THE IMPACTS OF AI ON CREATIVE PROCESSES IN UX/UI PROJECT DEVELOPMENT: A COMPREHENSIVE REVIEW

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Abstract: Artificial intelligence (AI) drives significant advancements in user experience (UX) and visual interface design (UI), leading to greater productivity and efficiency. It provides valuable insights into user behavior, enabling the creation of personalized and efficient interfaces. However, ethical implications of algorithms must be carefully considered, prioritizing responsible and respectful applications. The study conducted an exploratory analysis of literature and examined the impacts of AI on the creative processes of UX/UI projects, revealing a lack of literature on AI in the design process, limited user knowledge, as well as ethical issues and a lack of principles for AI tool implementation in companies.

Keywords: Artificial Intelligence; Design; Creative Processes; User Experience; User Interface.

OS IMPACTOS DA IA NOS PROCESSOS CRIATIVOS NO DESENVOLVIMENTO DE PROJETOS UX/UI: UMA REVISÃO ABRANGENTE

Resumo: A inteligência artificial (IA) impulsiona avanços relevantes na experiência do usuário (UX) e interface visual (UI), gerando maior produtividade e eficiência. Além de fornecer insights valiosos sobre o comportamento dos usuários, permite a criação de interfaces personalizadas e eficientes. Tais conceitos devem considerar as implicações éticas dos algoritmos, no qual devem visar a aplicação responsável e respeitosa. O trabalho se propôs a realizar um estudo exploratório das literaturas e análise dos impactos da IA nos processos criativos de projetos que envolvem UX e UI, que por sua vez apontou escassez de literatura sobre IA no processo de design e conhecimento limitado por parte dos usuários, bem como os problemas éticos e a falta de princípios para aplicação de ferramentas IA nas empresas.

Palavras-chave: Inteligência Artificial; Design; Processos Criativos; User Experience; User Interface.

1. INTRODUCTION

The start of modern Artificial Intelligence (AI) took place in the late 1950s and early 1960s, when researchers like McCarthy (Dartmouth), Minsky (Harvard), Rochester (IBM), and Shannon (Bell Laboratories) began working on algorithms and techniques that enabled machines to "think" and perform tasks autonomously. Since then, the evolution of Artificial Intelligence has revolutionized design workflows, offering new possibilities and targeted approaches to computational tools, which play a crucial role in various stages of User Experience (UX) and User Interface (UI) projects. These stages range from automated content generation to advanced data analysis and market insights[1], enhancing creative[2] and production processes, as well as interaction with the audience through chatbots and virtual assistants.

Since the beginning of the 21st century, technological advancements in the creative sector have enabled artificial intelligence to become an essential tool for creative processes. Considering the transformations in the design fields, gaining a better understanding of creative concepts and processes when utilizing AI in UX/UI creative projects becomes fundamental. In this regard, this study aims to briefly analyze literature related to Artificial Intelligence, particularly concerning its application in the creative processes of UX/UI design. Moreover, the research seeks to investigate the impacts and relevance of this technology for the development of both physical and digital design projects.

Therefore, paper provides a thorough examination of artificial intelligence's effects on the creative aspects of UX/UI design. Through a systematic literature review, it analyzes AI behavior and its impact on digital product projects. It also compiles publications focusing on AI's benefits and support in UX/UI endeavors. The article aims to explore intelligent system possibilities, limitations, and drawbacks in creative processes and user interactions. In addition, the present work is part of the course completion final paper defended in the Technical Course in Multimedia.

1.1. Creativity and Artificial Intelligence

Creativity plays a fundamental role in human evolution, empowering individuals to create and innovate across various fields throughout history. These creative processes have driven significant advancements and have enabled the exploration of an advanced stage of technology, based on artificial intelligence. Web 4.0, in turn, has allowed for the organization of metadata and the customization of content based on user data and interactions, reflecting the changes brought about by these technological trends [1].

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[1] Insights in UX/UI design are discoveries about user behavior, obtained through observation, analysis, and interpretation of data, research, and usability testing.

[2] The creative process is defined by the human capacity to exercise, create, and structure a set of thoughts to give fluency to a specific activity.

