessible
	N2	ChatGPT have a negative impact on learning as
		students can easily find answers and solutions
		without putting in much effort
+Optimism	01	ChatGPT's quality will see significant
		improvements soon
	02	I feel optimistic about ChatGPT
-Tricky to use	T1	Formulating questions for ChatGPT can be
•		challenging or require careful consideration
	T2	ChatGPT does not understand my questions
-Uncertainty about	U1	I feel quite uncertain about the impact of
impact		ChatGPT and how it will change our life
	U2	I am concerned about the impact of ChatGPT

additions to align with the study's objectives. Following the pilot study, all participants confirmed that the items in the questionnaire were clear, concise, and relevant. As a result, the researchers used the questionnaire for the subsequent stages of the study.

This study's population comprised Amity University (Noida campus) design students. Amity University was selected because the institute is in the Delhi NCR (National Capital Region), which is more digitalized. Also, it ranked among the top 3% globally in 2018 (Jain, 2024), with a population of more than 4000 students across over 200 programs yearly, including bachelor in product design (PD) and user experience design (UXD) programs. These factors made it relevant and suitable for the current study. The questionnaire was randomly distributed to the students enrolled in PD and UXD programs through official year-wise groups linked in WhatsApp. Students were asked to express their agreement level with each statement in the questionnaire using a 5-point Likert scale (i.e., 1 = not at all, 2 = no, 3 = average, 4 = yes, and 5 = yesvery much). The questionnaire was divided into two sections. The first section included questions about the respondents' demographic information. The second section, which comprised 27 items, captured students' views on ChatGPT (refer to Table 1). At the beginning of the

survey, there was a filtering question to ensure that the students had used ChatGPT version 3.5 for design-related courses, assignments, or projects. Following this phase, the researchers obtained 167 responses (PD = 83 and UXD = 84) from all the students covering the undergraduate programs' second, third, and fourth years, of which 18 questionnaires were either missing or incorrectly filled out by the respondents. During the survey, first-year semester exams were going on; hence, 1st-year students were not included in this study. Therefore, 149 responses (77 UXD and 72 PD students) were deemed suitable for further analysis. This resulted in a response rate of 89.2%, which surpasses the minimum threshold of 60% recommended by Deutskens et al. (2004).

The data was analyzed using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 23. The researchers employed Cronbach's alpha test to assess the reliability of the items to measure students' perception of ChatGPT. The obtained alpha value of 0.770 indicates a good level of internal consistency among the items in the questionnaire (Tavakol & Dennick, 2011). To summarize the survey data, the researchers performed descriptive statistics (i.e., frequency, percentage, average, and standard deviation (SD)) and inferential statistics (i.e., one-way ANOVA). One-way ANOVA was conducted to examine the effects of the variables (gender, program, and academic level) on the perceptions of ChatGPT. This analysis provides insights into the potential impact of these variables on students' perceptions of ChatGPT within the context of design education.

3. Results and discussion

3.1. Respondents' characteristics

The characteristics of the respondents are shown in Table 2. Regarding the participant's gender, 54.37% were females, and 45.63% were males. Table 2 indicates that in the respondents' program of study, 51.60% of participants were from the UXD program, and 48.40% were from the PD program. The table further reveals that among the respondents, the highest number of participants (46.97%) were in the second year, followed by the third year (30.21%) and fourth year (22.82%). As previously mentioned, the study did not include first-year students as they were not part of the survey due to ongoing semester exams.

3.2. Design students' perception of ChatGPT

Furthermore, the study delved into analyzing students' perceptions of ChatGPT. According to Table 3, the students commonly described ChatGPT as easy to use (E1), amazing capabilities (EA1), and interesting (IM1), with mean scores of 4.40, 4.24, and 4.23, respectively. The findings that were obtained align with previous studies conducted in various domains. For instance, Shoftan (2023) found that computing students in the UAE described ChatGPT in terms of its interesting and amazing capabilities. Similarly, Zou et al. (2023) reported that students' perception of ChatGPT leaned towards its ease of use. Concerning the

able 2	
hous stanistics	of the

Characteristics	of	the	respondents.
Gilaracteristics	01	unc	respondents.

Characteristic		Frequency	Percentage		
Program of study	UXD	77	51.60		
	PD	72	48.40		
	Total	149	100		
Gender	Male	68	45.63		
	Female	81	54.37		
	Total	149	100		
Academic level	Second year	70	46.97		
	Third year	45	30.21		
	Fourth-year	34	22.82		
	Total	149	100		

Table 3

Design students' perception of ChatGPT.

