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Integrating Elder and Youth into Co-Design Approach—A Case Study of Medication Aids Design

Yu-Meng Xiao[1], Ding-Hua Huang[2*], Rung-Tai Lin[1]

[1]Graduate School of Creative Industry Design, National Taiwan University of Arts, New Taipei City
[2]Institute of Creative Design and Management, National Taipei University of Business, Taoyuan
Email: xiaoyuuumeng@163.com, *hauhuang@ntub.edu.tw, rtlin@mail.ntua.edu.tw

Abstract

Designs for the elderly should consider their characteristics and needs. However, in previous research, the role of the elderly has been chiefly as consultants or testers, and they rarely actively participate in the design process. This study integrates steps and methods based on experience based co-design and design thinking, developing an elder and youth co-creation model. This model is applied to the medication-assistance design closely related to the needs of the elderly, exploring the impact and benefits brought by the elder and youth co-creation model for both the elderly and young designers. In this research, nine elder individuals, ranging in age from 61 to 74, and eight graduate students, primarily from design fields, participated in the co-creation workshops. This study implements the elder and youth co-creation model in the form of workshops, organizing five co-creation workshops to address the existing medication problems of the elderly and redesign medication assistance. Focus group interviews are conducted after the end of the workshop. The results show that through this model, young designers can enhance empathy with users, discover the potential needs of target customers, and design products that meet the needs of the target customer group. Furthermore, the model can enhance the confidence level of the elderly in creativity and serve as a means to present the abilities and experiences of the elderly.

Keywords

Design Thinking, Experience Based Co-Design, Elder and Youth Co-Creation Model

1. Introduction

As the globe grapples with the escalating challenge of an aging populace, the elderly demographic finds itself increasingly susceptible to chronic ailments such as hypertension, diabetes, and chronic cardiac conditions (Jafari et al., 2022; Meher et al., 2022; Quiñones et al., 2022). Contemporary society largely overlooks the natural decline in physiological function characteristics of older individuals, particularly in medication packaging. This demographic may encounter visual and behavioral obstacles in their use of pharmaceuticals. Consequently, amplifying the safety of pharmaceutical usage among the elderly becomes imperative in safeguarding their overall well-being and enhancing their quality of life. Many studies use participatory methods to involve the elderly in the design process. This method of involving stakeholders directly in the design can strengthen the development and implementation of medical services to improve patient outcomes and provide high-quality care (Botti et al., 2022; Grigorovich et al., 2022; James & Buffel, 2022). One of the methods is Experience based co-design (EBCD), which is a method of designing medical-related interventions. It allows patients and stakeholders to participate in cooperation to improve medical quality. The Experience based co-design emphasizes the importance of incorporating the experience of patients and stakeholders in the design process, drawing on their insights, and understanding nursing approaches from multiple perspectives (Bielinska et al., 2022; Korstjens & Moser, 2022). This method uses in-depth interviews, observations, group discussions, and other ways to collect information and ideas, forming a more comprehensive and sympathetic design scheme. Experience based co-design ensures that the end product aligns with the needs and expectations of patients and stakeholders, fostering a sense of ownership and involvement in the healthcare process. However, this methodology, largely reliant on sharing nursing and medication experiences through interviews, discussions, and collaborative design and testing, may fall short of facilitating comprehensive patient participation in product design. As a result, the design framework may inadequately reflect their needs. Past medical interventions that omitted stakeholder participation throughout the design process failed to deliver the anticipated outcomes. Traditional participatory design methodologies have proven insufficient in effectively advocating for elderly participation, who frequently assume a more passive advisory capacity rather than engaging proactively in the collaborative design process.

Hence, it becomes crucial to broaden the purview of participatory design techniques in the healthcare sector, necessitating the comprehensive involvement of patients throughout the design process. This should encapsulate their active participation in decision-making, conceptualization, prototyping, and testing, ensuring that the solution meets their needs and expectations. In addition, it is essential to consider the cultural and social factors that may affect the experience and views of the elderly and ensure that their voices can be heard and included

in the design process. To address these limitations, the key is to provide the inclusiveness of the entire design process and consider the views and experiences of all stakeholders, especially the elderly. To achieve this, the elderly can play a more active role in the design process and provide them with sufficient resources and support to effectively participate in joint design activities. This guarantees that the eventual product caters to the distinctive needs of the elderly, thereby enhancing the likelihood of ameliorating their health outcomes and quality of care. Moreover, it is vital to continually assess and scrutinize the efficacy of these design strategies, facilitating requisite improvements and adjustments, thereby ensuring their sustained adaptability to the evolving needs of the elderly.

