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INTEGRATION OF NUDGING-BASED KANSEI ENGINEERING AND HUMAN-CENTERED DESIGN: A CONCEPTUAL FRAMEWORK IN HEALTHCARE SERVICE

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Abstract This study presents a conceptual framework for the modification of Kansei Engineering (KE), incorporating nudging-enabled features with human-centered design (represented by Design Thinking (DT) methodology) applied in healthcare. Prior studies have integrated KE with other methods (such as Kano model, Theory of Inventive Problem Solving/TRIZ, and Quality Function Deployment/QFD) but have not combined KE with Nudge Theory (NT) yet. This research framework addresses this gap by explicitly targeting patient behavioral outcomes in non-critical care. KE focuses on translating customer emotional needs (Kansei) into design parameters, whereas NT stresses changing customer behavior through positive reinforcements. Once Kansei is obtained, it is hoped that positive behavior will follow. Hence, a novel integrated framework combining KE, NT, and DT will develop emotionally and behaviorally supportive strategies for non-critical patient care. In addition, it may enhance patient recovery through emotional support, build loyalty through engagement, and contribute to sustainable healthcare practices by promoting more user-centered service design.

Keywords: Kansei Engineering; Nudge Theory; Design Thinking; Healthcare; Emotional needs

1. Introduction

Nowadays, people generally have a clear and precise understanding of what they expect. That is all about the expectations that any service provider or product designer must meet when contacting their target users or clients. The growing awareness and justification of customer expectations affirm that both service providers and product designers pay detailed attention to not just what they deliver, but how it leads to positive feelings and impressions. This shift shows a transformation from product-centric thinking to a human-centered design approach, where customer emotions, experiences, and behavioral outcomes become the deep layer of innovation. Addressing customers' emotions in both product and service experiences is not merely a value addition; rather, it is beyond customer satisfaction. Surely it is more of a strategic business necessity. Customers connect emotional responses to powerful conditions when they make judgments, decisions, and form long-term relationships with certain brands. Addressing customers' emotions in both product and service experiences is critical for a spectrum of reasons, including the fact that feelings lead to customer satisfaction, delight, and loyalty.

According to Hartono's research [1], improving the user experience and impression is a critical point. This study proposes that the inclusion of user experience (UX) in any product and service experiences through the lens of emotional satisfaction will increase the level of overall customer satisfaction and sustainable loyalty. Emotional satisfaction, in turn, has been linked to increased levels of repeat usage and consumption, word-of-mouth promotion, and a stronger emotional linkage between the customer and the product or service experience. Thus, emotions are not peripheral to the design process; instead, they are central to shaping the customer journey.

Customer feelings or emotions (also known as Kansei [2]) are critical in influencing purchasing decisions, establishing brand loyalty, and creating differentiation in a saturated market. The term Kansei, rooted in Japanese design philosophy, refers to a customer's psychological feeling and emotional response to an object or situation. In a crowded market, emotional engagement can be a crucial differentiator, resulting in a distinct identity and value proposition. In a marketing perspective and in user experience design, Kansei is closely related to affective perception, shaping how users

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interpret and emotionally react to a product or service they interact with. Kansei will capture the subtle interplay between cognition and emotion, making it a valuable construct in modern experience design. This study explores how emotions triggered by a physical product, such as feelings of comfort, trust, elegance, or excitement, can profoundly influence customer choices, brand loyalty, and perceived value. Several people have raised this question. Why does emotion matter? In a more competitive and saturated market, products and services must be emotionally perceived by users, not just functional and usable. More specifically, emotional engagement provides a distinct identity to offerings and enhances perceived differentiation, especially when utility becomes commoditized. Brands like Apple, Muji, and Toyota have strategically utilized Kansei-based design and development to appeal to deep-rooted customer emotional needs, making a significant positioning for their offerings. Even though they are mainly product-focused things, the customer's emotional satisfaction is highly considered the similar experience.