Code	Item	Overall	Rank	
		Mean	SD	
E1	ChatGPT is easy to use	4.40	0.75	1
EA1	I am amazed by the capabilities of ChatGPT	4.24	0.76	2
IM1	ChatGPT is interesting	4.23	0.74	3
R1	Human intelligence is needed to work with	4.22	0.81	4
	ChatGPT			
01	ChatGPT's quality will see significant	4.21	0.62	5
01	improvements soon		0.02	U
N1	The availability of ChatGPT could notentially	4 1 5	0.84	6
141	make academic cheating more accessible	4.15	0.04	0
N2	ChatGPT have a negative impact on learning as	4 04	0.94	7
142	students can easily find answers and solutions	1.01	0.94	/
	without putting in much offort			
DA1	ChotCDT con movide informative and well	2.00	0.00	0
PAI	ChatGPT can provide informative and well-	3.98	0.88	0
	explained responses	0.07	0.07	0
HLI	ChatGP1 is regarded as a valuable and efficient	3.97	0.97	9
D 40	technology for supporting learning	0.07	0.01	10
PA2	The responses generated by ChatGPT are well-	3.96	0.81	10
	structured and organized			
R2	Having some background knowledge of your	3.96	0.97	11
	question can be beneficial to utilize ChatGPT			
	effectively			
HL2	ChatGPT serves as a valuable supplementary	3.94	0.77	12
	learning resource			
IA1	ChatGPT is not perfect and can benefit from	3.89	0.91	13
	further improvements			
HC1	Engaging in follow-up questions can assist	3.81	0.83	14
	ChatGPT in refining its responses and arriving at			
	more accurate answers			
EA2	ChatGPT offers unique advantages compared to	3.77	0.92	15
	search engines like Google			
02	I feel optimistic about ChatGPT	3.73	0.91	16
HW1	ChatGPT proves to be a valuable and effective	3.72	0.91	17
	tool for tasks related to design work			
IM2	I feel motivated to use ChatGPT more	3.72	0.90	18
U1	I feel quite uncertain about the impact of	3.72	0.88	19
	ChatGPT and how it will change our life			
U2	I am concerned about the impact of ChatGPT	3.70	1.01	20
M1	ChatGPT has the potential to create opportunities	3.67	0.87	21
	for manipulation and misuse			
HW2	ChatGPT enables me to study with greater	3.62	0.99	22
	efficiency and effectiveness	0.02	0.55	
HL3	ChatGPT can enhance creativity	3 52	1 1 1	23
HC2	ChatGPT creates a user-friendly impression and	3 38	1.00	24
1162	enhances human experiences	5.56	1.00	24
140	The responses provided by ChatCDT are	3 36	0.80	25
1772	appendix accurate	5.50	0.00	20
TT1	Exemplating quantions for ChatCDT as the	2 1 0	0.07	26
11	commuting questions for ChatGP1 can be	3.18	0.97	20
T 0	changing or require careful consideration	0.01	0.00	07
12	ChatGP1 does not understand my questions	2.81	0.93	27

generated answers, the accuracy of ChatGPT received a relatively moderate rating (IA2), with a mean score of 3.36. This aligns with the observation that most students perceive ChatGPT as imperfect and needing improvement (IA1), as reflected by a mean score of 3.89. However, most students believe that ChatGPT provides good explanations (PA1; mean score = 3.98) and offers well-structured answers (PA2; mean score = 3.96). Engaging and user-friendly, ChatGPT facilitates interaction through natural language conversations, making it easy and enjoyable for users to engage with the system. Due to a sense of comfort and reduced thoughtfulness while composing queries, students may inadvertently produce less accurate responses from ChatGPT. Also, providing good explanations by ChatGPT can sometimes lead to a false sense of accuracy (Shoufan, 2023). While the explanations may be clear and well-presented, users need to be cautious and verify the accuracy of the information provided by consulting additional sources. Hence, it is of utmost importance for instructors and educators to guide students on effective techniques for generating prompts and evaluating responses.

The widely agreed-upon concern regarding ChatGPT is that it cannot replace human intelligence (R1; mean score = 4.22). It is acknowledged

that one needs to possess sufficient background knowledge to utilize ChatGPT effectively (R2; mean score = 3.96). To effectively utilize ChatGPT, students must possess a sufficient background in the relevant study domain. This background knowledge enables them to generate appropriate prompts and critically evaluate the responses generated by the system. Regarding the actual interaction with the system, although students perceive ChatGPT as easy to use, they find that formulating prompts can be challenging (T1; mean score = 3.18). However, the students expressed that asking follow-up questions can aid in finding the correct answer (HC1; mean score = 3.81). Regarding its impact on learning, most students perceive ChatGPT as beneficial for their educational journey (HL1; mean score = 3.97) and consider it a valuable supplementary resource (HL2; mean score = 3.94). Interestingly, students believe that ChatGPT has the potential to enhance their study efficiency (HW2; mean score = 3.62). Still, they do not perceive it as a tool significantly enhancing their creativity (HL3; mean score = 3.52). According to the student's responses, they perceive the negative impact of ChatGPT on academic integrity and learning as relatively modest. This is evident from their mean scores of 4.15 for the perception of academic cheating (N1) and 4.04 for the belief that it reduces students' effort in their learning (N2).

