

AI Literacy and Attitudes Towards AI in Design Education: A Comparative Study of Communication and Architectural Design Students

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Abstract: Generative artificial intelligence (AI) has expanded its role in design processes, making it essential for design students to develop the skills needed to navigate AI's opportunities while also critically reflecting on its risks. We used a two-part quantitative and qualitative survey to understand the attitudes of communication and architectural design students towards AI and assess their AI literacy. Students expressed positive and negative viewpoints on AI and rated their AI literacy skills as moderate. We find that design students are very aware of AI's potential for enhancing productivity and acknowledge downsides such as decreased creativity, job losses, and copyright concerns. They identified the competency gaps in the use of specific AI technologies and ethical considerations. We therefore argue for the structured integration of AI competencies in design curricula.

1 INTRODUCTION

Artificial intelligence has become an important technological part of design processes (Lin and Liu, 2024). For creative professions such as graphic design, a full replacement by AI seems unlikely (Hoque, 2024). In the most likely scenario, human designers will be essential for managing the design process and making key decisions, while AI enhances their productivity and capabilities (Irbite and Strode, 2021). Designers are concerned about the potential loss of ownership and creativity when using generative AI (Inie et al., 2023).

AI literacy has become an essential skill, similar to traditional literacy and mathematical abilities, which are the foundation for participation in the job market and civil life (Ng et al., 2021). Alongside this growing need for AI literacy, attitudes towards AI are equally important in shaping how these technologies are embraced or resisted (Marrone et al., 2022).

To study AI literacy and attitudes towards AI of design students, survey participants were recruited from two higher education formats in communication and architectural design at a German and Italian uni-

versity. Although AI technologies are not typically part of communication design or architecture curricula, many practical use cases can be found throughout their studies (Schauer and Simbeck, 2024). Our survey results highlighted the need to integrate AI literacy in design education and revealed knowledge gaps and questions among students.

2 AI IN DESIGN

Design processes are often illustrated as an interplay between problem and solution. This interplay involves three main activities in a non-linear order: analysis, synthesis, and evaluation (Lawson, 2006). Expert designers usually create a unique path in their design process shaped by their experiences and priorities. The resulting design is thereby influenced by the choices and the priorities they establish (Daly et al., 2012).

Generative AI can be a valuable tool throughout the entire design process (Verganti et al., 2020; Thorning et al., 2023), it can simplify design processes by automating and assisting in transforming concepts into tangible products (Furtado et al., 2024) and evaluating creative output (Cetinic and She, 2022). However, there are concerns about losing the human touch

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and creativity (Karaata, 2018) and creating an overreliance on these tools (Popescu and Schut, 2023).

In the analysis phase, AI can assist designers by gathering and processing data to identify design patterns, current trends, and user needs (Shi et al., 2023). During the synthesis phase, AI tools help by brainstorming ideas and generating design concepts based on criteria set by the designer (Shi et al., 2023; Berni et al., 2024). Further, automating repetitive tasks such as image editing and layout adjustments enhances efficiency and allows designers to spend more time on creative tasks (Lin and Liu, 2024; Gallardo-Rodriguez et al., 2023; Furtado et al., 2024). AI can also aid in creating prototypes and visualisations, enabling designers to efficiently experiment with different ideas through various iterations (Shi et al., 2023). AI can be critical in testing and refining design solutions in the evaluation phase. It can assess user interactions and provide feedback on usability and user experience (Shi et al., 2023).

Creativity is defined as "the ability to come up with ideas or artefacts that are new, surprising, and valuable" (Boden, 2007). Human-AI co-creation, describes the use of AI technology in creative processes where humans and AI collaborate and support each other's strengths (Suh et al., 2024). This includes (1) human-AI co-creation, where AI enhances human creativity; (2) human-only creativity, considered a mark of 'true' creativity; (3) blind reliance on AI, leading to plagiarism; and (4) AI potentially diminishing human creativity by undermining individuals' motivation and self-concept of creativity (Ivcevic and Grandinetti, 2024; Vinchon et al., 2023). Due to its increasing use in creative tasks, a shift from human-centred creativity to co-creativity, or "generative synesthesia," a blend of human exploration and AI exploitation (Zhou and Lee, 2024), seems likely (Wingström et al., 2024).