KE is extensively used to understand how to customize services and products to achieve customer emotional satisfaction. To systematically involve customer emotional needs in the design process, KE has been developed as a methodology that translates emotional impressions into tangible design parameters, applied to either product or service. This method was initially introduced by Professor Mitsuo Nagamachi in the 1970s [2]. It serves as a bridge between psychological traits and physical elements, supporting designers and engineers in developing products and services that “feel good” to the user. KE has been applied across a diverse range of domains, covering automotive interiors, consumer electronics, web design, kitchenware, service environments, and increasingly, healthcare services and equipment. Inherently, this approach involves identifying emotional descriptors (e.g., calm, energetic, professional), mapping them to product or service attributes (e.g., colors, shapes, layout, interface flow), and validating these correlations through empirical methods such as experiment designs, simulations, surveys, regression models, and semantic differentials.

Companies that focus on their customers' emotional satisfaction can design service environments, procedures, and interactions that are not only efficient but also emotionally satisfying and memorable. This leads to increased client happiness and loyalty. Basically, KE is an approach for turning emotional responses into physical parameters. It can be used in service contexts to influence service environment design, customer interaction points, service process design, personalization and customization, emotional branding and marketing, feedback and continuous improvement, employee experience design, and the integration of technology and human interaction. For example, a hospital can employ KE to create waiting areas that promote quiet rooms, clean ambience, and reduced anxiety. KE can also be used to develop customer engagement points, streamline operations, and personalize services based on consumer data and feedback. However, limited human rationales and cognitive processes sometimes fail to translate positive emotions into good intentions [1].

KE could potentially apply to a service context, in addition to physical products. In a service domain and environment, KE enables companies to design every user touchpoint (referring to Parasuraman SERVQUAL’s model, it is covered from physical space design to interpersonal interactions) [3; 4]. This approach deals with customers’ emotional expectations. For instance, a healthcare facility or hospital employing KE may install its waiting area with soft ambient lighting, neutral color palettes, and calming music to reduce patient anxiety and promote a sense of trust, hominess, and safety. Likewise, another example is that mobile banking apps can use Kansei principles to create emotionally appealing interfaces that signal reliability, simplicity, and control (see Fig. 1). KE also supports the personalization and customization of services based on user segments or individual preferences, enhancing the subjective quality of experience. The KE methodology emphasizes continuous feedback loops, enabling iterative improvements based on user input, emotional metrics, and dynamics of customer behavioral data. However, it is also highlighted that positive emotional responses do not always follow intended user behavior [4]. Users may express satisfaction with a product but fail to engage with it as intended due to cognitive biases,

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cultural backgrounds, decision fatigue, or any potential limited rational processing. This scenario illustrates the particular relevance of NT [4].

NT, inherently popularized by Richard Thaler and Cass Sunstein [4], is based on the condition that people often make irrational decisions due to bounded rationality and heuristic-driven thinking. Occasionally, it deals with emotion as a coupling mechanism in the human-based decision-making process. Nudging offers subtle cues or changes in the choice architecture to steer users toward better decisions without limiting their freedom of choice. This study highlights the use of nudges in healthcare services. It may include initiatives to promote healthier eating and using reminders or social proof to encourage desired patient behaviors. It is quite often the case that patients forget to take intended medicines or eat due to unmotivated behavior and unsupportive health mechanisms. Nonetheless, in the digital world, nudging can take the form of persuasive interaction design and behavioral prompts that subtly shape user journeys, including patient behavior. For instance, a health tracking app might use visual progress indicators and push notifications to encourage patients' physical activity. Such interventions work by influencing the patient's automatic decision-making system, thus bypassing any resistance.

Fig 1 Example of banking app employing sense of positive emotions [www.bca.co.id]

This study highlights and proposes a new integrative framework of KE and NT as two concepts that aim to influence and lead user behavior and product design, but they approach these aims from distinct angles and techniques. In some cases, these approaches may be complementary. For example, a KE-designed product (KE product) that elicits positive emotions can be reinforced via nudges to promote user behavior toward optimal product use. Combining the two strategies can produce things that are both emotionally appealing and inspire positive user behavior.