Nevertheless, with the challenges in formulating prompts and the limited level of accuracy, students view ChatGPT as a beneficial and effective tool for both their learning and professional endeavors. They see it as an asset that aids them in acquiring knowledge and enhancing their performance in various academic and professional contexts. In the context of ChatGPT, if students perceive it as useful and easy to use, they are more likely to have a positive behavioral intention (Shoufan, 2023). Conversely, when evaluating the drawbacks of ChatGPT for learning purposes, students provide a moderate assessment. This aligns with the perception that ChatGPT can enhance students' creativity, reduce the effort in their learning, and prevent academic cheating. Ahmed and Miller (2023) recognized that while ChatGPT and other AI tools can be powerful assets, their effectiveness ultimately relies on the capabilities and expertise of human users. Designers must harness their creativity and knowledge to ensure AI tools enhance the overall design process. Kocaballi (2023) argued that ChatGPT can potentially enhance creativity and innovation in the design process. Consequently, students do not perceive the system as a significant threat to learning. This alignment with their perception is likely because they recognize that ChatGPT is not a definitive source of knowledge. Instead, utilizing ChatGPT necessitates a foundation of background knowledge and careful engagement in formulating prompts and critically assessing the responses.

The students demonstrated significant interest and moderate motivation towards ChatGPT, expressing strong positive sentiments towards the system. Interest plays a crucial role in the learning process as it enhances problem-solving abilities, collaboration, students' selfregulation, and enjoyment of learning (Hidi et al., 2004, pp. 103–130). Several factors are likely to have contributed to these positive attitudes, including the perceived usefulness of ChatGPT for learning purposes, human-like conversation, ease of use, and provision of good explanations. These factors collectively contribute to the students' favorable perceptions and attitudes towards the system. However, the study did not find any significant correlations between these factors and the perceived level of interest among the students. Understanding how this situational interest can transform into individual interest that motivates the long-term usage of this technology is highly desirable (Schraw & Lehman, 2001).

Additionally, the study analyzed statistical variations concerning the academic level, study program, and gender. According to the results presented in Table 4, a statistically significant difference was observed between the study programs concerning the items T1 (p = 0.044) and T2 (p = 0.013). Upon examination of the mean scores, it was found that students in the UXD program had a high average score of 3.35 and 3.00, respectively, for finding it challenging to formulate questions for

Table 4

Analysis of Variances (ANOVA) for students' perception of ChatGPT.

Code	Item	Program	n	Gender		Academic level	
		F	<i>p</i> - value	F	<i>p</i> - value	F	<i>p</i> - value
E1	ChatGPT is easy to use	0.958	0.329	0.737	0.392	0.014	0.986
EA1	I am amazed by the capabilities of ChatGPT	0.007	0.932	0.095	0.758	3.236	0.042 ^a
IM1	ChatGPT is interesting	0.416	0.52	2.472	0.118	3.863	0.023 ^a
R1	Human intelligence is needed to work with ChatGPT	0.171	0.68	0.036	0.85	0.887	0.414
01	ChatGPT's quality will see significant improvements soon	0.02	0.888	2.055	0.154	0.007	0.993
N1	The availability of ChatGPT could potentially make academic cheating more accessible	0.015	0.903	0.158	0.691	3.117	0.047 ^a
N2	ChatGPT have a negative impact on learning as students can easily find answers and solutions without	0.734	0.393	0.691	0.407	0.049	0.952
	putting in much effort						
PA1	ChatGPT can provide informative and well-explained responses	0.072	0.788	0.394	0.531	0.716	0.49
HL1	ChatGPT is regarded as a valuable and efficient technology for supporting learning	1.047	0.308	13.457	0.001 ^a	5.19	0.007 ^a
PA2	The responses generated by ChatGPT are well-structured and organized	0.617	0.433	0.743	0.39	3.424	0.035 ^a
R2	Having some background knowledge of your question can be beneficial to utilize ChatGPT effectively	0.238	0.626	0.943	0.333	3.149	0.046 ^ª
HL2	ChatGPT serves as a valuable supplementary learning resource	1.44	0.232	4.741	0.031 ^a	4.783	0.01 ^a
IA1	ChatGPT is not perfect and can benefit from further improvements	0.249	0.618	2.521	0.114	3.056	0.05 ^ª
HC1	Engaging in follow-up questions can assist ChatGPT in refining its responses and arriving at more accurate answers	0.481	0.489	0.023	0.878	2.051	0.132
EA2	ChatGPT offers unique advantages compared to search engines like Google	1.608	0.207	0.282	0.596	1.431	0.242
02	I feel optimistic about ChatGPT	0.362	0.548	1.294	0.257	0.35	0.705
HW1	ChatGPT proves to be a valuable and effective tool for tasks related to design work	1.696	0.195	8.533	0.004 ^a	5.973	0.003 ^a
IM2	I feel motivated to use ChatGPT more	1.725	0.191	0.741	0.391	0.193	0.824
U1	I feel quite uncertain about the impact of ChatGPT and how it will change our life	0.77	0.382	0.28	0.598	3.847	0.024 ^ª
U2	I am concerned about the impact of ChatGPT	0.59	0.444	0.64	0.425	0.3	0.741
M1	ChatGPT has the potential to create opportunities for manipulation and misuse	0.099	0.754	0.014	0.905	1.449	0.238
HW2	ChatGPT enables me to study with greater efficiency and effectiveness	0.668	0.415	0.572	0.451	0.952	0.388
HL3	ChatGPT can enhance creativity	0.115	0.735	0.636	0.426	0.085	0.918
HC2	ChatGPT creates a user-friendly impression and enhances human experiences	0.413	0.522	0.317	0.574	0.777	0.462
IA2	The responses provided by ChatGPT are generally accurate	0.24	0.625	1.441	0.232	1.404	0.249
T1	Formulating questions for ChatGPT can be challenging or require careful consideration	4.142	0.044 ^a	2.707	0.102	1.007	0.368
T2	ChatGPT does not understand my questions	6.253	0.013 ^a	0.322	0.571	4.3	0.015 ^a