In architectural design, AI is already demonstrating its capacity to revolutionise practice. AI provides extensive data processing capabilities for visualisation and prototype production (Ceylan, 2021; Rane et al., 2023; Li et al., 2024). One example of the potential use of generative AI in architecture is the text-to-image AI tool Midjourney, which finds uses for architectural visualisation. It supports creative thinking by generating images based on prompted keywords for easy and quick visualisation of concepts and spatial ideas (Tan and Luhrs, 2024). However, these generative AI platforms still face difficulties with complex prompts, typically because they lack a deep semantic understanding of the image content (Ploennigs and Berger, 2023).

Several AI integration points in design study curricula, such as design law and ethics classes, design foundation, or material and sustainability, have been identified. However, AI has not yet been incorporated systematically (Schauer and Simbeck, 2024). Key challenges when integrating AI into design education include overcoming the initial learning curve for students unfamiliar with technology, preserving artistic originality within AI-generated templates, and addressing ethical concerns related to authorship and ownership (Omran Zailuddin et al., 2024). An attempt to integrate AI into the architecture curriculum was made as an elective course in two universities (Başarı, 2021). The course emphasised AI's potential to enhance architectural practice and its impact on architectural education (Başarı, 2021).

Given AI's expanding role in design processes it is crucial to examine the AI literacy of design students to tailor higher education curricula to meet the needs of future designers.

3 AI LITERACY

AI literacy describes the skills that empower individuals to critically assess AI technologies, effectively interact and collaborate with AI, and utilise AI as a tool (Long and Magerko, 2020). It requires an understanding of the technical concepts and the ability to apply them in real-world situations and integrate them with other thinking skills, such as creativity and evaluation (Ng et al., 2024). AI literacy and AI education has been extensively investigated at all levels of education, from K-12 (Wang and Lester, 2023) to higher and adult education (Laupichler et al., 2022).

AI literacy assessment instruments are crucial for evaluating the effectiveness of AI education programs and comparing AI literacy across different groups. AI literacy can be split into three main dimensions: *Technical Understanding*, *Critical Appraisal* and *Practical Application* (Laupichler et al., 2023). *Technical Understanding* includes abilities related to AI's data-driven aspects and theoretical foundations. *Critical Appraisal* encompasses skills for ethically evaluating AI, assessing the outcomes of AI applications, and addressing legal concerns. *Practical Application* captures competencies involving the practical use of AI, such as identifying examples of AI applications and determining whether an application uses AI technology. To measure these domains, Laupichler et al. introduced a tool called the "Scale for Non-Experts' Assessment of AI Literacy" (SNAIL) (Laupichler et al., 2023).

Another AI literacy scale proposed by Soto-Sanfiel et al. comprises competencies across four categories: "(1) What is AI? (a: Recogni[s]ing AI, Understanding Intelligence and Interdisciplinarity; b: General vs Narrow AI); (2) What can AI do?; (3) How does AI work?; and (4) How should AI be used?" (Soto-Sanfiel et al., 2024). These categories aim to provide a comprehensive assessment of AI literacy, covering recognition, understanding, functionality, and ethical usage of AI.

The AI literacy of students across disciplines shows a predictable pattern, with engineering students leading in AI knowledge, followed by those in other STEM fields and social sciences (Hornberger et al., 2023). Lérias et al. assessed AI literacy among teachers at a Portuguese Polytechnic university, finding an average score of 3.28 on a 5-point Likert scale, indicating moderate literacy. While proficiency in applying and using AI was relatively high (3.85), significant gaps were found in understanding how AI learns and the influence of data on its behaviours (2.86) (Lérias et al., 2024). This reveals a critical gap in foundational knowledge, even among educators.