This study builds on prior research in the development and use of KE integration models in potential products and services, considering nudging systems that point to more human-centric design (human-centered design) using Design Thinking (DT) methodology. DT offers a human-centered, iterative, and problem-solving approach that aligns well with the goals of both KE and NT, especially in the complex and emotionally sensitive domain of healthcare. KE's human-centered design, which is founded on and connected to nudging, is expected to generate unique solutions that meet patients' emotional demands, improve patient-product interaction by overcoming patients' reasoning limitations, and assist patients in better understanding their functional needs. In other words, in healthcare, the integration of KE, NT, and DT is particularly critical since patient experiences (i.e., non-critical patient care) are shaped not only by functional service delivery but also by emotional and behavioral experiences. In contrast to commercial settings, healthcare environments must resolve patient anxiety, worry, stress, and the need for emotional support to boost comfort and speedy recovery.

Again, prior studies have often emphasized KE applications in consumer products, yet less attention has been paid to how Kansei and nudging architecture can be systematically applied to healthcare services. Hence, this study bridges the gap by proposing an integrated framework of KE–NT–DT that facilitates healthcare providers in designing servicescapes and patient experiences that are emotionally engaged, behaviorally supported, and quite conducive to improved health.

2. Recent KE in Services

"This cave is so magnificent and makes me excited!" "When I'm sitting, I forget to stand." "This room feels warm, and it makes me feel more welcome." This statement is a collection of

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consumer declarations known as Kansei. These are the emotions and impressions of those who are influenced by external stimulation. Their minds are filled with emotions and feelings. Kansei is also known as an affective process, which refers to the emotional impact on the user because of the stimulation created by its connection with the product, as well as how the product's features integrate into the human system. KE addresses relevant methods that understand and translate customer emotional needs into product or service design parameters [1; 3].

One of the benefits of KE is its adaptability, as it can be integrated in various ways or with instruments to enhance quality and solve problems with the use of various products, such as the Kano model, the Theory of Inventive Problem Solving (TRIZ), the Service Quality (SERVQUAL) model, and Quality Function Deployment (QFD) [4]. Moreover, the DT method has the potential to be engaged with KE in terms of a more comprehensive approach to exploring customer needs and prototyping using dynamic relationships. This research is based on two identified gaps, which are domain-specific gaps (in this current study case, selected healthcare or hospital environments are set) and gaps connected to KE methodological enhancements.

Various sectors have applied the KE methodology to their service and product systems, considering the supporting methods involved. Here's a summary mapping of the implementation of KE, considering the context/tools/methods of the last decade (see Table 1 for the details). It shows that general KE is a common methodology used in a recent decade of KE research and studies in services. KE alone enhances emotional satisfaction (Kansei) but does not shape user behavior. NT closes this gap by addressing bounded rationality and supporting patient compliance. This is now tied directly to healthcare features and facilities (e.g., bed adjustment button, medication reminders, healthier food nudges, and others). Hence, there is a potential opportunity to explore more contexts or methods to enhance the KE methodology, such as nudge theory and healthcare services.

It appears that areas in healthcare or hospitals present potential for exploration. This assertion is reinforced by the intricacies of patients' and customers' requirements and emotional fulfillment, which must be improved to hasten the healing process. In this context, KE plays a crucial role. In the area of healthcare, nudging refers to modest interventions that aim to impact public behavior positively without imposing on or restricting their options. These nudges are intended to encourage better behaviors such as increased exercise and a healthier diet. A basic example of a nudging application is in a male toilet's urinal, which is given a fly image to encourage 'targeted' urinating at the fly image and does not cause the fluid to disperse, saving staff time cleaning the floor and water (see Fig. 2). For example, if the application is in a hospital, displaying healthy food options at eye level or near the cash register encourages people to choose healthier foods.