 a Significant at p < 0.05 level.

ChatGPT and its understanding. On the other hand, students in the PD program had slightly lower mean scores of 3.03 and 2.62 for the same aspect, as shown in Table 5. The observed difference in perception between UXD and PD students regarding T1 and T2 could be attributed to

the differences in their curriculum. As UXD students have programming as part of their curriculum, they may find it more difficult to formulate questions due to the technical nature of programming (Shoufan, 2023). Hence, ChatGPT could not understand their questions. In contrast, PD

Table 5

Design students' perception towards ChatGPT based on study program, gender, and academic level.

Code	Study program				Academic level						Gender				
	UXD	UXD		PD		II		III		IV		Female		Male	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
E1	4.34	0.77	4.46	0.73	4.39	0.79	4.40	0.72	4.41	0.74	4.44	0.72	4.34	0.78	
EA1	4.25	0.76	4.24	0.76	4.40	0.65	4.16	0.74	4.03	0.94	4.26	0.72	4.22	0.81	
IM1	4.27	0.77	4.19	0.70	4.40	0.71	4.02	0.75	4.18	0.72	4.15	0.76	4.34	0.70	
R1	4.19	0.71	4.25	0.92	4.17	0.85	4.36	0.77	4.15	0.78	4.21	0.83	4.24	0.79	
01	4.21	0.55	4.22	0.70	4.21	0.72	4.22	0.52	4.21	0.54	4.15	0.55	4.29	0.69	
N1	4.16	0.78	4.14	0.91	4.29	0.78	4.16	0.82	3.85	0.93	4.17	0.82	4.12	0.87	
N2	4.10	0.84	3.97	1.03	4.04	1.00	4.07	0.84	4.00	0.95	4.10	0.96	3.97	0.91	
PA1	3.96	0.75	4.00	1.01	4.07	0.86	3.89	0.93	3.91	0.87	3.94	0.87	4.03	0.90	
HL1	4.05	0.87	3.89	1.07	4.23	0.80	3.67	1.04	3.85	1.08	3.72	1.06	4.28	0.75	
PA2	3.91	0.78	4.01	0.85	4.13	0.74	3.73	0.89	3.91	0.79	4.01	0.80	3.90	0.83	
R2	3.92	0.90	4.00	1.05	3.79	1.08	4.24	0.80	3.94	0.89	3.89	1.01	4.04	0.92	
HL2	4.01	0.70	3.86	0.84	4.13	0.70	3.69	0.85	3.88	0.73	3.81	0.82	4.09	0.69	
IA1	3.92	0.76	3.85	1.06	3.70	0.92	4.11	0.83	3.97	0.94	3.78	0.88	4.01	0.94	
HC1	3.77	0.83	3.86	0.84	3.96	0.79	3.67	0.95	3.71	0.72	3.80	0.90	3.82	0.75	
EA2	3.86	0.84	3.67	0.99	3.87	0.93	3.58	0.89	3.79	0.91	3.73	0.84	3.81	1.01	
02	3.69	0.88	3.78	0.94	3.77	0.92	3.76	0.77	3.62	1.04	3.65	0.88	3.82	0.93	
HW1	3.82	0.76	3.63	1.04	3.93	0.84	3.36	0.93	3.79	0.88	3.53	0.91	3.96	0.85	
IM2	3.82	0.87	3.63	0.93	3.73	0.92	3.67	0.95	3.79	0.81	3.67	0.91	3.79	0.89	
U1	3.78	0.87	3.65	0.89	3.91	0.86	3.62	0.91	3.44	0.79	3.75	0.73	3.68	1.03	
U2	3.77	0.93	3.64	1.09	3.73	1.03	3.76	1.00	3.59	0.99	3.77	0.94	3.63	1.09	
M1	3.65	0.84	3.69	0.91	3.54	1.02	3.80	0.73	3.76	0.70	3.68	0.80	3.66	0.96	
HW2	3.69	0.91	3.56	1.07	3.74	1.02	3.51	0.94	3.53	0.99	3.57	0.97	3.69	1.01	
HL3	3.49	1.06	3.56	1.17	3.54	1.19	3.47	1.08	3.56	1.02	3.46	1.10	3.60	1.13	
HC2	3.32	0.97	3.43	1.05	3.46	1.03	3.22	1.06	3.41	0.86	3.33	0.99	3.43	1.03	
IA2	3.32	0.80	3.39	0.80	3.47	0.83	3.24	0.80	3.26	0.71	3.28	0.79	3.44	0.80	
T1	3.35	1.02	3.03	0.90	3.07	0.97	3.33	0.98	3.21	0.98	3.06	0.99	3.32	0.94	
T2	3.00	0.96	2.62	0.87	2.63	0.94	3.13	0.84	2.74	0.96	2.77	0.99	2.85	0.87	