> More and more, we have devices and digital interfaces based on interaction with artificial intelligence. Machine learning algorithms perform predictions of content that may interest users. The significant advantage of integrating these algorithms into digital interfaces [...] would be to deliver relevant content to the user without them needing to make choices. This scenario is only possible with large data storage and very fast calculations, but to achieve usability goals, as defined by ISO 9241-11 (1998) - effectiveness, efficiency, and satisfaction [1].

According to Bodegraven [2], AI has directly impacted the development of the design process, altering the way people experience products and services. However, it is necessary to consider the advantages, challenges, and potential drawbacks of computational algorithms, as referenced by Madhugiri [3] in Table 1.

Table 1. Overview of Pros and Cons of AI-based Resources.

Pros	Cons
High accuracy and reduction of human error	Over-reliance on machines, diminishing human abilities and autonomy.
Allows you to automate repetitive tasks in different industries	Need for investment in infrastructure and training, making the application of AI more expensive.
Efficient Big Data Processing	Data privacy and security concerns.
Fast decision making	Creative limitations in challenging situations that require innovative thinking
Improved interaction with customers	Lack of emotional understanding.
Discovery of trends and patterns	Misleading conclusions due to bias in data interpretation and limitations in the models.
Organizes the management of processes and workflows	Lack of flexibility or adaptability of systems.

The importance of computational algorithms in the Creative Industry is evident, especially in the field of UX/UI. Considering the information presented, they play a fundamental role in processing large volumes of data in real-time and automating repetitive tasks, enabling designers to focus on strategic activities such as creating innovative solutions and tackling complex usability challenges. However, it is crucial to emphasize the ethical challenges associated with this technology.

The incorporation of artificial intelligence as a codesigner[3] in the creative processes of UX/UI brings with it the need for tools and software that optimize workflows. In this context, various software tools have stood out by offering features that facilitate the generation of visual ideas, creation of documentation and specifications, and even usability testing. These tools, such as Midjourney, Chat GPT, Designer Plugin (Figma), Zeplin, and Visual Eyes, make activities more agile for professionals. In Table 2, a selection of other software platforms used in the creative processes of UX/UI is presented. This variety of options reflects the growing importance of collaboration between humans and artificial intelligence in this new

[3] *Codesigner refers to an individual or team that actively collaborates in the design process, contributing technical and creative skills to the development of products, interfaces, or solutions.*

working environment, raising relevant questions about the evolution and adaptation of professionals in the face of these transformations in creative processes.

Table 2 - UX Designer Assistant Platforms/Software.

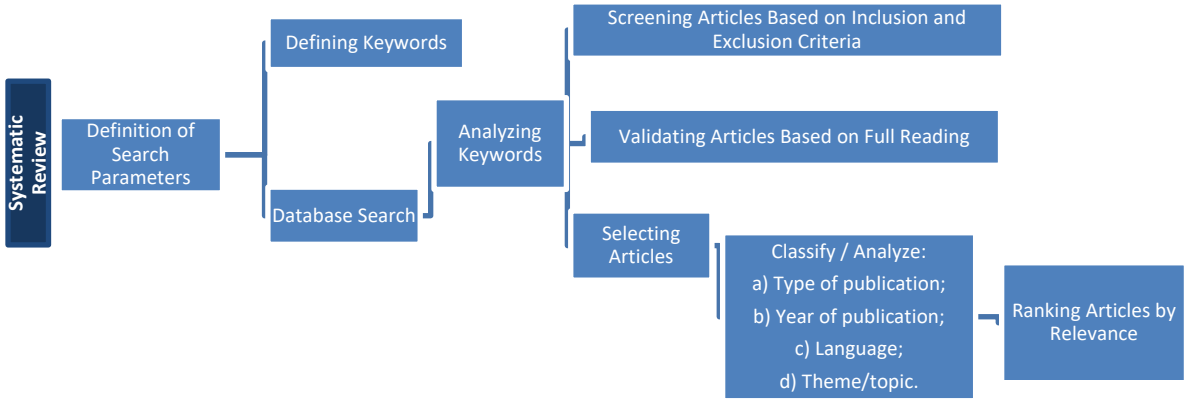
Platforms/Software	Functionality
Adobe Sensei	Automate repetitive tasks and offer suggestions for creative solutions.
Figma Auto Layout	Create flexible and responsive layouts.
Frontify	Develop style guides and manage a company's brand more efficiently.
PageCloud	Create custom and responsive website designs; lets you create designs from scratch or import and tweak existing designs; offers integration with other tools such as Sketch.
The Grid	Create unique and customized website designs, considering the needs of the user.
Plaster	Draw wireframes in a few minutes based on freehand drawings.
Stable Diffusion	Elaborate from custom 3D models.
Sketch2Code	Turn paper drawings into functional user interface prototypes.
Uizard	Generate codes from designs, custom color palettes and automatic creation of images from text transmission.