Table 1. Mapping of general KE research with contexts/tools/methods identified

Study	Contexts/Tools/Methods									
	General	SERVQUAL	Kano	TRIZ	Culture	Sustainability	Logistics	Robust	Mining	Nudge & Healthcare
[5]	√	√	√							
[6]	√	√	√	√			√	√		
[7]	√		√							
[8]	√	√	√							
[9]	√									
[10]	√	√	√		√	√				
[11]	√	√	√		√					
[12]	√						√			
[13]	√	√	√	√		√				
[14]	√								√	
Current	√	√	√			√				√

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Another possible example is delivering a medical appointment reminder via text message, which will help patients better prevent and manage chronic illnesses. It has been shown that this practice is able to improve patient engagement and help manage chronic conditions more effectively. When combined with KE, surely, these practical nudging strategies can be further refined to ensure they influence behavior and resonate emotionally with customers, thereby enhancing their long-term impact.

Fig 2 Nudge-based urinal of a male toilet (taken from https://kwworks.com/blog/why-is-there-a-fly-in-my-urinal/).

3. Identification of KE Research Gap with Context of Healthcare Services

KE can be used to promote and design products that not only meet functional needs but also arouse positive emotions in users and customers. Emotion (or Kansei) becomes very critical, especially when customers must choose between products that have the same rational attributes. In other words, there remains ample room for flexibility in the development of the KE methodology. This is particularly true when the KE is addressing more complex issues, also known as socio-technical problems. One point to a solution is not enough. A more profound understanding exists regarding a more comprehensive approach. Nevertheless, its methodology or approach is inherently expected to be as efficient and coherent as possible [1]. Both service and product designers are frequently trapped in their desired preferences to deepen consumer wants, and their attribute fulfillment sometimes goes beyond what is thought to be confronted with the user's actual needs. This scenario is what inspired the notion of incorporating the Kano model into the KE technique [5].

Sometimes filling with small portions and beyond the designer's expectations can bring about a very high level of satisfaction, called delight. It is beyond satisfaction. KE deals with it. Emotional satisfaction (Kansei) is also capable of providing sustainable attitudes to users and customers. For example, a product and service designed using KE can enhance positive emotions (such as pride or excitement) and further influence behavior to use less energy (like the case study provided in [1]). The more emotional needs are fulfilled, the happier the customer is. Healthcare or hospitals, like any other product or service experience, should provide their patients with more emotional pleasure to promote more friendly and compassionate services. Eventually, it will improve recovery and survival rates. The hospital's unique design has been demonstrated to help patients recuperate faster [5]. It demonstrates that the patient requires both functional and cognitive aspects, as well as emotional aspects. Given the qualities and concepts of human factor engineering, customers prefer something more humanizing [15].

Humans should be more intensively humanized. Additional efforts are required, but they should be directed toward the advancement of intelligent systems rather than burdening humans as users or customers. It's like a catalyst. KE creates a gap to improve its process, which aligns with KE's primary purpose of creating "wow" and "indeed." KE introduced the concept of nudging during the improvement process. Nudging is a behavioral approach that encourages people to conduct little, sometimes voluntary, activities to achieve substantial effects that lead to positive perceptions. There is no need for something sophisticated to urge a person to act differently, but a tiny impulse can sometimes touch or satisfy an emotional need [6]. It's highly consistent with the KE technique.