students who do not have such modules may have less experience with programming and, therefore, perceive it to be less challenging when formulating questions for ChatGPT. Furthermore, statistically significant differences were found between gender and the following items: HL1 (p = 0.001), HL2 (p = 0.031), and HW1 (p = 0.004). According to the findings in Table 5, male students demonstrated a greater inclination towards using ChatGPT than female students across all three items. This inclination may stem from male students perceiving ChatGPT as an effective supporting tool and valuable learning resource for their academic purposes. The results were consistent with similar studies (Kasneci et al., 2023; Shoufan, 2023), indicating that male students may exhibit greater self-confidence and comfort with technology than their female counterparts. This technological self-assurance may make male students more receptive and open to exploring the capabilities of AI-powered tools, such as ChatGPT, in their design process (Filippi, 2023). Furthermore, male students tend to be more willing to take risks and experiment with new technologies, whereas female students may be more cautious (Zou et al., 2023). This propensity for risk-taking and a greater inclination to explore uncharted technological territories could make male students more inclined to incorporate ChatGPT into their design work, even if the outcomes are uncertain. This suggests a potential gender-based difference in the perception and utilization of ChatGPT for academic reasons.

Table 4 reveals significant differences between the academic level and items such as N1 (p = 0.047), IA1 (p = 0.05), and U1 (p = 0.024). Further, statistically significant differences between the academic level and items, including R2 (p = 0.046), HL2 (p = 0.01), and T2 (p = 0.015) were also observed. These significant differences indicate that the year of study influences the respondents' perceptions and attitudes toward these items. The results indicate that third-year students at the academic level obtained higher mean scores for the items R2, HL2, and T2 (refer to Table 5). The observed difference can be attributed to third-year students' education in programming-related courses, unlike their counterparts in the second and fourth years. Consequently, although they perceive ChatGPT as a valuable learning resource, their prior knowledge and familiarity with the subject matter may contribute to their enhanced understanding and appreciation of the questions posed to ChatGPT. From Tables 4 and it was also observed that there was a significant difference between academic level and multiple items such as EA1 (p =0.042), IM1 (p = 0.023), HL1 (p = 0.007), PA2 (p = 0.035), and HW1 (p = 0.003). In all these items, the mean score of the second-year students was higher than other academic-level students (refer to Table 5). The variations in mean scores indicate that second-year students expressed a high level of amazement at the capabilities of ChatGPT. They found it to be interesting, well-structured, and a valuable tool for enhancing their learning about their coursework. This could be attributed to the fact that second-year students begin to delve into core subjects and perceive ChatGPT as an effective tool for completing their design-related tasks and assignments.

According to Meron and Araci (2023), as design students progress from one level to the next, they tend to have more time to delve deeper into technological applications and exploration. In this case, the third-year students have had more time than second- and fourth-year students, as second-year students may be in the process of transitioning and adapting to the design curriculum. In contrast, fourth-year students may be focused on preparing for their internship or transitioning into the professional world, which could distract from their academic performance in the short term (Filippi, 2023). Hence, it is deduced that the third-year students had more time to explore and engage with ChatGPT. This deeper familiarity with the technology could have led the third-year students to be more cautious and discerning in their use of ChatGPT, recognizing that it is not a perfect solution and that its integration into their design work may have uncertain impacts. Furthermore, the third-year students' increased exposure to and experience with ChatGPT may have also made them more aware of the potential for misuse or cheating. Similarly, the second-year students appear to find ChatGPT more interesting and are more amazed by the capabilities of the AI-powered tool. They tend to view ChatGPT as a well-structured and valuable resource that can support their learning and academic endeavors within the design curriculum. This observation aligns with the notion that second-year students are adapting to the design program and are still in the transitional phase of their academic journey (Filippi, 2023).

4. Implications

The findings of this study carry significant implications for the research and practice of design education.

