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Data and Artificial Intelligence as Design Material in Digital Health: Methodological Challenges and Interdisciplinary Design Practices

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Abstract: ***The development of artificial intelligence and data analytics technologies has radically transformed the nature of digital product design, particularly in the field of Digital Health. In modern medical systems, data and machine learning algorithms increasingly act not merely as supporting tools but as full-fledged design materials that shape interaction logic, how information is interpreted, and user decision-making. The behavior of such systems is determined by probabilistic models trained on historical and streaming data, which fundamentally distinguishes them from traditional deterministic digital interfaces. However, integrating artificial intelligence into design processes is accompanied by significant methodological and practical challenges: high technological complexity, the immaterial nature of data as a design material, limited prototyping capabilities, and communication gaps between designers, data specialists, and clinical experts. In the context of Digital Health, these challenges are further intensified by requirements related to safety, responsibility, interpretability, and trust, as design errors may have direct clinical consequences. This article examines the concept of data and artificial intelligence as design materials based on an analysis of existing research in HCI, UX, data studies, and industry practices in AI system design. Special attention is given to the specificity of Digital Health as a high-risk domain. As a result, a structured methodological framework is proposed, describing the properties of data and AI as materials and enabling more sustainable interdisciplinary design practices for digital medical systems.***

Keywords: artificial intelligence, data as design material, Digital Health, UX, machine learning

1. Introduction

The digital transformation of recent decades means interactive system design now increasingly relies on large datasets and artificial intelligence algorithms. Unlike traditional digital products, the behavior of such systems is determined not by fixed interface logic but by probabilistic models trained on historical and real-time data. These models can adapt, evolve over time, and demonstrate behaviors that are not always directly controllable by the designer.

This logic stands out in Digital Health. Here, patient data, sensor measurements, clinical indicators, and predictive models all directly influence user experience, clinical decisions, and trust in the system. In this context, the interface ceases to be merely a visual layer and becomes a mediator between complex computational processes and human perception. The designer no longer works only with form and navigation but participates in shaping how medical information is interpreted, what decisions the system supports, and where the boundaries of automation lie.

In the classical UX paradigm, data was primarily used as a source of insights for design decisions. It was analyzed during the research phase and then transformed into requirements, scenarios, and interface solutions. However, with the spread of artificial intelligence, data and algorithms become an active component of the designed experience. They generate recommendations, automate the interpretation of medical information, and mediate interactions between patients, doctors, and digital systems.

In this context, it becomes necessary to consider data and artificial intelligence not only as technological infrastructure but also as design material with its own properties, constraints, and expressive potential. This shift requires a reconsideration of traditional design approaches, tools, and roles within interdisciplinary teams.

The literature considered in this article was selected based on relevance to HCI, UX design, data studies, and interdisciplinary collaboration in AI-driven systems. Priority was given to peer-reviewed publications, foundational theoretical works, and recent studies reflecting current industry practices.

The goal of this article is to systematize existing approaches to understanding data and artificial intelligence as design material, identify key methodological challenges faced by designers in industrial and medical contexts, and propose a conceptual framework that supports more meaningful integration of AI into the design processes of Digital Health systems.

2. Related Research and Theoretical Context

2.1 Data as Design Material

The idea of viewing technology through the lens of material has deep roots in design theory and HCI. Classic works emphasize that design knowledge is formed through a “reflective dialogue with the material, ” where the material responds to the designer’s actions and shapes further decisions. In physical design, such material consists of

tangible substances; in digital design, interface elements and interactive states serve as the material.

In the case of data and AI algorithms, this dialogue becomes mediated, delayed, and often opaque. The designer does not interact directly with the material but encounters its manifestations through metrics, visualizations, statistical indicators, and model behavior. This radically changes the nature of design activity and complicates decision-making processes.

Research in HCI highlights that machine learning and AI differ fundamentally from previously studied digital technologies. Their behavior is not fully deterministic, depends on the quality and structure of data, and changes as models are retrained. As a result, data and AI act as unstable, probabilistic, and difficult-to-predict materials for design.

2.2 Industrial Challenges of Working with Big Data

Analysis of industry practices shows that working with large datasets often brings technical complexity and structural challenges. These include fragmentation of data across departments, limited access to infrastructure, and the absence of unified frameworks for collaboration between designers and data specialists.

Under such conditions, designers are often excluded from early stages of AI solution development and become involved only at the stage of adapting interfaces for ready-made models. This shifts the role of design toward visual explanation of decisions made at the level of data and algorithms and reduces the potential of design to influence system logic.

2.3 Artificial Intelligence and Interdisciplinary Collaboration

A separate body of research focuses on interaction between designers and data specialists. These works show that key problems lie not so much in the level of individual expertise as in the absence of a shared language, aligned practices, and common artifacts. User goals defined by designers are not always correctly translated into model metrics and parameters, and the outputs of AI systems are often difficult to interpret and properly integrate into the user experience.

3. Data and Artificial Intelligence as Material in Digital Health

3.1 Specific Nature of Digital Health

Digital Health represents a unique context in which the properties of data and artificial intelligence are most clearly expressed. Medical data is sensitive, heterogeneous, and context-dependent. It includes structured indicators, unstructured data, and real-time information collected from sensors and wearable devices.