While KE may have proven valuable in capturing and translating patients' Kansei into healthcare design parameters, its impact on actual behavioral change remains limited. KE fundamentally addresses the emotional features (both experience and ambience), enabling more human-centered and emotionally resonant healthcare solutions [16]. However, emotional fulfillment alone does not guarantee sustained

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behavioral obedience, such as medication compliance, lifestyle modifications, or preventive checkups. In such cases, a complementary approach of NT is required to guide decision-making within real-world contexts. Nudges, including reminders, defaults, and framing strategies, have been shown to improve patient health-related behaviors by smoothly shaping choices without restricting freedom [17]. The integration of KE and NT, therefore, addresses a critical healthcare gap. While KE ensures designs resonate with patient emotions, NT enhances their capacity to drive actual behavioral outcomes. This approach is considered promising in offering a more novel and comprehensive one to be more patient-centered healthcare innovation.

4. Conceptual Framework Development

It starts with the selection of the service domain and ends with the action plans. Fig. 3 depicts step-by-step methods. The research will be conducted in two phases, with KE serving as a foundation and DT methodology incorporating a nudging system (see Fig. 3), namely (a) Phase 1: Existing condition and adjustment, with a focus on the stages of empathizing and defining, and (b) Phase 2: Proposed improvement strategies, implementation, and feedback, with a focus on the activities of ideating, prototyping, and testing.

The two-phase framework (i.e., Phase 1 and Phase 2) draws on DT's iterative cycle while embedding KE and NT in interrelated roles. KE contributes through a mathematical Kansei model, which functions as a confirmatory mechanism connecting Kansei to quantifiable design parameters. The model applies multivariate statistical methods (e.g., regression or structural equation modeling) or machine learning mechanisms to validate whether the finalized Kansei correspond to purposive design features. NT is then used to operationalize nudges (e.g., defaults, framing, or choice architecture) that drive patient behavior. In short, KE provides the Kansei, DT demonstrates the iterative design cycle, and NT ensures behavioral outcomes.

The motivation for the inclusion of a nudging system lies in its low-cost, non-coercive approach to customer behavior change. It has been widely applied in domains such as public health, education, environmental sustainability, and financial planning. Yet, nudging is most effective when combined with the KE method, as customers are more likely to respond to nudges that align with their emotional expectations and motivational drivers.

Phase 1 involves analyzing the existing condition and making necessary adjustments. By applying a market pull strategy and a more human-centered approach, it is highlighted that what is required by the customer is being the focus of the product or service domain and its formalized problem. Potential methods can be considered, such as in-depth interviews, in-depth observation, and immersive field experience. This approach involves not only asking questions of the potential lead customer but also experiencing the actual conditions in which the customer lives. Additionally, some potential external issues are considered, including existing artificial intelligence technology, sustainability, and health issues related to the aging population.

Once the customer's needs, wants, and opportunities have been researched, then the problems will be defined. It is called the "defining" stage; it consists of two parallel activities, i.e., Kansei/affective-based spanning and product attribute spanning. Kansei/affective-based spanning starts with the exploration of customer emotional needs (known as Kansei), the refinement or finalization of Kansei, and ends with Kansei rating. Simultaneously, we conduct the product spanning. This process involves selecting product attributes categorized by Kano (as either attractive, one-dimensional, or basic) and assessing the product's performance gap, which is the difference between perception and expectation (see [5] for details). After combining them, we proceed to the synthesis stage, the Kansei model, and the adjustment stage. A mathematical model, either linear or non-linear, will be generated and adjusted to the confirmatory mechanism for the Kansei model. It is to judge whether the Kansei mathematical model is in line with real conditions or not (see [1] for the illustration of the confirmatory mechanism for the Kansei model). The outcome will be what product attribute(s) is/are significantly influencing certain Kansei. We refer to these as critical attributes. To implement KE within our framework, Kansei will be measured through semantic differential (SD) scales developed from elicited Kansei words (e.g., calm-

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anxious, comfortable-uncomfortable, modern-classic, et cetera). These data will be analyzed using regression and/or multivariate models to identify links between design attributes and Kansei responses, with optional physiological indicators (e.g., heart rate variability, eye tracking pattern) for validation or more evidence-based measures. Nudging techniques, such as reminders, default options, and environmental cues, will then be systematically linked and mapped to the identified Kansei words. Qualitative feedback is possibly embedded to enhance the model.