ChatGPT appears to be an appealing platform for design students. The students have expressed a strong sense of interest and optimism about ChatGPT. Educators should explore strategies to capitalize on this interest and maximize its potential benefits. By understanding the factors that contribute to students' positive perceptions and engagement with ChatGPT, educators can develop effective methods for incorporating technology into educational settings. This may involve designing activities, assignments, or projects that leverage the capabilities of ChatGPT to enhance student learning and foster critical thinking skills.

Indeed, further research should focus on a deeper understanding of the specific factors that make ChatGPT so appealing to design students. The study has identified specific factors, such as the quality of explanations and the human-like interaction, that merit consideration when examining the attractiveness of ChatGPT. By investigating these aspects, educators can develop evidence-based practices and interventions that enhance the educational experience and optimize the benefits of using ChatGPT in the classroom (Javaid et al., 2023). The study has emphasized some factors commonly associated with technology acceptance, such as the perceived usefulness and ease of use of ChatGPT. These factors have been identified as influential in shaping design students' attitudes and willingness to adopt and use the technology, which can elucidate the behavioral intention to use ChatGPT (Shoufan, 2023).

The potential of ChatGPT to enhance the creativity of design students remains unclear. Empirical research is needed to establish a link between this factor and the ChatGPT's responses. By conducting empirical studies, researchers can explore whether and to what extent ChatGPT contributes to enhancing the creative abilities of design students. In addition, workshops and tutorials should be offered to students based on their study program to educate them on the ethical use of ChatGPT (Susnjak, 2022), highlighting its strengths and limitations and best practices for integration into the design process. Furthermore, design curricula, especially for UXD programs, should be reviewed and updated to incorporate AI-related topics, such as machine learning, generative design, and the ethical considerations surrounding using AI in design. Preparing UXD students for the evolving landscape of design practice is crucial, as AI tools like ChatGPT are poised to play an increasingly prominent role in programming and developing interactive experiences (Shoufan, 2023). By updating the curriculum to cover these AI-related topics, UXD programs can ensure that students have the necessary knowledge and skills to integrate AI technologies into their future design work.

If design students perceive ChatGPT as less useful or relevant for their design-focused coursework and activities, they may be less motivated to incorporate the tool into their workflows. To increase the motivation and adoption of ChatGPT within design education, educators should take proactive steps to demonstrate the tool's design-specific capabilities. This could include prompting ChatGPT to generate initial design ideas, conceptual explorations, and creative concepts based on specific design briefs or user needs (Filippi, 2023). Educators can also showcase how AI can describe detailed specifications for user interface elements, interaction flows, and product features, supporting the prototyping and mockup development. Moreover, educators should demonstrate how design students can leverage ChatGPT to summarize relevant field design research, trends, and best practices. This can help inform the students' design decision-making and provide valuable insights to guide their creative process. In addition to these design-specific use cases, educators should provide hands-on workshops and tutorials that illustrate how design students can integrate ChatGPT into their creative workflows. These hands-on learning opportunities will allow students to experience the tool's value firsthand and develop the necessary skills to utilize it effectively within their design-focused coursework and activities (Ahmed & Miller, 2023).

This research will provide valuable insights into ChatGPT's impact on creativity and inform educational practices that aim to foster and nurture creative thinking within the design field. In response to the evolving landscape, design education may need to adapt by offering courses covering AI-related subjects and instructing students on incorporating AI into their design practice. By providing such educational opportunities, design programs can equip students with the knowledge and skills to effectively navigate and integrate AI technologies into their design processes, ensuring they remain competitive and proficient in an AI-driven world.

5. Limitations

This study was subject to several limitations. First, this research focused on understanding students' perceptions of ChatGPT version 3.5, the most readily accessible version in the Indian context. As ChatGPT continues to evolve, with the release of more advanced versions like ChatGPT 4.0, future studies may need to explore how students' perceptions and experiences differ across these varying contexts and capabilities of the language model. The potential differences in the features, performance, and implications of ChatGPT 3.5 versus newer versions could impact students' attitudes and approaches to incorporating the technology into their work. Expanding the scope of research to include an examination of student perspectives on the latest iterations of ChatGPT would provide a more comprehensive understanding of how this rapidly advancing AI tool is being perceived and utilized within educational settings.

Second, this study's participants were limited to design students, and the responses gathered were based on their general experiences with ChatGPT rather than being specific to their design-related coursework or activities. Future research should explore students' experiences using ChatGPT for discipline-specific tasks and assignments. This could involve developing design-focused projects and activities that leverage ChatGPT's capabilities to support and enhance relevant skills and processes, such as ideation, prototyping, research, and communication. By examining how students in design-oriented programs engage with and apply ChatGPT within the context of their coursework and projects, researchers can gain a more comprehensive understanding of the tool's impact and effectiveness within this specific educational domain.

