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RESEARCH ARTICLE

Participatory Design Thinking: A User-Centered Approach to Computer Science Innovation

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ABSTRACT

Traditional design thinking, while valuable, has limitations in user involvement. This paper proposes Participatory Design Thinking (PDT), a novel approach that addresses these limitations by placing users at the core of the entire design process in computer science (CS) projects (2). In this study, the shortcoming of traditional design thinking in user centricity was discussed and core principles and benefits of PDT are presented. Then, the practical implementation of PDT in CS, including user selection, training, and integration throughout the design stages were investigated. Finally, the potential impact of PDT on CS innovation and propose directions for future research were explored.

Keywords: Computer Science (CS), Design Thinking, Participatory Design Thinking (PDT), User-Centered Design.

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1. Introduction

Developing innovative solutions in computer science (CS) requires a deep understanding of user needs. Design thinking has emerged as a popular methodology to achieve this goal [1]. Brown argues that design thinking fosters user-centered innovation [1]. However, traditional design thinking can be criticized for its limited user involvement. Users are often consulted in the initial "empathize" stage and the final "test" stage, but not actively involved in the crucial stages of defining the problem, ideating solutions, and prototyping, which are considered to be more technical stages of the design thinking process [1]. This limited user engagement can lead to solutions that miss the mark on user needs and preferences [1].

This paper introduces *Participatory Design Thinking (PDT)* as a novel approach that addresses these limitations [2]. PDT emphasizes user involvement throughout all stages of the design thinking process, fostering a deeper understanding of user needs and leading to more user-centered solutions in CS innovation [2].

2. Critique of Traditional Design Thinking in CS

Traditional design thinking offers a valuable framework for user-centered design. However, in the context of CS, several limitations can hinder its effectiveness:

- *Limited User Involvement*: Users are often brought in at the beginning and end of the process, neglecting their valuable insights during crucial stages of problem definition, ideation, and prototyping. As highlighted in Fig. 1, targeted users are involved primarily in the empathy and testing stages [3]. This means their involvement in the development process, which is intended to directly impact them, is significantly limited [3].
- *Linear Progression*: The linear structure of design thinking can be inefficient. Lack of user input early on can necessitate revisiting earlier stages, leading to wasted time and resources [3]. Proponents of design thinking, especially in the design field, argue that it is a non-linear process, allowing for movement between stages, such as shifting from testing back to ideation [4]. However, this perspective overlooks the fact that users of design thinking cannot skip critical stages like prototyping and then return directly to testing. The process typically follows a sequence: empathize, define, ideate, prototype, and test. Users of design thinking cannot simply empathize with users, jump to prototyping, and then backtrack to defining the problem. Therefore, despite claims to the contrary, design thinking is fundamentally a linear process [4].
- *Users as Consultants, Not Collaborators*: Traditional design thinking positions users primarily as information sources, not active collaborators in the

