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Designing Inclusive Companion Robots to Mitigate Bias and Enhance Empathy in AI-Driven Care Systems

Karnawati[1], Dwi Nur Ramadhan[2], Tiurida Lily Anita[3], Risma Nurmala[4], Lily Maria[5*]
[1]Department of Management, State University of Semarang, Indonesia
[2]Pandawan Group, Indonesia
[3]Faculty of Digital Communication and Hotel Tourism, Bina Nusantara University, Jakarta
[4]Bank BRI, Indonesia
[5]Pandawan Incorporation, New Zealand
[1]karnawati@students.unnes.ac.id, [2]dwi.nur@raharja.info, [3]tiurida.anita@binus.ac.id, [4]risma.nurmala@raharja.info,
[5]evans@pandawan.ac.nz
***Corresponding Author**

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ABSTRACT

This study adopts a qualitative research approach using a semi-structured interview design. Data were collected from individuals with diverse physical, sensory, and cognitive disabilities who have prior experience interacting with AI-based care technologies. **The data were analyzed** using thematic analysis to identify recurring patterns and key experiential dimensions related to ethical perception, inclusivity, trust, emotional support, and well-being. The findings reveal that ethical AI design, particularly in terms of transparency, fairness, and privacy, plays a crucial role in fostering user trust and a sense of security. Inclusive design features, such as accessibility, adaptability, and personalization, were found to enhance user comfort, independence, and emotional engagement. **Furthermore, emotional** support emerged as a central theme, indicating that users perceive AI care agents not only as assistive tools but also as sources of psychological reassurance and companionship. This study contributes to the growing body of human-centered AI research by providing qualitative insights into how ethical and inclusive design principles shape meaningful user experiences and well-being outcomes among people with disabilities. **The findings** highlight the importance of integrating humanistic values into AI care development to promote equitable, responsible, and sustainable digital care solutions.

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1. INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has significantly transformed healthcare and assistive technology ecosystems, creating new opportunities to enhance independence, accessibility, and overall quality of life for people with disabilities [1]. AI care agents are intelligent systems capable of providing assistance, monitoring, communication support, and emotional interaction, and are increasingly implemented in both institutional and home-based care environments [2, 3]. These technologies offer substantial benefits, including reducing caregiver burden, supporting daily living activities, and facilitating social participation. As AI systems become more integrated into care infrastructures, their role extends beyond functional support

toward shaping broader user experiences and well-being outcomes [4].

However, alongside these technological advancements, important ethical and inclusivity concerns have emerged, particularly regarding how such systems affect autonomy, dignity, and psychological well-being among vulnerable populations. Despite the growing adoption of AI-driven care systems, many existing solutions prioritize technical efficiency and functional performance over ethical responsibility and inclusive usability [5, 6]. Issues such as algorithmic bias, opaque decision-making processes, limited accessibility features, and insufficient personalization mechanisms may unintentionally reinforce digital exclusion [7]. These concerns highlight the necessity of critically evaluating AI care agents not only for what they can do, but also for how they affect users in meaningful social and emotional ways [8].

For people with disabilities, who represent a heterogeneous population with diverse physical, sensory, and cognitive needs, design limitations can significantly influence trust, acceptance, emotional comfort, and long-term engagement with AI technologies [9]. Inclusive and ethical shortcomings may weaken user confidence and reduce perceived autonomy, thereby limiting the intended benefits of assistive AI systems. Consequently, there is an urgent need to examine AI care agents through an ethical and inclusive design lens that foregrounds human-centered outcomes rather than focusing exclusively on performance metrics [10].

Existing literature has conceptually emphasized ethical AI principles such as transparency, fairness, accountability, and privacy protection, alongside inclusive design principles including accessibility, adaptability, and multimodal interaction [11]. While these dimensions are widely discussed in normative and theoretical frameworks, empirical qualitative evidence demonstrating how ethical and inclusive design features shape user trust, technology acceptance, emotional support, and well-being outcomes remains limited, particularly within disability contexts [12]. Many prior studies concentrate on usability testing or exploratory qualitative insights, leaving a gap in in-depth interpretive research that explains how these design dimensions are experienced and constructed by users in real-life contexts [13, 14].

