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IS AI 'JUST' A NEW TECHNOLOGY? ON INTEGRATING AI EDUCATION IN DIGITAL DESIGN CURRICULA

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ABSTRACT
Design schools in digital media and interaction design face the challenge of integrating recent artificial intelligence (AI) advancements into their curriculum. To address this, curricula must teach students to design both "with" and "for" AI. This paper addresses how designing for AI differs from designing for other novel technologies that have entered interaction design education. Future digital designers must develop new solution repertoires for intelligent systems. The paper discusses preparing students for these challenges, suggesting that design schools must choose between a lightweight and heavyweight approach toward the design of AI. The lightweight approach prioritises designing front-end AI applications, focusing on user interfaces, interactions, and immediate user experience impact. This requires adeptness in designing for evolving mental models and ethical considerations but is disconnected from a deep technological understanding of the inner workings of AI. The heavyweight approach emphasises conceptual AI application design, involving users, altering design processes, and fostering responsible practices. While it requires basic technological understanding, the specific knowledge needed for students remains uncertain. The paper compares these approaches, discussing their complementarity.

Keywords: Artificial Intelligence, digital design, interaction design, design education

1 INTRODUCTION
Many design schools struggle with how artificial intelligence should be taught in their curricula. This is particularly challenging for programs with a substantial digital design component, such as media or interaction design. All design schools must incorporate in their curricula novel AI-based design tools, future work processes, new design jobs, and work environments for designers – but interaction design students must also be prepared for a role as (interaction) designers of AI-based systems.
In a way, this is business as usual for digital design schools. In the past two decades, novel technologies have been introduced every couple of years. Schools have had to adapt to the rise of the internet, mobile technologies, embedded media [1], and extended realities (XR), to name a few [2]. However, this time, it seems to be different. Unlike the other technologies, AI is considered a 'system technology'. System technologies are ubiquitous, subject to constant change, and enable complementary innovation [3]. Therefore, AI is expected to have a much more profound impact on the industry than other technologies that have entered the field.
As such, introducing AI has sparked more heated discussions in teaching institutes. Staff in our institute, for example, wonder how much students should know about the underlying technology, whether they need to gain 'hard' knowledge about AI, acquire coding skills, develop a particular attitude towards such technologies or work more on '21st-century skills'. Additionally, the rationales for selecting skills to be taught vary widely. Questions such as whether future students need to be able to conceptualise systems using AI or to what extent conversations with programmers require programming skills lead to fierce debates among the staff. We cannot disentangle all aspects of these discussions in a single paper; many depend on the programs' details, the teaching teams, and other institutional-specific aspects. However, in our experience, it already helps to identify and clarify the fundamental choices that educational teams face. Our aim in this paper is to bring some structure to the debate that is going on in our school and other schools like ours.

2 FOUR WAYS IN WHICH NEW TECHNOLOGIES IMPACT DESIGN EDUCATION

In general, discussions on curriculum design tend to be chaotic and based on staff members' private views rather than a thorough analysis of the changes that warrant curriculum change [4]. Interaction design education is no exception; academic discourse on interaction design curricula tends to focus on generic didactic principles [5], or to favour a very specific approach in response to an external development [6]. Our experience is, however, that creating an overview of external developments can be incredibly helpful to guide curriculum level decision-making. We analysed discussions on the redesign of curricula in Dutch institutions for higher education in The Netherlands and summarised our understanding of those discussions in Table 1 below. It lists the four primary ways, educational staff considered AI to change the work of future interaction designers. Even though all four can be shared under the heading 'impact of AI on design education.', they inherently spark different discussions. Identifying which of the aspects is the focus of a discussion may lead to tidier arguments and swifter closure. We will discuss and illustrate each aspect below.

Table 1. Four ways in which AI could have an impact on digital designers

How design is done	Design Outcomes
Different work processes Designers will use different tools and approaches to design.	*Different interface design challenges or control of AI* Designers will be asked to shape the interactions with AI-based applications.
Different work environments Designers will take on new roles, new companies hire designers, designers work with other people (i.e.) data scientists.	*Different types of applications or capabilities of AI* Designers will be asked to conceptualise novel AI-based applications.