According to Pengreen [4], algorithms integrated into the user interface offer opportunities for new projects and stimulate the creativity of designers, fueling concepts, styles, and influencing design choices across various platforms. Therefore, it is important to highlight that human creativity and artistic sensitivity are essential in creating innovative products; in this sense, intelligent systems serve as assistants to UX/UI designers, not substitutes.

2. METHODOLOGY

In order to comprehend the current scenario regarding the use of AI in creative processes and its impact on the development of UX/UI projects, the following steps were taken: a) a systematic literature review on artificial intelligence, analyzing its behavior and impacts on the creative processes of UI/UX design; b) compilation of articles and theses containing information about the benefits or assistance of AI in UX/UI projects; c) analysis of the paths to be pursued and/or design foresight. These criteria aim to observe and comprehend information in a holistic manner, analyzing each aspect related to the addressed topic. Based on the set objectives, a flowchart of activities was devised and applied to facilitate better data management, as depicted in Figure 1.

Figure 1. Flowchart of Activities prepared.



The systematic literature review was conducted remotely from February 24th to June 2nd, 2023, using the Google Scholar platform. To ensure the quality of the results, inclusion and exclusion criteria were established for the selection of materials, as outlined in Table 3 below:

Table 3. Exclusion and Inclusion Criteria.

Exclusion Criteria	Inclusion Criteria
a) Duplicate or unavailable publications; b) Publications that are not in the languages Portuguese, English or Spanish; c) Publications of case studies and dissertations; d) Targeted AI publications with technical contexts; e) Publications for other areas of design; f) Publications prior to the year 2019.	a) Publications in the following languages: Portuguese, English or Spanish; b) Publications involving artificial intelligence analysis in the creative processes of the creative area (*Design*); c) Publications involving artificial intelligence analysis in creative processes and impacts on UX/UI projects; d) Publications containing the keywords: human intelligence, AI, creative processes, UX and UI. e) Studies published between the years 2019 and 2023.

3. RESULTS AND DISCUSSION

The systematic study of the literature analyzed 432 publications, resulting in 30 valid articles, of which 13 were included in the study corpus, while 17 were excluded, resulting in 7 studies for analysis and construction of this review. Below is Table 4 with the list of the main 7 publications in this study and the summaries of the analyzed articles.

Table 4. Analyzed Articles.

Author(s)	Article Title	Topic/Person
Ferreira (2023)	Artificial Intelligence in Communication Design in Portugal: Overview and Perspectives	Artificial Intelligence and Communication *Design* / Design students and professionals
Ruiz & Quaresma (2021)	Innovation with Data: The user experience with systems based on Artificial Intelligence	Reflection on the impacts on the user experience with the insertion of AI algorithms in interfaces/UX, *design* and users
Ruiz & Quaresma (2022)	The involvement of the UX designer with artificial intelligence projects: recommendation system	Understand the involvement of the UX *Designer* in the process of development of recommendation systems based on AI / UX *designer*
Boechat (2019)	Artificial intelligence, empathy and inclusion: a design problem	User interaction with AI tools
Dasgupta. et al (2023)	A Review of Generative AI from Historical Perspectives	History of generative AI computer engineers/scholars or related fields
Huang et al (2018)	Gesture-based system for next generation natural and intuitive interfaces.	Gesture-based system for natural and intuitive interfaces - Users
Carvalho (2020)	Artificial and the Perspectives of the World of Work from the World of Work	Artificial intelligence, industry 4.0 and the labor market.