In Phase 2, there are three activities involved, i.e., ideating, prototyping, and testing. The purpose of the ideation activity is to identify improvement strategies along with their corresponding engineering specifications based on the critical attributes. We can utilize the House of Quality (HoQ). It has two dimensions, i.e., WHAT refers to critical attributes, and HOW refers to improvement strategies. Other methods are potentially used, such as brainstorming, the theory of inventive problem solving (TIPS/TRIZ), and principles of popular issues such as nudging systems and sustainable development goals (SDGs). Afterwards, we create and test a physical prototype to validate the previously discussed analytical concept. Feedback from potential and lead users and customers will be gathered.

Specifically, the goal is to create a KE model or framework that considers nudge-based systems used to support products for non-critical patient care in hospitals, as well as to identify critical attributes of current services and products, particularly modified-adjusted beds.

5. Discussion

This study framework has been shown to be beneficial. Integrating KE and DT can yield a powerful paradigm for developing emotionally engaging and user-centered products and services. The anticipated benefits are as follows. The combination of KE's deep emotional insights and DT's user-centered approach ensures a full understanding of users' needs and goals. The creative ideation and prototyping phases of DT provide distinctive and emotionally appealing results, influenced by KE's emotional data. Integrating these strategies ensures that products and services are not only functional and usable but also emotionally engaging. Finally, by addressing customers' practical and emotional needs, firms can differentiate their offerings and increase customer loyalty.

The following steps can be used to effectively integrate the DT and KE. First, empathy in DT focuses on directly observing and engaging with users to understand their requirements, actions, and feelings. This approach is consistent with KE's Identify Emotions phase, which seeks to understand people's emotional responses to products or services. After that, developers combine observations to form problem descriptions and measure emotional responses. This task includes developing personas and user journey maps to emphasize critical emotional touchpoints. Second, conceptualize (in DT) and transform emotions into design elements (in KE). In DT, ideation stimulates the production of a diverse variety of ideas, but in KE, emotions are translated into design aspects. The next step in KE prototypes is to create actual representations of ideas to investigate solutions. Prototypes in KE might use sensory design aspects to increase emotional impact. Third, user feedback on prototypes is critical in determining the emotional impact of the design. The fourth step is implementation and delivery (in DT). In summary, both techniques emphasize ongoing improvement driven by customer feedback, which ensures that the product or service evolves to better meet user needs and emotional expectations.

Integrating KE, DT, and NT into hospital services is hoped to yield a more complete approach to improving patient care and operations [15]. This integration focuses on understanding and meeting the emotional, functional, and behavioral needs of patients, staff, and visitors. NT includes developing modest interventions to influence behavior. These tasks will be completed as part of the NT implementation. First, improve design in medical environments to elicit desirable emotions and enhance the user experience. Second, use nudges to encourage healthy habits and improve patient outcomes, such as placing hand sanitizers in easily accessible locations or using floor markings to direct patient flow and prevent misunderstanding. Third, train staff in empathetic communication skills and praise positive behaviors with subtle cues and reminders.