2.1 Different work processes

The first change is not unique to digital design education and relates to the fact that AI-based tools alter designers' work processes. Designers will use generative AI to create content or as a source of inspiration. They might engage in AI-based research of target groups and rely more on data-driven decision-making. Many of these changes already have entered and will continue to enter the workspace. Earlier examples are tools such as Google search and 'context-sensitive fill' in Adobe software. Newer tools are potentially more disruptive to the extent that they inspire worries about how AI might replace design jobs. We believe, however, that cost reductions through AI-based tools translate, at least partly, into increased demand. Nevertheless, students do need to be prepared to increase their efficiency with novel AI tools and to find means to convince others of the added value of their human touch.

Discussions among teaching staff on using AI-powered tools focus on the juxtaposition between craftmanship (artisan work) versus the value of being able to work well with the new tools. They also sometimes touch identity questions: 'what sets me apart as a creative mind who can design beautiful and effective interfaces, if anyone can ask AI to design that as well'. Teachers are aware the landscape of AI tools is constantly changing, so they also want to teach students how to educate themselves on new tools. Finally, students need ways to assert themselves as people who bring more to the table that just someone who works with AI-tools. Not only can this support their value as a designer, but it will also reinforce their self-perceived professional identity.

2.2 Different work environments

If AI is a system technology, it is bound to impact the economic structures in which design takes place. Different companies will feature design in their product portfolio, and design companies will hire people in new roles to solve tasks for clients together with designers. These changes are much more complex to monitor and more challenging to predict than changes in the work processes of existing roles. However, it does seem plausible that the relationship between digital designers and programmers will intensify. IT companies currently identify interaction design as part of their value proposition and, as

such, invest more in-house designers rather than outsourcing design to agencies. Design agencies, in turn, acknowledge that they need more skills in data-driven design and AI to compete with IT companies. For prospective students, this means they need to be prepared to have meaningful and fruitful discussions with data scientists and AI specialists, and they need to be taught processes [7] and models that can cross the epistemic and cultural boundaries between these fields, such as the data-driven feedback loop [8]. A common discussion within our teaching staff is whether learning to code is essential to improve communication between programmers and designers. Although there are valid arguments to include coding – as one teacher put it, 'coding is also a communication skill' – much communication between stakeholders in the development of AI-based systems is not related to actual code. Much more then coding, stakeholder management seems to be essential.

2.3 Different Design Challenges for AI-based applications: interface v. concept design

Whereas the first two developments probably apply to all design fields, the second two are particularly relevant to digital design. For digital designers, AI is not only a means to an end but also a desired outcome of a design activity. In other words, designers may be asked to design AI-based applications - ranging from designing the interface to the entire ai-concept - and different knowledge and skills are needed to prepare design student for these tasks. When engaging in discussions about these skills, in our experience, it is vital to distinguish between front-end design and concept design. Front-end design includes the design of an interface of a system for which the functionality and expected performance of the system is more or less given. The designer's task is to develop an interface that harnesses this functionality in a way that the user can work with it. Most tasks in the industry that focus on front-end design are carried out by bachelor students. In our view, even if schools focus on interface design challenges, they need to consider certain particularities of AI-based applications. We will elaborate on these and our efforts to address them in section 3.

Concept design, in contrast, also includes the design of the system's functionality. This requires a much more thoughtful exploration of an application's technical, economic, and ethical aspects and arguably requires a deeper understanding of the underlying technologies and their limitations. Because we believe that it is the more senior designers who will generally work on this aspect, we teach conceptualising AI-based systems mainly in the Data-Driven Design master program [8]. Nevertheless, in our experience, unpacking the requirements of such roles is also beneficial for bachelor teachers, if only because the contrast with the challenges in interface design brings clarity, also when it comes to designing a curriculum. We will elaborate on this in section 4.

3 THE 'LIGHT' APPROACH TO INTERACTION DESIGN OF AI APPLICATIONS: FOCUS ON CONTROLS OF AI

Many of the design skills that interaction designers are already taught in curricula can be directly transferred to the design of AI-based systems. Human-computer interfaces aim to make a system's functionality accessible for users, and there is no *a priori* reason to expect this goal to be any different for systems based on AI. Below, we list however four considerations that do have an impact on the design process and results.