AI literacy needs to be promoted also among non-technical audiences (Southworth et al., 2023). The demand for AI skills has increased in most professional fields. However, despite its increasing relevance there remains a notable lack of research on AI literacy within non-technical disciplines, particularly design education. Therefore, in this paper, we will address the following research questions:

- RQ1: What is the level of AI literacy among design students?
- RQ2: Where do design students have "literacy gaps" that must be addressed in higher education?

The general attitude towards AI technologies differs between countries. AI positivity was measured through statements such as "Much of society will benefit from a future full of Artificial Intelligence" and was found to be highest in Finland, followed by Poland, Italy, Germany, Ireland, and France (Bergdahl et al., 2023). Further, feeling competent and connected when engaging with new technologies is linked to more positive attitudes towards them, particularly concerning AI (Bergdahl et al., 2023).

University students' attitudes towards AI have been researched with mixed results. Students appreciate AI's potential for increasing efficiency but were also concerned about its impact on learning quality and academic integrity (Fošner, 2024). Generally, students with a stronger understanding of AI held more favourable views on integrating it into their academic practices. Students with limited understanding were

more apprehensive (Marrone et al., 2022). One study analysed students' attitudes in three categories: cognitive, affective, and behavioural. The affective component, with statements like "AI is related to my life", was ranked highest (Suh and Ahn, 2022), showing a positive attitude towards AI, especially when a connection to the student's personal life can be made. Meanwhile, the cognitive component, with statements such as "I want to work in the field of AI", had the lowest score. Multiple studies have focused on AI attitudes of students in the healthcare and medical field (Yüzbaşıoğlu, 2021; Pinto dos Santos et al., 2019), but a literature gap remains regarding how students in the design field perceive AI. Addressing the literature gap, our paper aims to explore the following research question:

- RQ3: What attitudes do design students have towards AI?

4 METHODOLOGY

An AI literacy survey has been carried out at a university in Germany and Italy. Both student groups filled out a questionnaire to assess their AI literacy. They were first provided text fields to share their general opinions on AI and to specify the AI topics they were most interested in. The qualitative questionnaire was chosen to collect different aspects of AI interests, thereby addressing research questions two and three.

The second half contained items from the SNAIL tool (Laupichler et al., 2023) on a 5-point Likert scale. The questionnaire captures AI competencies, especially for non-technical respondents, and will answer research questions one and two. 15 were selected to focus on the most relevant questions in the *Critical Appraisal* and *Practical Application* categories.

The first survey group consisted of 14 participants recruited from the communication design program at the HTW Berlin University of Applied Sciences. Four of them identified as male and ten as female. They were between 20 and 31 years old. A second group with 13 participants was recruited in the following semester. Here, three identified as male, nine as female and one did not indicate a gender. They were aged between 19 and 29 years.

A second group of participants was recruited from architectural design at the University of Florence. 35 people participated, ranging in age from 21 to 33, and one person being 67. Ten identified as male, 24 as female, and one as non-binary.

5 FINDINGS

The survey results were analysed using a mixed methods approach. Qualitative responses were evaluated using the grounded theory method to identify codes in the recurring responses. Quantitative data were statistically evaluated using the median test to compare the differences between groups and the Levene test to compare variances.

5.1 Communication Design Students

5.1.1 General Opinion on AI

Some participants view AI as a beneficial tool, with several respondents describing it as "very useful". However, there are concerns about the rapid pace of AI development, with one respondent warning that it "can [...] be seen critically" and another emphasising that "what is done with AI and how it is used always depends on human actions". One student remarked, "I'm quite open to the whole topic" while also stating they "often find it overrated. Not every product needs to have AI integrated".