Errors in interpretation or visualization of information may lead not only to degraded user experience but also to real clinical risks. Therefore, design in Digital Health is inseparable from issues of responsibility, algorithm explainability, confidence levels, and boundaries of automation.

3.2 Material Properties of Data and AI

This article examines data and artificial intelligence through four interrelated aspects: semantic, qualitative, algorithmic, and experiential. These aspects help describe how data and AI function as materials in the design process and how they manifest within the user experience.

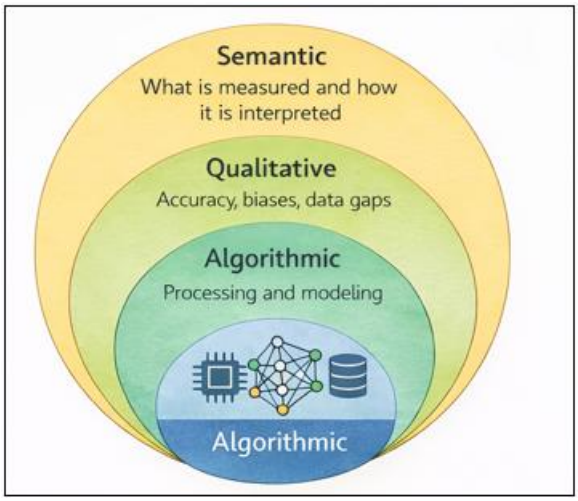

Figure 1: Layers of Data and AI Materiality in AI Health Design

4. Methodological Challenges of Designing with AI

4.1 The Problem of Understanding and Interpretation

One of the key challenges is the limited understanding designers often have regarding the capabilities and limitations of artificial intelligence. This leads either to inflated expectations about automation or to excessive caution in designing AI-based features. In both cases, the quality of the user experience and the level of trust in the system suffer.

4.2 Prototyping Limitations

Prototyping AI systems requires access to data, models, and computational resources, which makes it difficult to use traditional fast-iteration design approaches. As a result, designers are forced to work with abstractions, simulations, or simplified scenarios that do not always reflect real system behavior.

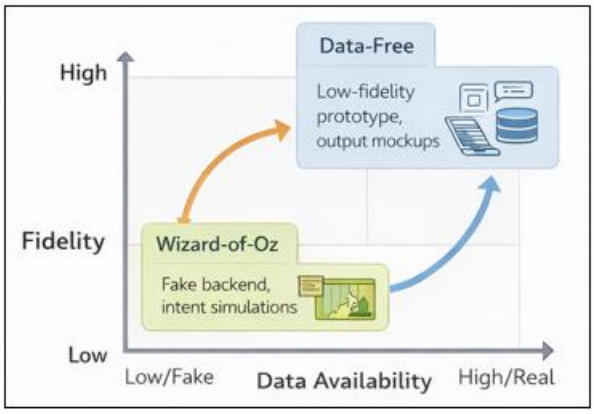

Figure 2: Typology of AI prototyping Approaches in Design Process

4.3 Interdisciplinary Coordination

The absence of stable collaboration practices between designers, data specialists, and clinical experts leads to fragmented decisions and reduced quality of the final product. This is particularly critical in Digital Health, where communication failures can have systemic consequences.

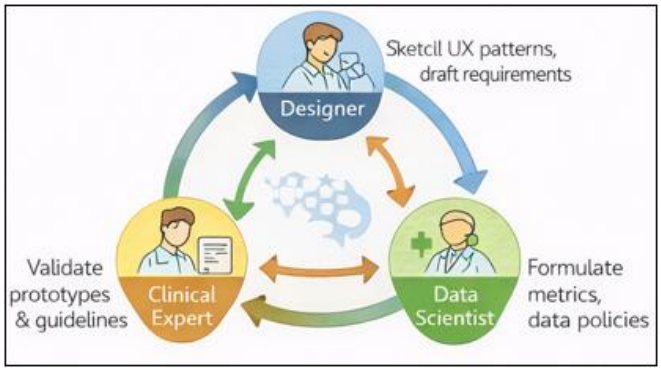

Figure 3: Cycle of Interdisciplinary in AI system Design for Digital Health

4.4 Implications for Design Practice

Viewing data and artificial intelligence as design material allows the formulation of several practical implications. Design should be involved in the early stages of working with data, participate in defining model quality criteria, and contribute to the design of explainability and feedback mechanisms.