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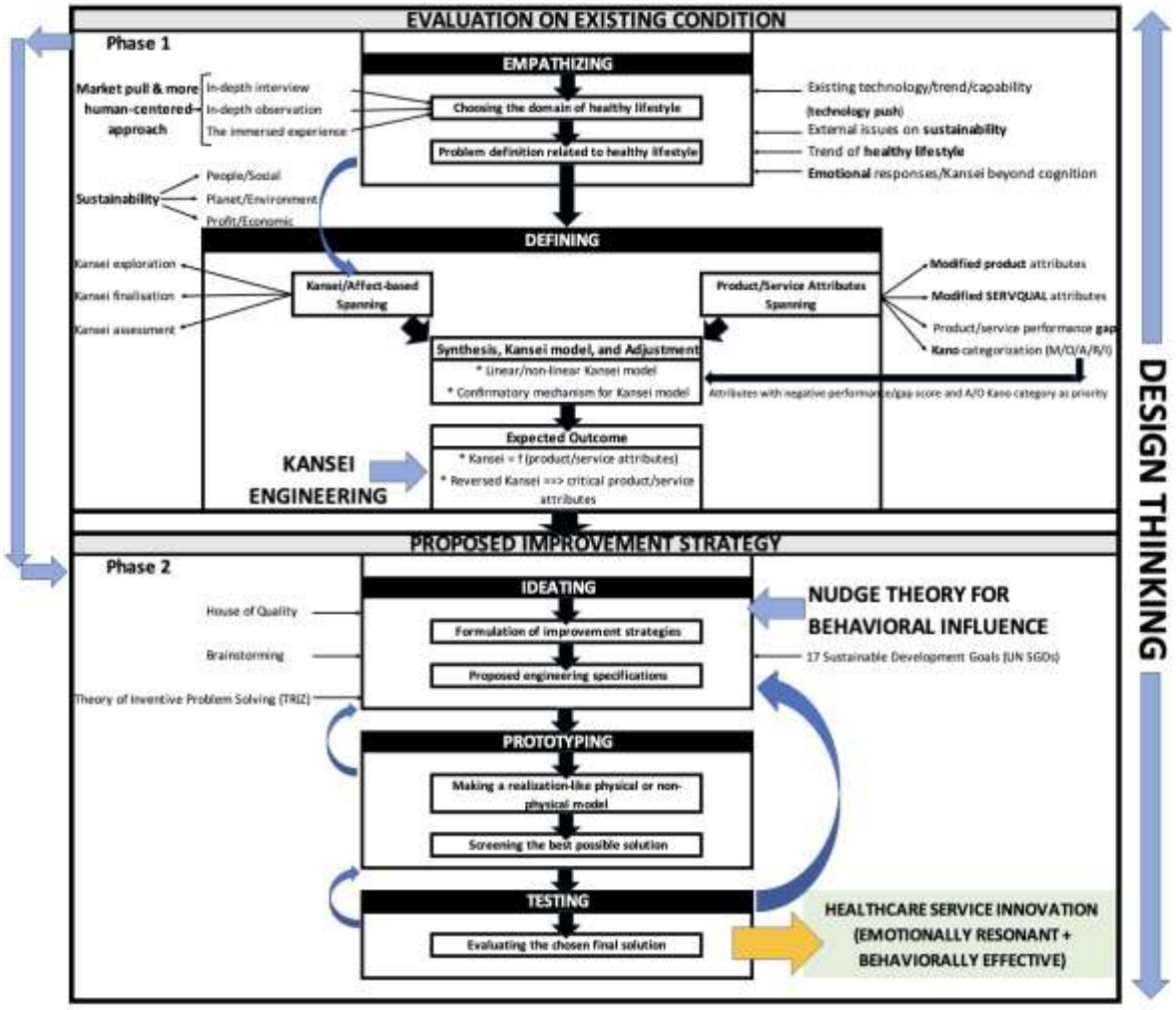

Fig 3 Two-phase Conceptual Framework of KE-DT-NT Applied to Healthcare Services

This study argues that KE and NT are complementary in their goals and can be integrated to create customer experiences that are emotionally engaging and behaviorally effective and more robust yet agile [18]. Where KE focuses on creating emotional resonance through design, NT ensures that users are guided gently toward beneficial outcomes. Together, they offer a powerful human-centered approach to innovation, wrapped together in DT methodology.