Several respondents see AI as a way to improve productivity and efficiency in various tasks. One participant believes AI is "a helpful tool to speed up work processes", while another states that AI can "greatly simplify our daily lives". Another positive viewpoint is that AI will increasingly gain value in society, and "we should learn to use it and apply it for our well-being". However, the same respondent also acknowledges a downside, predicting that "in the future, our brain structures will change because we will use AI for certain things like writing, calculating, etc".

Concerns about job losses and ethical issues also surface. One participant finds AI "interesting but also scary", particularly regarding potential job losses. Another student states it is "critical in terms of dealing with intellectual property".

5.1.2 AI Fields of Interest

Participants mentioned that they are currently interested in "AI in art/design" and the "use in social and private contexts, impact on society" and "AI in museums". Several participants were particularly interested in the creative and professional applications of AI. For example, "image generation" and "generative AI, AI for supporting everyday applications, artistic implementation/use of AI" were mentioned. Additionally, one respondent expressed a desire to understand "how AI works and how [they] can develop [their] own [AI model]".

The capabilities of AI and its future potential were also common themes. One participant wanted to explore "what AI can do currently and where it can go", "how to use AI efficiently", and "what AI tools are available now". Another participant noted the importance of knowing the "boundaries of AI" and "discrimination within AI", highlighting the need for technical understanding and limitations of AI. In general, ethical and legal considerations were significant topics among the respondents. Many emphasise the "advantages, disadvantages, development, potential", and "perspectives/dangers of AI". One participant specifically mentioned the "development of the legal situation of AI-generated content", indicating an awareness of the evolving legal aspects surrounding AI. Lastly, some respondents focused on the technical parts of AI and data privacy. They expressed interest in "large language models and how they are structured and trained" and "data protection".

5.1.3 AI Literacy

Students feel most confident about giving AI examples from their daily lives, with an average confidence level of 4.5. They also express significant confidence in critically evaluating the implications of AI (4.07) and explaining why data plays an important role (4.15). A moderate confidence level was shown when assessing if a problem in their field can and should be solved with AI methods (3.59) and critically reflecting on the potential impact of AI on individuals and society (3.74). They are also fairly confident in naming examples of technical AI applications (3.93), naming weaknesses of AI (3.78), and identifying ethical issues (4.04). They also feel somewhat less confident in explaining AI's importance (3.67) compared to other areas. The areas where students feel the least confident include describing what AI generally is (3.41), describing legal problems surrounding AI (3.33), telling if the technologies they use are supported by AI (3.22), explaining why humans play an important role in the development of AI systems (3.59), and naming natural language processing/understanding applications (2.48).

5.2 Architectural Design Students

5.2.1 General Opinion on AI

Many students acknowledged AI's general usefulness, with one noting "I like artificial intelligence and I believe it's very useful to the future, especially in our field of work". Similarly, a participant remarked that it could "make some processes faster and easier", while another student emphasised AI's potential

to "change the world, especially in the way of working".

Several students highlighted the importance of adapting to AI as a natural progression. One student stated that it "is a natural consequence of progress" and that people "should learn to live with this new reality and not reject it". Another participant echoed this sentiment, stating that it "is an instrument to make our lives easier and help us to do things faster".

The survey also revealed concerns about AI's impact on society and individual creativity. One student expressed that AI "facilitates the creation of concepts but also limits creativity", and another warned that they might "start to forget to use [their] own mind". Generally, students viewed AI positively, seeing it as a crucial advancement with remarks such as "AI is generally very important and useful both in today's life and in professional experience" and "it is human's future, and AI can dramatically improve human capabilities".

Table 1: Mentions of codes during the qualitative survey of general opinion on AI by communication design (CD) and architectural design (AD) students.