First, as it is, interaction design is an overlooked area in creating responsible AI. Designers should step up to ensure human agency within AI-based systems [9]. Human action possibilities within such systems determine, to a large extent, whether users feel control over the outcomes of a system and therefore can be held accountable for how they use the systems and its outcomes. Devising such interaction possibilities and using them to increase the accountability of ai-supported human decision-making is a significant developmental area within interaction design of AI-based systems. Students need to be aware of their responsibility and need training in the potential for human agency they could unleash.

Second, while traditional systems, too, need to acknowledge and design for their users' mental models, working for the mental model of AI-based systems is particularly hard. Typically, users build their models upon a mix of signals, thus feeding into a hybrid of how laymen tend to reason about such systems [10][11]. How user interfaces are designed, in turn, impacts this mental model formation [9]. Students should, therefore, know how (1) humans generally reason about AI-based systems, (2) how users may incorporate emerging behaviour of the AI into their mental models, and (3) how interaction designs could course-correct faulty mental models or reinforce helpful ones. Although work on explainable AI gives us some sense of direction [12], more effort is required to support designers' a deep understanding of these mechanisms in order for them to work confidently on AI-systems.

Third, as with other new technologies, novel interaction languages are emerging, specifically tailored to the possibilities that AI-based systems offer. Hekman et al. [13] coined the term *algorithmic affordances* to cover this emerging area of interactions with algorithms. Such interactions go beyond *explainability* and include all ways users could influence (the outcome of) algorithms through interaction possibilities. Students focusing on AI's front end should be familiar with this emerging solution repertoire [14]. Research has shown that beginning designers are empowered by exploring collections of such materials [16][17].

Fourth, interaction design students need to consider the impact of AI within the more extensive work context in which these systems are used. For example, consider the situation where AI-generated credit scores play a role in loan applications. Ethical and interaction design considerations would be pretty straightforward if the credit score were the only indicator in the decision process (assuming the creation of the score is unbiased). However, loan application decisions take many other factors besides credit score into account and reside within a collaborative work environment. Such embedding of an AI-based system in the broader work and decision context is much more complex than simply providing an explanation or an algorithmic affordance for the AI-based component. Students must be trained to consider all aspects of these contexts and how they influence their approach to transparency, explainability, or control [18]. Furthermore, they should confidently be able to test their designs.

4 THE 'HEAVY' APPROACH TO INTERACTION DESIGN OF AI APPLICATIONS: FOCUS ON THE CAPABILITIES OF AI

The conceptual design of AI-based systems encompasses interface design, including algorithmic affordances, but it entails also other design challenges. Some of these are related to the complex settings in which responsible AI systems will be developed. First, many stakeholders are involved in the design of responsible AI, with divergent knowledge and perspectives on the system under design. Designers, being generalists, can take a role in facilitating design-oriented conversations among non-designers, addressing complex questions such as shifting power distributions in the envisioned AI system. More than technical knowledge about the AI system, to play such a role, they need facilitation skills and an overview of different perspectives on and attitudes towards AI and their corresponding limitations and blind spots.

Second, as a concept designer of novel AI-based systems, students must be able to envision such systems. From our experience, students find it quite hard to conceptualise 'intelligence' in novel systems [16]. Their points of reference are human (or animal) intelligence or systems they know well, such as Google or Netflix. Neither suffice as models of artificial intelligence. As a generative concept, human intelligence encourages students to envision systems as other humans, focusing on general rather than special-purpose intelligence. Netflix and Google, in contrast, embody a specific purpose intelligence, but students find it hard to translate these to novel application areas. Even with the help of various AI ideation toolkits [19][20][21], students can get stuck on building a dashboard. As one student proclaimed, 'It has data, so it is an AI-concept'.