This study addresses this gap by developing a qualitative research framework that integrates Ethical AI Design and Inclusive Design Features as key experiential dimensions influencing User Trust, Technology Acceptance, and Emotional Support, which subsequently contribute to Humanistic Well-Being among people with disabilities [15]. Through an interpretive and thematic analysis of user experiences, this research provides rich, contextualized insights into how ethical and inclusive AI design shapes meaningful interactions and well-being outcomes. Furthermore, the study aligns with broader global development priorities, particularly Sustainable Development Goals (SDGs) 3 (Good Health and Well-Being), SDGs 10 (Reduced Inequalities), and SDGs 9 (Industry, Innovation, and Infrastructure), thereby contributing to responsible digital transformation and the development of compassionate, equitable, and sustainable AI-driven care ecosystems [16].

2. LITERATURE REVIEW

This section presents the theoretical and conceptual foundations underlying the study by synthesizing prior research on ethical AI design, inclusive technology, and AI care agents in relation to humanistic well-being [17]. The review aims to identify key principles, recurring themes, and research gaps that explain how artificial intelligence influences user experiences, particularly among people with disabilities. These perspectives provide the conceptual grounding for understanding how ethical and inclusive design dimensions shape trust, emotional responses, and perceived well-being [18].

2.1. Ethical AI Design

Ethical AI design emphasizes transparency, fairness, accountability, and privacy protection as core principles in systems that interact directly with users. These principles are particularly critical in care-oriented applications, where algorithmic decisions may influence autonomy, safety, and dignity [19]. In disability contexts, ethical shortcomings such as algorithmic bias, opaque decision-making processes, and inadequate data protection mechanisms may undermine user trust and reinforce social marginalization.

The absence of explainability can also create uncertainty, limiting users' sense of control and confidence in AI systems [20]. To address these challenges, ethical by design approaches advocate embedding human values throughout the entire system development lifecycle from data collection and model training to deployment and monitoring ensuring responsible and trustworthy AI-enabled care environments [21, 22].

2.2. Inclusive Technology and Disability

Inclusive design theory focuses on developing systems that accommodate diverse physical, sensory, and cognitive needs through accessibility, adaptability, and multimodal interaction. Rather than assuming a standardized user profile, inclusive technology frameworks promote flexible interfaces, customizable interaction modes, and compatibility with assistive tools to ensure equitable access [23, 24]. Previous studies indicate that inclusive features enhance autonomy, usability, and long-term engagement by reducing functional barriers. However, many AI care systems still rely on uniform interaction models that fail to reflect user diversity [25], potentially limiting their effectiveness for individuals with varying impairments. This limitation highlights the need for adaptive systems capable of responding to heterogeneous user needs and contextual conditions [26, 27].

2.3. AI Care Agents and Humanistic Well-Being

AI care agents are increasingly recognized not only as assistive tools but also as socio-emotional systems capable of providing companionship and psychological reassurance. Research in affective computing suggests that conversational interaction, empathetic responses, and adaptive feedback mechanisms can enhance users' comfort and perceived support [28]. These affective dimensions are essential components of humanistic well-being, particularly in contexts where individuals with disabilities may experience social isolation or limited mobility. Nevertheless, concerns remain regarding over-dependency on automated systems, reduced human interaction, and ethical boundaries in emotionally responsive technologies [29]. Based on this conceptual foundation, this study explores how users interpret and experience ethical and inclusive AI features in relation to trust, emotional comfort, and perceived well-being, while aligning with broader development priorities reflected in SDGs 3, SDGs 9, and SDGs 10 [30, 31].

3. RESEARCH METHOD

This section describes the methodological approach employed to explore how ethical and inclusive design features of AI care agents shape user experiences among people with disabilities [32, 33]. It outlines the research design, participant selection, data collection procedures, and analytical techniques used to ensure systematic and rigorous qualitative inquiry. The methodological framework is designed to capture in-depth experiential insights while maintaining transparency and trustworthiness throughout the research process [34].

3.1. Research Design

This study adopts a qualitative research approach using an exploratory design to examine how ethical and inclusive design features of AI care agents influence user trust, acceptance, emotional support, and perceived well-being [35]. A qualitative approach is appropriate for capturing rich, contextualized insights into user experiences, ethical perceptions, and emotional responses that cannot be fully represented through quantitative measurement.

The study is grounded in human-centered AI and inclusive design theory, emphasizing lived experiences, meaning-making processes, and interpretive understanding rather than statistical generalization [36]. Data were collected through semi structured in-depth interviews and analyzed using thematic analysis to identify recurring patterns and conceptual relationships among key constructs [37, 38].