Nowadays, artificial intelligence (AI) can inform the visual and tonal identity of a wellness and healthcare app designed for chronic disease patients, eliciting feelings of empathy, care, and hope. According to a recent study [19], emotions evoked from AI service interactions can range from primary emotions like joy and sadness to self-conscious and moral emotions, which might be applied in healthcare services. Simultaneously, nudges such as default medication reminders and encouraging feedback can promote and drive users' consistent health behavior. An example has been demonstrated by a study by [20], which is investigating how different types of AI (thinking vs. feeling) and consumption contexts (public vs. personal) influence consumers' willingness to purchase healthy food. Moreover, a collaborative effort involving patients, providers, and technologists led to the development of an AI-driven nudge intervention aimed at improving medication adherence [21]. Hence, the combination of nudge-based emotional design enhanced with AI-based technology enhances both the emotional experience and the actionability of the intervention.

This study highlights the novelty of integrating KE, NT, and DT into a consolidated conceptual framework for healthcare services. In

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contrast to previous work that applies these approaches separately, this framework promotes a patient-centered design ecosystem by combining affective sensitivity (KE) and behavioral guidance (NT) wrapped in an iterative problem-solving technique (DT). More specifically, KE translates patient emotions into design parameters, NT reinforces behavior with profound cues, and DT refines them through co-creation. This integration emphasizes the importance of addressing not only functional needs but also Kansei and cultural issues. However, several limitations are identified. Measuring Kansei responses remains difficult due to some constraints. They may include the subjectivity of patient emotions and their dynamics; nudging may face cultural resistance if perceived as manipulative, requiring prudent adaptation. Moreover, AI-assisted KE-NT-DT applications face practical challenges related to data integration, regulation, and hospital readiness. Addressing these dynamics will be critical for advancing the framework and ensuring its real-world applicability. For example, a case for patient bed redesign further illustrates this integration by combining emotional experiences (KE), safe use signages (NT), and wrapping in ergonomic prototyping (DT). However, the potential challenges are there. The cultural differences, hospital readiness, and technological constraints may limit adoption.

Again, from a methodological perspective, this integrated framework promotes a multidisciplinary approach involving psychology, behavioral economics, human-based interaction design, and service design. Using DT as a framework backbone, the healthcare-based development teams can apply iterative cycles of empathizing with users and customers, defining emotional and behavioral goals, ideating solutions, proposing prototyping and improvement strategies, and testing for emotional impact and behavioral compliance and fulfillment.

6. Conclusions

Integrating KE, DT, and NT into hospital services provides a complete strategy for improving patient happiness. By addressing the emotional, functional, and behavioral components of patient care, hospitals can improve health outcomes, provide more positive experiences, and strengthen patient connections. This comprehensive strategy not only addresses patients' urgent needs but also promotes long-term loyalty and trust, resulting in a superior reputation and competitive advantage in the healthcare business.

This study spotlights the potential of KE-DT-NT methodology to improve patient engagement in healthcare services. Nevertheless, there are several limitations that should be noted, and its present scope is conceptual. While the present work does not conduct pilot validation, future research might test this framework in healthcare service settings. They might include systematic usability testing with patients in bed-patient-nurse interaction, prototype validation for patient beds and hospital waiting rooms, and evaluation of AI-based nudging systems such as telemedicine platforms. Hence, it is hoped that evaluation of both emotional appeal (via Kansei metrics) and behavioral obedience (via nudging metrics) will be finalized.

More specifically, for a step ahead, it is important to apply this integrative approach to redesigning patients' experiences and usability to improve their emotional satisfaction. Those who have experienced hospitalization for at least one night are targeted as potential subjects. During the patient experience journey, we will analyze all feedback and concerns from patients, including suggestions for features to add or adjust. We will propose a new modified patient bed and other related infrastructures based on human-centered design principles at the end.

Again, this study builds upon prior work exploring KE applications in emotional product and service design and extends it by embedding nudging principles wrapped in DT methodology into the user experience and impressed feelings. The result is a more holistic model of behavior-driven design, particularly valuable in complex socio-technical systems such as healthcare, public services, and digital well-being platforms. Despite this study's focus on healthcare services, other service domains could potentially utilize this integrated framework of KE and DT.

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