Third, designers conceptualising novel AI-based systems need to envision the capabilities of such systems. Apart from finding appropriate metaphors, this entails understanding the characteristics of AI-based systems. Yang et al. [22] suggest two dimensions of AI-based systems that are particularly difficult to design: *capability uncertainty* and *output complexity*. With capability uncertainty, Yang et al. refer to the intrinsic difficulties of estimating the performance of AI-based applications. AI-based systems are typically trained on certain materials but then used in different contexts. For example, face recognition software may perform relatively good in the lab, with fair lighting conditions and 'single face' images, but much worse in the wild, where conditions are different and images to be judged may not even contain a face. The differences between training and usage conditions are inherent to AI-based systems, and designers need to find means to deal with such uncertainties. This should be part of their curriculum. The second dimension is output complexity. Output complexity refers to the situation where human input can lead to many systems' responses, and the designer cannot reasonably envision them all. A classic example is chatbot design, where the diversity of human responses can lead to infinite dialogs that need to be 'designed'. Designers cannot design all possible paths and need more abstract means of exercising control over the emerging dialog.

Although all these challenges require some knowledge of AI, it seems that the conception of AI systems does not necessarily require students to understand the inner workings of AI systems. It does, however, require them to get a sense of their outer workings, whether it be its capability uncertainty, output

complexity, its intelligence characteristics or its embedment in societal systems. These aspects are qualitatively different from the challenges involved in the front-end design of AI- systems.
Discussion among teaching staff on incorporating AI-concept design reveal a varying degree of ethics in the curriculum. While some feel that ethics are taken care of with a course on GDPR and the AI-act, others include psychological aspects of human-AI-teams [15] and ideas like Contestable AI. More marked, however, based on complaints on the lack of originality and the 'AI-ness' of their concepts, students need to receive thorough training in concept development. Experience has shown, furthermore, that students' feasibility assessment (what can AI do now, and when can it reasonably expected to do more?) should also receive attention. Our master students have a hard time estimating to what extent their ideas can be executed.

5 CONCLUSIONS

In this paper, we have examined the impact of AI on digital and interaction design education. Unlike previous new technologies, AI is a system technology [3] with set of unique characteristics that impact design. Interaction design programs need to adapt to these developments. While the field has earlier needed to adapt to technological developments, the advance of AI brings qualitatively different challenges. Much more than in earlier developments, designers need to adapt to uncertainty in the system output: output complexity and capability uncertainty; much more than before, designers need to see how designs impact different sets of stakeholders and how these technologies impact their relations. Although these elements have been at the heart of interaction design from its beginnings, AI -as a development- profoundly steps up both the game's speed and impact.
Discussions on how to accommodate AI in design curricula, as for all curricula redesigns, have been muddled. In our view, it is beneficial for design curricula to distinguish four separate approaches to involving AI, thereby focusing the discussion, the questions, and the potential curriculum interventions better. The four approaches were presented in Table 1, and are reiterated in Table 2, this time supplemented with related discussions and potential curriculum design choices.

Table 2. Common discussions on AI in digital design curricula

Approach	Discussions	Curriculum Interventions
Designing with AI: Different work processes	- Craftmanship vs. user of AI-tools - Identity as a designer - Value of design and dire job perspectives	- Using AI tools critically and efficiently - Assessing and learning new tools - Presenting the value of a human designer
Designing with AI: Different work environments	- Do designers need to be able to code? - Do designers need to master advanced data science techniques? - Is coding a communication skill?	- Introducing specific models that smoothen communication - Co-design strategies are more emphasised - Stakeholder management
Designing for AI: interface design of AI systems (control)	- Are students concept designers or interface designers? - Identity as a designer - What level of ethics? - How do we foster the communication with engineers (data scientists, developers)	- Algorithmic affordances and their impact - Roles of AI (coach, decider, etc.) - Understanding needs of decision contexts and varying roles of AI - User testing on complex constructs such as *trust* - Ethical design
Designing for AI: Concept design of AI systems	- What level of ethics? - Students can/cannot be expected to develop novel AI-concepts - Students have a hard time assessing the feasibility and future developments of AI.	- Ethical design (responsible AI) - Contestable AI - Human-AI collaboration/hybrid teams - Concept development skills, fostered by courses on feasibility assessment, high-level domain and user research, Prospective design

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