After analyzing the selected studies, significant gaps were identified in the creative process in the UX/UI area, including the scarcity of works on the use of AI in design, absence of content on AI-based technologies in design courses, limited knowledge about the potential and limitations of artificial intelligence, ethical and liability issues related to tools based on AI algorithms and the lack of adoption of these tools by companies. On the other hand, the appreciation of UX designers in the creation of innovative services and systems was evidenced, with a user-centered approach and creativity, in addition to the relevance of these instruments for the development of natural and intuitive systems and interfaces, aiming at a better interaction with users.

Considering the significance of these addressed gaps, it is noteworthy to emphasize that the integration of computational algorithms in UX/UI design is seen as a revolution in user experience, providing improvements in usability, efficiency, and satisfaction through dynamic personalization, predictive and automated interactions, as well as advanced features. However, this technological transition raises questions about the impact on creative processes and the activities of designers.

Many discussions have arisen after the integration of intelligent systems into creative workflows. In this regard, how can we ensure that AI acts as a co-designer rather than replacing human intervention in UX/UI projects? According to Holzinger, cited in Ruiz & Quaresma [5], it is essential to combine HCI (Human-Computer

Interaction) and KDD (Knowledge Discovery/Data Mining)[4] in ML projects, integrating the user perspective with artificial intelligence to enhance the outcomes. Yang [6] also points out that designers lack practice, knowledge, and appropriate tools for projects involving machine learning (ML).On the other hand, UX/UI designers face the challenge of working together with machines, understanding their capabilities and limitations, and integrating deep learning algorithms into their creative processes. Transparency and explainability of intelligent systems are essential to build trust with users and establish AI as a reliable partner. Moreover, AI's ability to adapt digital interfaces to individual needs can be a significant breakthrough for accessibility.

Nevertheless, it is important to address the ethical and practical challenges associated with this use. In this context, what are these challenges, and how can we confront them in an ethical and responsible manner? One concerning aspect, as highlighted by Ruiz & Quaresma [5], is that most UX/UI designers are unaware of the existence of interaction principles with AI published by market institutions, such as the "Google AI Principles" (Google PAIR AI Principles, 2019) and the "Beijing AI Principles" (Beijing AI Principles, 2019), among others. Therefore, it is essential to increase awareness and promote responsibility in the use of AI, taking into consideration both its positive and negative implications. It is crucial for designers, institutions, and governments to explore and address the ethical and practical challenges associated with AI to ensure ethical and inclusive benefits.

Regarding the prospects for UX/UI designers with AI integration, as well as the evolution of creative processes for user experience and user interface, Sam Anderson from Intuit[5] and Andrew Hogan from Figma consider that the involvement of intelligent systems in UX/UI tasks will not replace the role of human designers but rather complement it [7]. The creation of roles like HCML[6] (Human-Centered Machine Learning) and DLUX[7] (Design for Machine Learning User Experiences) underscores the importance of designers' participation in the selection and adjustment of production models [8].

With the continuous progress of artificial intelligence, new opportunities are emerging in the field of UX/UI, unveiling new potentials for use in all stages of the design process. This evolution empowers designers to create exceptional and impactful user experiences, driving innovation in interface design.

4. CONCLUSION

The study on the impact of artificial intelligence on the creative processes of UX/UI projects identified gaps, such as the lack of research on the use of AI in design, limited knowledge about its potential and ethical issues, and the appreciation of UX/UI in creating innovative user-centered services, with intelligent systems as partners for more natural and intuitive interfaces. It is crucial to disseminate knowledge about

[4] KDD (Knowledge Discovery/Data Mining) is the process of extracting valuable information and useful knowledge from large datasets.
[5] Intuit Inc. - an American company specialized in computer software development.
[6] Human-Centered Machine Learning - is a machine learning approach that prioritizes the involvement and consideration of human factors in the design and development of algorithms and models.
[7] Design for Machine Learning User Experiences - designs intuitive and reliable interfaces that enable users to interact with machine learning systems.

intelligent systems in design, with responsibility and ethics in adopting this technology. The integration of AI promises enhanced personalization, automation, and collaboration among teams, with designers focusing on solutions that provide exceptional experiences to meet individual needs in a constantly evolving digital world.

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