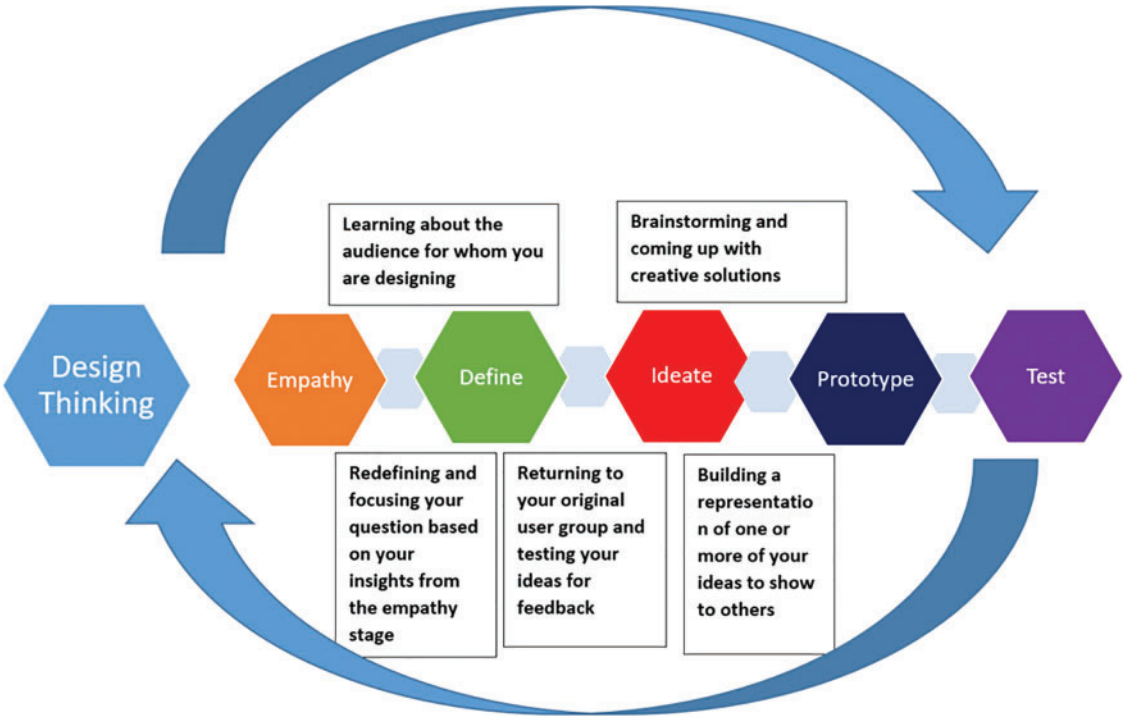

Fig. 1. Design thinking process.

design process [4]. This can result in solutions that are engineer-driven and biased rather than truly user-centered. These limitations highlight the need for a more user-centric approach to design thinking in CS [4].

These limitations highlight the need for a more user-centric approach to design thinking in CS.

3. Participatory Design Thinking: A User-Centered Approach

Participatory Design Thinking (PDT) addresses the limitations outlined above by placing users at the heart of the entire design process. Here are its core principles:

- *Increased User Involvement*: Users are actively involved in all stages of participatory design thinking, as highlighted in Fig. 2, from empathizing with the problem to testing and refining solutions. Although users who don't have a technical background may not fully grasp the technicalities involved in CS, when explained in a way they can understand, their insights are invaluable at every stage.
- *Representative User(s)*: Representative user(s), chosen to reflect the diversity of the target audience, are integrated as part of the design team, as seen in Fig. 2. This allows the design process to truly be user-centered.
- *Immediate Feedback*: User feedback is obtained during prototyping stages, allowing for faster iterations and adjustments based on user needs. Testing is done on a wide user base to validate the insights of the representative user(s).

4. Benefits of Participatory Design Thinking in CS

Implementing PDT in CS projects offers several advantages:

- *Improved Solution Relevance:* Solutions are more likely to meet user needs and gain acceptance from the target audience due to the extensive involvement of users throughout the entire process. This ensures that the solutions developed are inspired by and resonate with them.
- *Reduced Time Consumption:* Immediate user feedback during prototyping and testing accelerates iterations, minimizing development time. PDT also prioritizes user-desired ideas over technical team biases, ensuring relevance and user-centricity. This approach addresses the time-consuming flaw of consulting users traditionally observed in design thinking, as users are integrated into the team process, and feedback is immediate.
- *Increased User Buy-in:* Users who are actively involved in the design process are more likely to feel invested in the final solution, leading to greater user(s) buy-in and adoption and better Human-computer Interactions.
- *Enhanced Innovation:* PDT fosters a more creative and collaborative environment, potentially leading to more innovative solutions in CS. Thus bolstering Human-computer Interactions.
- *Cost Saving:* PDT's efficiency leads to long-term cost savings on projects.