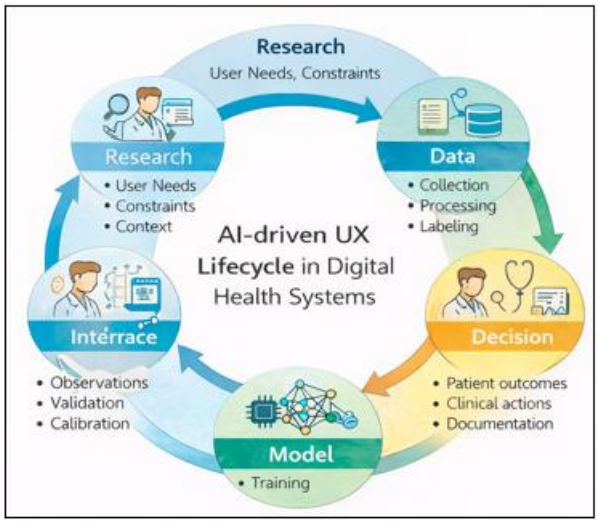

Figure 4: AI- driven UX lifecycle in Digital Health Systems

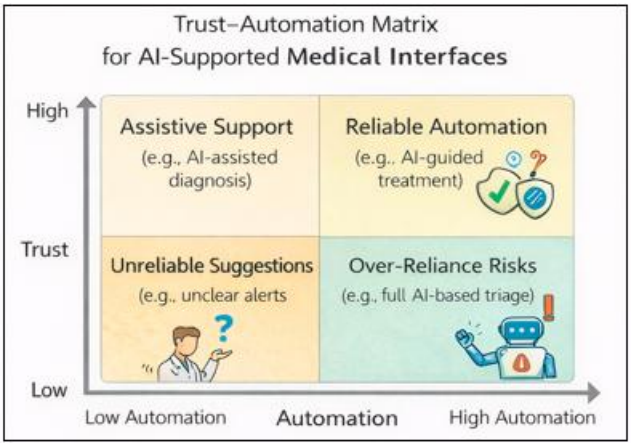

Figure 5: Trust- Automation for AI- supported Medicinal Interfaces

5. Discussion

Considering data and artificial intelligence as design material offers a new perspective on the role of design in digital medical products. Instead of adapting interfaces to ready-made algorithms, design becomes part of shaping the logic of AI systems, their interpretation, and their integration into practice.

The proposed framework expands existing approaches described in UX and data-driven design research and adapts them to the conditions of Digital Health. It demonstrates that a shift from a technology-centered approach to a material-centered approach helps reduce the gap between user needs and the capabilities of artificial intelligence.

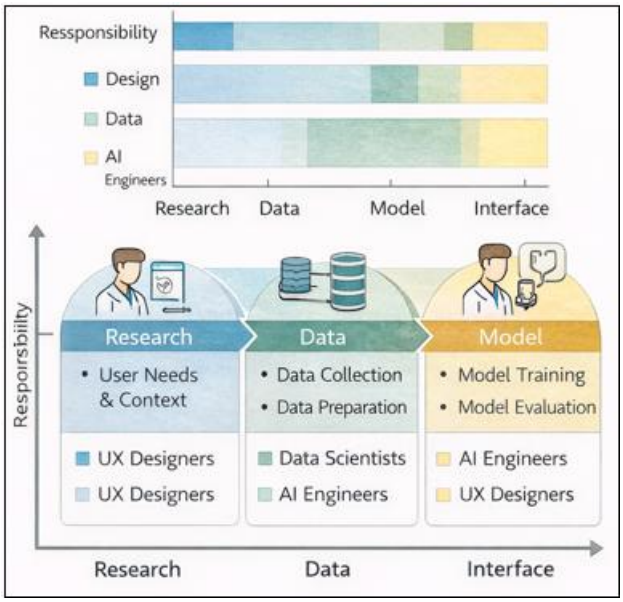

Figure 6: Distribution of Design responsibilities across the AI pipeline

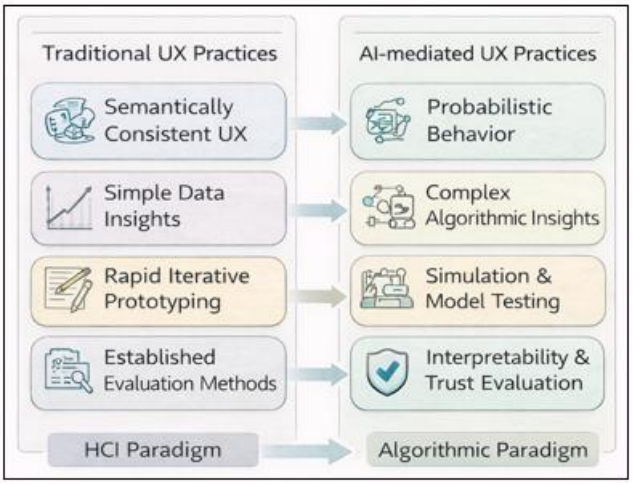

Figure 7: Comparison of Traditional UX and AI- mediated UX practices

6. Conclusion

This article demonstrates that data and artificial intelligence in Digital Health should be considered full-fledged design materials with specific properties that require a reconsideration of traditional design methods. The integration of AI into design processes involves methodological, organizational, and ethical challenges that can be addressed only through the development of interdisciplinary practices and new conceptual frameworks.

The proposed methodological framework may serve as a foundation for further research and practical tools that support designers working with artificial intelligence at early stages of system development. Future research may focus on empirical validation of the model in real Digital Health projects and on developing tools that promote more transparent and responsible integration of AI into user experience.

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