3.2. Conceptual Framework

The conceptual framework positions Ethical AI Design and Inclusive Design Features as central experiential dimensions influencing User Trust, Technology Acceptance, Emotional Support, and Humanistic Well-Being [39]. Ethical AI Design shapes perceptions of system integrity through transparency, fairness, accountability, and privacy protection, while Inclusive Design Features address diverse needs through accessibility, adaptability, personalization, and multimodal interaction [40, 41].

User Trust, Technology Acceptance, and Emotional Support function as mediating constructs that translate these design dimensions into meaningful experiential outcomes, reflecting perceptions of reliability, usability, reassurance, and psychological comfort [42]. These relationships ultimately contribute to Humanistic Well-Being, including enhanced dignity, autonomy, emotional stability, and quality of life [43, 44].

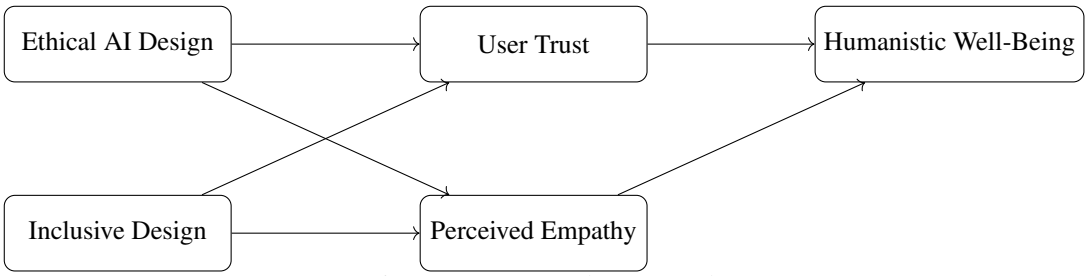

Figure 1. Conceptual Framework

As illustrated in Figure 1, ethical and inclusive design dimensions influence user experiences through mediating constructs before contributing to well-being outcomes. These design foundations including transparency, fairness, accessibility, and adaptability shape psychological responses such as trust, acceptance, and emotional support, which subsequently enhance perceived quality of life [5, 45].

3.3. Participants and Sampling

Participants consisted of individuals with physical, sensory, and cognitive disabilities who had prior experience interacting with AI-based care technologies. A purposive sampling strategy was employed to select participants with relevant experiential knowledge, ensuring that the findings reflect real-world interactions.

A total of 24 participants were included in the study. Data collection continued until thematic saturation was achieved, indicating that no new meaningful insights emerged.

3.4. Data Collection Procedure

Data were collected through semi-structured interviews lasting approximately 45–60 minutes. This approach allowed flexibility in exploring participants' experiences while maintaining consistency across key research themes.

Interview questions focused on:

- Ethical perceptions (transparency, fairness, privacy)
- Accessibility and inclusivity features
- Trust and emotional responses
- Perceived impact on well-being

All interviews were conducted with informed consent and transcribed verbatim for analysis.

3.5. Data Analysis

To ensure a systematic and transparent analytical process, this study employed thematic analysis consisting of four main stages. Each stage was designed to progressively transform raw interview data into meaningful themes that reflect participants' experiences and perceptions.

Table 1. Thematic Analysis Procedure

Stage	Process	Description
1	Familiarization	Repeated reading of transcripts to understand participants' experiences and initial note-taking.
2	Coding	Identification and labeling of meaningful data segments related to ethical perception, inclusivity, and user experience.
3	Categorization	Grouping similar codes into broader conceptual categories.
4	Theme Development	Refining categories into overarching themes representing core experiential dimensions.

As shown in Table 1, the thematic analysis followed a structured four-stage process to ensure analytical rigor and depth. The familiarization stage enabled the researcher to gain a comprehensive understanding

of the data through repeated reading. This was followed by coding, where key ideas were systematically identified and labeled. In the categorization stage, related codes were grouped into broader conceptual clusters to reveal underlying patterns. Finally, these categories were refined into overarching themes that represent the central experiential dimensions shared across participants. This structured approach enhances the credibility and transparency of the qualitative findings.

3.6. Trustworthiness and Rigor

To ensure the reliability and validity of qualitative findings, this study applied established trustworthiness criteria, including credibility, dependability, confirmability, and transferability.