5. Implementing Participatory Design Thinking in CS

Successfully implementing PDT in CS projects requires careful consideration of several factors:

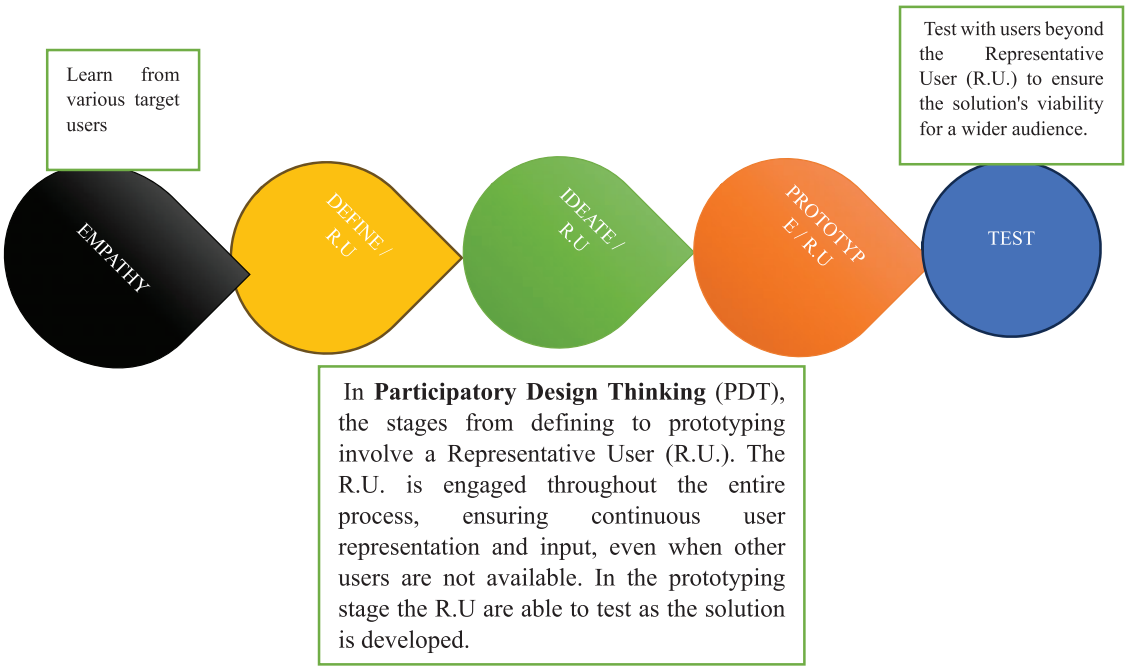

Fig. 2. Participatory design thinking process.

- *User Selection:* Choosing representative users is crucial. Users should reflect the diverse needs and perspectives of the target audience.
- *User Training:* Providing users with some training on the design thinking process helps them understand their role and contribute more effectively.
- *Integration Throughout Stages:* Developing methods to effectively integrate user input throughout all stages of design thinking is essential. This might involve workshops, brainstorming sessions, and user feedback mechanisms during prototyping and testing.

6. Future Research Directions

PDT presents a promising approach for user-centered design in CS. Future research can explore the following:

- *Evaluation Frameworks:* Developing robust frameworks to evaluate the effectiveness of PDT in different CS contexts.
- *Tool Development:* Creating tools and platforms specifically designed to facilitate user participation in all stages of the CS design thinking process.
- *Case Studies:* Documenting case studies of successful PDT implementations in various CS projects to showcase the real-world benefits of this approach.

7. Conclusion

Traditional design thinking, while valuable, has limitations in achieving true user centricity.

Participatory Design Thinking (PDT) addresses these limitations by involving users throughout all stages of the design process. Implementing PDT in CS projects can lead to more relevant, user-centered solutions, increased innovation, and greater efficiency. Future research and practical implementations will further elucidate the benefits and challenges of this approach, paving the way for more user-centered innovation in computer science.

Conflict of Interest

The author(s) declare that they do not have any conflict of interest.

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