Third, this study was limited to design education. To validate its findings, it would be crucial to replicate the research across a broader range of academic disciplines and subject areas. Conducting similar studies with students from diverse educational backgrounds, such as engineering, humanities, or science programs, would help confirm the generalizability of the findings. Replicating this research in various educational contexts can provide a more comprehensive understanding of how ChatGPT is perceived and its impact across different domains of study. This would help establish a clearer picture of the tool's effectiveness and applicability within the wider landscape of higher education.

Last, the study findings were derived solely from the responses and experiences of PD and UXD students enrolled at a single university in India. Further investigations could explore students' perceptions regarding ChatGPT from the vantage point of design programs offered by different universities and other institutions of higher learning. Next, the study's variables used to describe ChatGPT were limited and drawn from existing literature. Future research should aim to conduct qualitative studies to delve deeper into the variables related to ChatGPT. For example, this study observed significant differences between design students' programs of study on two variables, T1 and T2. Further investigating these differences through targeted interviews with students in the PD and UXD programs could help researchers better understand whether these distinctions are due to their respective courses' unique requirements and learning objectives or are more broadly related to programming and computational thinking skills. This approach would contribute to a more thorough exploration of the potential impacts, challenges, and benefits of ChatGPT in the context of design education.

6. Conclusion

While numerous studies examined the potential applications of ChatGPT in various contexts, this study was the first to explore the perceptions of PD and UXD students with ChatGPT specifically. This survey-based study determined the significant difference between study programs, gender, and academic levels. Overall, the findings indicate that PD and UXD students found ChatGPT interesting and easy to use and were amazed by ChatGPT's capabilities. Furthermore, students found that ChatGPT provides informative responses and is a valuable supplementary learning resource. While the students expressed generally positive views of ChatGPT, their motivation to use the tool appeared to be more moderate, potentially due to a perceived lack of relevance or applicability of ChatGPT to the specific tasks and workflows associated with their design-focused coursework.

The study also examined statistical variations in the perceptions of ChatGPT among the different student groups. First, concerning the program of study, the UXD students reported that ChatGPT did not comprehend their questions as effectively and found it more challenging to formulate appropriate prompts for the tool. This may be because the UXD curriculum involves programming components, making it more complex for these students to articulate their queries in a way that the language model can properly understand. Second, concerning gender, the male students exhibited greater self-assurance and comfort with using ChatGPT. This could be attributed to the tendency for male students to be more inclined to take risks, experiment with new technologies, and embrace the capabilities of AI-powered tools like ChatGPT. Third, concerning the academic level, third-year students were more familiar and experienced with ChatGPT, as they had more time to explore and engage with the tool throughout their studies. This increased familiarity and exposure likely contributed to their greater comfort and proficiency in ChatGPT. These observations suggest that the design students' perceptions of ChatGPT may be influenced by factors related to their specific academic programs, gender, and academic levels. In the future, understanding these factors can help tailor training and support to increase overall student engagement and adoption of the technology. It is anticipated that the findings of this study can help guide future research efforts to investigate further the role and impact of AI language models in design education and creative disciplines.

Ethics statement

The study was approved by an ethical committee of Amity University Noida, ID:2023–2024/ASD/AU/1160. All participants gave informed consent, and their privacy rights were strictly observed. The participants were protected by hiding their personal information during the research process. They knew that participation was voluntary and that they could withdraw from the study at any time.

Data availability

The data can be obtained by sending request e-mails to the corresponding author.

Funding

No funds, grants, or other support was received.

CRediT authorship contribution statement

Vigneshkumar Chellappa: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Yan Luximon:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, technology, and applications. Machine Learning With Applications, 2, Article 100006. https://doi.org/ 10.1016/j.mlwa.2020.100006
- Ahmed, A., & Miller, D. (2023). Exploring the impact of artificial intelligence language model ChatGPT on the user experience. *International Journal of Technology Innovation* and Management, 3(1), 1–8. https://doi.org/10.54489/ijtim.v3i1.195
- Appleby, C. (2023). Will colleges ban ChatGPT?. Retrieved October 5, 2023, from https://www.bestcolleges.com/news/will-colleges-ban-chatgpt.
- Creswell, J. W. (2014). Research design: Qualitative, quantitative and mixed methods approaches. In English language teaching (4th ed., Vol. 12, p. 40). Thousand Oaks, CA: Sage. https://doi.org/10.5539/elt.v12n5p40, 5.
- Dempere, J. M., Modugu, K. P., Hesham, A., & Ramasamy, L. K. (2023). The impact of ChatGPT on higher education. *Frontiers in Education*, 8. https://doi.org/10.3389/ feduc.2023.1206936
- Deutskens, E., Ruyter, D. J. K., Wetzels, M., & Oosterveld, P. (2004). Response rate and response quality of internet-based surveys: An experimental study. *Marketing Letters*, 15(1), 21–36. https://doi.org/10.1023/b:mark.0000021968.86465.00
- Farhi, F., Jeljeli, R., Aburezeq, I. M., Dweikat, F. F. I., Al-shami, S. A., & Slamene, R. (2023). Analyzing the students' views, concerns, and perceived ethics about chat GPT usage. Computers & Education: Artificial Intelligence, 5, Article 100180. https:// doi.org/10.1016/j.caeai.2023.100180
- Filippi, S. (2023). Measuring the impact of ChaTGPT on fostering concept generation in innovative product design. *Electronics*, 12(16), 3535. https://doi.org/10.3390/ electronics12163535
- Gilson, A., Safranek, C. W., Huang, T., Socrates, V., Chi, L., Taylor, A., & Chartash, D. (2023). How does ChatGPT perform on the United States medical licensing examination? The implications of large language models for medical education and knowledge assessment. *JMIR Medical Education*, 9, Article e45312. https://doi.org/ 10.2196/45312
- Hidi, S., Renninger, K. A., & Krapp, A. (2004). Interest, a motivational variable that combines affective and cognitive functioning. Routledge eBooks. https://doi.org/ 10.4324/9781410610515-11
- Jain, L. (2024). Amity Noida ranking 2024: NIRF, QS, THE, outlook, India today. Shiksha. com. Retrieved January 6, 2024, from https://www.shiksha.com/engineering/arti cles/amity-university-noida-ranking-2024-nirf-qs-times-higher-education-the-outloo k-india-today-blogId-133121.

- Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Khan, I. H. (2023). Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations, 3*(2), Article 100115. https://doi.org/10.1016/j.tbench.2023.100115
- Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, Article 102274. https://doi.org/10.1016/j.lindif.2023.102274
- Kocaballi, A. B. (2023). Conversational AI-powered design: ChatGPT as designer, user, and product. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2302.07406
- Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. *Sustainability*, 15(7), 5614. https://doi.org/10.3390/ su15075614
- Meron, Y., & Araci, Y. T. (2023). Artificial intelligence in design education: Evaluating ChatGPT as a virtual colleague for post-graduate course development. *Design Science*, 9. https://doi.org/10.1017/dsj.2023.28
- Muenks, K., Canning, E. A., LaCosse, J., Green, D. J., Zirkel, S., García, J. A., & Murphy, M. C. (2020). Does my professor think my ability can change? Students' perceptions of their STEM professors' mindset beliefs predict their psychological vulnerability, engagement, and performance in class. *Journal of Experimental Psychology: General*, 149(11), 2119–2144. https://doi.org/10.1037/xge0000763
- Ouyang, F., Zheng, L., & Jiao, P. (2022). Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020. Education and Information Technologies, 27(6), 7893–7925. https://doi.org/10.1007/s10639-022-10925-9
- Owens, B. (2023). How Nature readers are using ChatGPT. Nature. https://doi.org/ 10.1038/d41586-023-00500-8. Retrieved August 8, 2023, from.
- Rahman, M. M., & Watanobe, Y. (2023). ChatGPT for education and research: Opportunities, threats, and strategies. *Applied Sciences*, 13(9), 5783. https://doi.org/ 10.3390/app13095783
- Schraw, G., & Lehman, S. (2001). Situational interest: A review of the literature and directions for future research. *Educational Psychology Review*, 13, 23–52. https://doi. org/10.1023/A:1009004801455
- Shoufan, A. (2023). Exploring students' perceptions of CHATGPT: Thematic analysis and follow-up survey. *IEEE Access*, 11, 38805–38818. https://doi.org/10.1109/ access.2023.3268224
- Susnjak, T. (2022). ChaTGPT: The end of online exam integrity? arXiv (Cornell University). https://doi.org/10.48550/arxiv.2212.09292
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd
- Urquiza-Yllescas, J. F., Mendoza, S., Rodríguez, J., & Sánchez-Adame, L. M. (2022). An approach to the classification of educational chatbots. *Journal of Intelligent and Fuzzy Systems*, 43(4), 5095–5107. https://doi.org/10.3233/jifs-213275
- Van Dis, E. A., Bollen, J., Zuidema, W., Van Rooij, R., & Bockting, C. (2023). ChatGPT: Five priorities for research. *Nature*. https://doi.org/10.1038/d41586-023-00288-7. Retrieved November 12, 2023, from.
- Wastiels, L., Schifferstein, H., Wouters, I., & Heylighen, A. (2013). Touching materials visually: About the dominance of vision in building material assessment. *International Journal of Design*, 7(2), 31–41.
- Welding, L. (2023). Half of college students say using AI is cheating. BestColleges.com. Retrieved April 7, 2023, from https://www.bestcolleges.com/research/college-st udents-ai-tools-survev/.
- Xue, V. W., Lei, P., & Cho, W. C. (2023). The potential impact of ChatGPT in clinical and translational medicine. Clinical and Translational Medicine, 13(3). https://doi.org/ 10.1002/ctm2.1216
- Zou, X., Su, P., Li, L., & Fu, P. (2023). AI-generated content tools and students' critical thinking: Insights from a Chinese university. *IFLA Journal*. https://doi.org/10.1177/ 03400352231214963