Table 2. Trustworthiness Criteria

Criterion	Technique	Purpose
Credibility	Member checking	Participants reviewed interpretations to confirm accuracy.
Dependability	Peer debriefing	Independent review of coding to reduce researcher bias.
Confirmability	Audit trail	Documentation of analytical decisions for transparency.
Transferability	Thick description	Detailed contextual descriptions to support applicability.

As presented in Table 2, the study ensured methodological rigor through four key validation strategies. Credibility was achieved through member checking, allowing participants to verify the accuracy of interpretations. Dependability was strengthened by peer debriefing, which helped minimize potential bias in the coding process. Confirmability was maintained through a detailed audit trail documenting all analytical decisions. Finally, transferability was supported by providing rich contextual descriptions, enabling readers to assess the applicability of the findings to other contexts.

4. RESULT AND DISCUSSION

4.1. Participant Overview

This study involved 24 participants with diverse types of disabilities, including physical, sensory, and cognitive conditions. All participants had prior experience interacting with AI-based care technologies, such as AI chat assistants, smart home systems, and assistive digital applications. The diversity of participants allowed the study to capture a wide range of lived experiences and interaction contexts.

To ensure transparency and provide contextual understanding, the participant profiles are summarized in Table 3. The use of participant codes maintains anonymity while enabling clear reference to individual experiences during the analysis.

Table 3. Participant Profile

Participant Code	Type of Disability	Gender	Age Range	Experience with AI Care Systems
P1	Physical	Male	31–45	AI chat assistant, smart home device
P2	Sensory	Female	18–30	Voice assistant, accessibility tools
P3	Cognitive	Male	>45	Reminder system, assistive app
P4	Physical	Female	31–45	Smart care device
P5	Sensory	Male	18–30	AI chatbot
P6	Cognitive	Female	31–45	Assistive application
⋮	⋮	⋮	⋮	⋮
P24	Cognitive	Female	31–45	AI-based assistive system

As shown in Table 3, the participants represent varied backgrounds in terms of disability type, age, and interaction experience with AI systems. This diversity strengthens the credibility of the findings by reflecting multiple dimensions of user experience, which is essential in qualitative research.

4.2. Thematic Findings

The thematic analysis identified several key themes that explain how participants perceive and experience ethical and inclusive AI care agents. These themes reflect core dimensions related to trust, inclusivity, emotional support, and well-being.

Table 4. Key Themes and Findings

Theme	Description	Example Insight
Ethical AI Design	Perceptions of transparency, fairness, and privacy	"I feel more comfortable when the system explains what it does."
User Trust	Confidence in system reliability and safety	"I trust it because it does not make unexpected decisions."
Inclusive Design	Accessibility, adaptability, and personalization	"It works well with my needs, not against them."
Emotional Support	Feelings of comfort, reassurance, and companionship	"It feels like someone is there when I need help."
Humanistic Well-Being	Perceived impact on dignity, independence, and quality of life	"It helps me feel more independent and confident."

As presented in Table 4, the findings highlight that participants do not perceive AI care agents merely as technical tools, but as systems embedded within social and emotional contexts. Ethical and inclusive design features are interpreted as meaningful elements that shape user experiences in terms of trust, comfort, and overall well-being.

4.3. Discussion

The findings of this study demonstrate that ethical AI design plays a critical role in shaping user trust and perceived safety. Participants consistently emphasized the importance of transparency, fairness, and privacy in building confidence toward AI systems. When systems provided clear explanations and predictable behavior, users reported feeling more secure and in control of their interactions. This suggests that ethical design is experienced not as an abstract concept, but as a tangible aspect of everyday system use. Inclusive design also emerged as a central factor influencing user experience. Participants highlighted the importance of systems that can adapt to diverse physical, sensory, and cognitive needs. Accessibility features, flexible interaction modes, and personalized settings were perceived as enabling independence and reducing barriers to technology use. These findings indicate that inclusivity is not merely a technical requirement, but a key determinant of user comfort and engagement.

Another significant theme is emotional support. Participants described AI care agents as providing reassurance and companionship, particularly in situations where human assistance may be limited. This reflects the evolving role of AI systems as socio-emotional agents, rather than purely functional tools. Emotional support contributes significantly to how users evaluate their overall experience with AI technologies. Furthermore, the findings reveal that user trust, technology acceptance, and emotional support are interconnected experiential dimensions that collectively influence humanistic well-being. Participants reported that when AI systems are perceived as ethical, inclusive, and emotionally supportive, they contribute to a greater sense of dignity, independence, and quality of life. Overall, these findings reinforce the importance of human-centered AI approaches that integrate ethical principles and inclusive design to create meaningful and supportive user experiences, particularly for people with disabilities.