Codes	CD	AD
Helpful/Useful Tool	13	19
Societal Value	1	8
Ethical Issues & Risks	3	4
Future Development	4	3
Limiting Creativity	-	4
Neutral or Mixed Feelings	2	2
Need for Regulation	2	1
Intellectual Property Issues	2	-
Job Loss Concern	2	-

5.2.2 AI Fields of Interest

Some participants emphasised AI's role in creative fields such as architecture and design, with one stating that they "would like to know more about the artificial intelligence linked to construction and architecture" and that it is "interesting also for the world of medicine". This highlights a dual interest in AI's potential applications in both creative and practical domains. Others were intrigued by AI's capabilities in generating and manipulating digital content. For instance, one respondent mentioned how "AI generates images by describing a few words or how AI generates codes", reflecting a curiosity about AI's creative potential in digital arts and 3D modelling applications. Additionally, participants expressed interest in AI's impact on education and its potential to enhance learning processes, noting they are interested "in the application of AI in the museum and [...] education".

Table 2: Mentions of codes during the qualitative survey of AI fields of interest by communication design (CD) and architectural design (AD) students.

Codes	CD	AD
Image, Video & Text Generation	11	9
Art and Design	5	6
Social Impact & Ethical Concerns	8	3
Architecture	-	10
Medical Field	4	5
Technical Understanding	5	4
Automation & Everyday Applications	5	2
Music	4	1
Education & Museums	2	2
Personal Digital Assistant	1	3
Legal Aspects	1	-
Gaming	-	1
3D Modelling	-	1

5.2.3 AI Literacy

The architectural design students demonstrate moderate confidence across different AI competencies. They feel quite confident in explaining why AI has become increasingly important (3.60) and in critically reflecting on the potential impact of AI on individuals and society (3.91).

Students are also confident in giving everyday AI examples (3.40) and naming examples of technical applications (3.63). Students show a fair level of confidence (3.66) when describing risks associated with using AI systems. They feel slightly less confident in assessing AI solutions for problems or (3.31) and explaining the role of data in AI development and application (3.29).

Furthermore, students report confidence in their ability to describe why humans play an important role in developing AI systems (3.69) and in naming weaknesses of AI (3.49). Understanding the potential legal problems that may arise when using AI (3.22), identifying ethical issues surrounding AI (3.14), and their ability to tell if the technologies they use are supported by AI (3.34) are areas where confidence is somewhat lower. The lowest confidence lies in naming natural language processing/understanding applications (3.06).

6 DISCUSSION

The findings indicate that communication design students see AI as a helpful and useful tool (13 mentions) and focused on positive aspects (e.g. increased efficiency), but also mentioned negative aspects (e.g. job losses and intellectual property concerns). Stu-

dents were interested in AI uses in a creative and professional context, such as media and text generation (11 mentions), art/design (5 mentions) and understanding the social impact and ethical implications (8 mentions).

Architectural design students acknowledge AI's usefulness (19 mentions) in speeding up processes and view it as a natural progression of technological advancement while expressing concerns about the impact on creativity and individual thinking (4 mentions), in line with creativity loss found in current literature (Marrone et al., 2022; Barile et al., 2022). Students were positive about AI's societal value (8 mentions) but were aware of ethical issues and risks (4 mentions). They voiced interest in AI's application in architecture (10 mentions) and medicine (5 mentions), as well as the capabilities for generating digital content and texts (9 mentions). This interest highlights AI's potential for architectural design, especially in visualising and prototyping (Ceylan, 2021; Rane et al., 2023; Tan and Luhrs, 2024). Compared to communication design students, they placed less emphasis on ethical and legal issues (3 mentions) and focused more on practical applications in their field.

These differences could be attributed to their field of study (communication or architectural design) or their country of residence (Italy or Germany), as attitudes towards AI tend to be more positive in Italy compared to Germany (Bergdahl et al., 2023).

The results indicate that although communication and architectural design students have similar overall confidence levels in their AI literacy, there are nuanced differences in their specific competencies. Despite the growing importance of AI, they feel only moderately confident in their competencies for critical appraisal and practical application of AI technology. Communication design students expressed high confidence in practical applications of AI, particularly in providing examples of how they use AI technologies. Architectural design students were most confident in reflecting on AI's societal impact, focusing on critical appraisal competencies. This contrasts with their stated areas of interest: communication design students frequently mentioned ethical and societal implications, i.e. critical appraisal and architectural design students focused more on practical applications. This suggests that students might be more interested in learning about areas where they feel less confident, as their curiosity aligns with the knowledge gaps they perceive in their expertise.

Both groups demonstrated the lowest confidence in naming natural language processing (NLP) examples. This points to an overall literacy gap in more advanced AI applications, such as NLP, which may

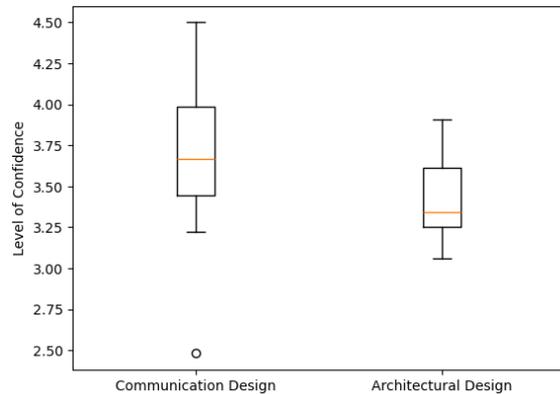


Figure 1: AI literacy survey results with a confidence level of 3.68 for communication design and 3.41 for architectural design.

not yet be integrated into their areas of study or daily lives.

The independent t-test finds no statistically significant difference in the means of the two groups ($p = 0.077$). The result of a Levene's test indicated no statistically significant difference in variances either, with a p-value of 0.117. However, communication design students visibly showed greater variability in their confidence levels (ranging from 2.48 to 4.5), whereas architectural design students had more consistent confidence levels (ranging from 3.06 to 3.91). Compared to architectural design students, who may have more consistent exposure to technical problem solving, communication design spans across different areas such as marketing, digital media, and product design. Therefore, students might have varying degrees of familiarity with AI technologies.

The findings reveal a strong interest among students in applying AI technologies to their design practices, echoing the survey results of Spanish students in business management (Almaraz-López et al., 2023). Both our results and those of Almaraz-López et al. indicate that while AI's impact is undeniable, students' current knowledge is limited, largely due to insufficient education.

Literacy gaps related to legal and ethical issues were identified, as well as a gap in recognising and understanding specific AI technologies. Incorporating AI's ethical implications, legal frameworks, and technical applications within design curricula will enhance students' competencies and align with their expressed interests. This could be integrated into existing design modules, such as design laws and ethics and design technologies taken from an exemplary communication design curriculum in Germany (Schauer and Simbeck, 2024).

7 CONCLUSION

This study examined AI literacy and attitudes towards AI among design students and identified key literacy gaps. Students value AI for enhancing productivity in creative tasks and recognise that AI is transforming design processes. Communication design students focus on the ethical and legal implications, while architectural design students express concerns about AI's impact on creativity and independent thinking. Despite acknowledging AI's significance, both groups demonstrated only moderate confidence in their AI literacy, with notable strengths and weaknesses.

The relatively small sample size restricts the generalisability of the findings. Student self-assessments may not accurately reflect their actual competencies, as confidence and perceptions can bias the results. Furthermore, the SNAIL tool used to assess AI literacy lacks cross-cultural validation (Lintner, 2024). Cultural and institutional differences between universities in Germany and Italy may also influence student perceptions and engagement with AI literacy.

Design students show a clear interest in AI and recognise its importance and potential for change; however, only little research has focused on AI literacy and competencies in non-STEM fields. Our study suggests that these insights could also apply to other creative domains, such as art and media studies, marking an area for future research. Ultimately, enhancing AI literacy among non-STEM students by integrating specific AI competencies into their curricula will ensure that graduates are well-equipped for their professional and creative careers.

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