5. MANAGERIAL IMPLICATIONS

The findings from the thematic analysis indicate that ethical and inclusive design features are interpreted by users not merely as technical attributes, but as expressions of respect, safety, and dignity. For developers and healthcare technology managers, this implies that transparency, fairness, explainability, and data privacy should be embedded throughout the AI development lifecycle as core experiential values rather than compliance-oriented add-ons. Participants associated clear system behavior and understandable decision processes with increased feelings of security and trust. Therefore, implementing explainable interaction flows,

accessible privacy controls, and participatory ethical review mechanisms can strengthen long-term user confidence in AI care agents.

From an operational perspective, inclusive design emerged as a critical factor shaping comfort, usability, and emotional reassurance. The diverse disability profiles of participants highlight the importance of adaptable interfaces, multimodal communication options, and personalized interaction settings. Managers should prioritize co-design practices involving people with disabilities to ensure that AI systems reflect real-world accessibility needs. Investment in assistive compatibility, simplified interaction pathways, and adaptive personalization can reduce usability barriers while enhancing perceived autonomy and independence in daily care contexts.

Strategically, the study shows that emotional support plays a central role in shaping perceived humanistic well-being. AI care agents are experienced not only as assistive tools but also as socio-emotional companions. Consequently, organizations should evaluate system effectiveness using well-being–oriented indicators such as emotional comfort, dignity preservation, and perceived psychological stability. By aligning AI innovation strategies with broader social inclusion and well-being objectives, technology providers can position themselves as leaders in responsible and compassionate digital care ecosystems.

6. CONCLUSION

This study addresses a critical gap in the existing literature concerning the ethical and inclusive design of AI care agents for people with disabilities. While prior research has extensively discussed ethical AI principles and inclusive technology frameworks at a conceptual level, empirical investigations capturing how these principles are experienced and interpreted by users remain limited. In particular, few studies have qualitatively examined how ethical transparency, fairness, accessibility, and adaptability translate into lived experiences of trust, emotional comfort, and perceived well-being within disability contexts. By focusing on user narratives and experiential dimensions, this study responds to the need for deeper human-centered evidence in AI care research.

The novelty of this research lies in its integrative qualitative framework linking Ethical AI Design and Inclusive Design Features to user trust, technology acceptance, emotional support, and ultimately humanistic well-being. Rather than evaluating AI systems solely through technical performance or usability metrics, this study foregrounds dignity, autonomy, and emotional reassurance as central evaluative dimensions. Through thematic analysis of in-depth interviews, the findings demonstrate that ethical and inclusive design elements function as socio-emotional enablers, shaping how users construct meaning and psychological comfort in their interactions with AI care agents. This contribution advances the discourse on human-centered AI by empirically grounding ethical and inclusive principles within disability-informed experiential insights.

Future research should extend this work by employing mixed-method or longitudinal designs to examine how perceptions of trust, acceptance, and emotional support evolve over time with continued AI interaction. Comparative studies across cultural contexts, disability types, or different AI care technologies would also enrich understanding of contextual variability. Additionally, integrating qualitative validation models alongside qualitative exploration may help establish stronger causal pathways between ethical design features and measurable well-being outcomes. Such future directions will contribute to the development of more responsible, adaptive, and socially sustainable AI care ecosystems.

7. DECLARATIONS

7.1. About Authors

Karnawati (KK) https://orcid.org/0000-0001-9744-4617

Dwi Nur Ramadhan (DR) https://orcid.org/0009-0004-2941-2364

Tiurida Lily Anita (TL) https://orcid.org/0000-0003-0167-1204

Risma Nurmala (RN) -

Lily Maria (LM) https://orcid.org/0009-0005-9759-710X

7.2. Author Contributions

Conceptualization: KK; Methodology: DR; Software: TL; Validation: RN and LM; Formal Analysis: DR and TL; Investigation: KK; Resources: RN; Data Curation: LM; Writing Original Draft Preparation: KK and LM; Writing Review and Editing: DR and TL; Visualization: RN; All authors, KK, DR, TL, RN, and LM, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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