Design thinking, an inherently human-centric, iterative problem-solving methodology, champions concurrent reasoning, experimentation, and iteration to conceive creative and efficacious solutions to multifaceted challenges. It places paramount importance on the needs and perspectives of end-users, fosters collaboration, and multidisciplinary team synergy, and permits continuous testing and iteration to realize the optimal solution. Routinely employed in realms such as product design, urban planning, healthcare, and more, design thinking may catalyze innovation, enhancing experiences and engendering positive societal impact (Stickdorn et al., 2018).

Older people are often underestimated as creative people. Nevertheless, research indicates that the elderly, with their wealth of life experiences and knowledge, bring a rich tapestry of insights to the creative process, rendering invaluable contributions in art, design, writing, and innovation (Anderson & Vyas, 2022; Partridge, 2022; Tromp & Glăveanu, 2023). Their life experiences equip them with a unique perspective and problem-solving abilities, empowering them to confront challenges through a fresh lens. A significant portion of this demographic continues to be deeply immersed in learning, continually exploring novel ideas and pursuits to augment their innovative capacities further. Moreover, their aptitude for fostering relationships and engaging in practical cooperation often produces imaginative and stimulating creations. By embracing their creativity, the elderly enhance their lives and inspire others to contribute meaningfully.

A collaborative design process engaging elderly and younger designers may yield unique advantages. The elderly bring rich life experience and an understanding of their specific needs and challenges, which can provide a reference for the design process. On the other hand, young designers bring new perspectives, creativity, and technical knowledge to the project. This amalgamation of disparate experiences and viewpoints can birth innovative and functional designs catering to the needs of the elderly and a wider audience. Furthermore, such collaboration can foster intergenerational exchange and learning, cultivating mutual appreciation and understanding across generations. The resultant design, a product of this synergy, promises to satisfy aesthetic sensibilities and enhance the quality of life for the elderly.

In light of the preceding contextual motivations, this study amalgamates the

strengths and characteristics of the experience based co-design approach and the design thinking process to co-create a medication assistance design for the elderly. This design incorporates the perspectives of both young designers and the elderly. Using Elder and Youth Co-creation as a catalyst and medication-assistance design as the focal theme, this study probes the effectiveness of the Elder and Youth Co-creation model with the following objectives:

To investigate, from the perspective of empathy, the influence of the Elder and Youth Co-creation model on young designers.

To explore, from the standpoint of design thinking, the impact of the Elder and Youth Co-creation model on young designers.

To examine, from a design experience viewpoint, the effects of the Elder and Youth Co-creation model on the elderly.

From the essence of the design model, discern the ramifications of the Elder and Youth Co-creation model on both the youth and elderly cohorts.

2. Literature Review

2.1. Experience Based Co-Design

Experience based co-design (EBCD), initially conceived by Bate & Robert in 2006, stands as an innovative methodology for research focused on enhancing healthcare services. This approach aims to shepherd service improvements through the collaborative efforts of employees and service users, co-creating superior services (Bate & Robert, 2006). Serving as a form of participatory action research, it has been successfully implemented in various healthcare enhancement projects. The crux of this methodology lies in recognizing the experiences of service users as unique and integral components of the process (Brady & Roe, 2020; Green et al., 2020; Iedema et al., 2010; Tsianakas et al., 2012a). Experience based co-design signifies a true partnership amongst stakeholders (Donetto et al., 2015). This approach necessitates the collaboration of healthcare professionals, patients, and caregivers, operating through four phases: garnering experience, comprehending the experience, refining, and tracking progress (Bate & Robert, 2006, 2007a; Tsianakas et al., 2012b). Through this methodology, patients and caregivers come together to identify crucial aspects of the caregiving journey, using them as a foundation for collaborative service improvement. This procedure encompasses eight stages: clinical observations; interviews with service providers and service users; creation of a trigger film (an edited interview film that highlights the service user interview theme); service provider feedback events; service user feedback events; workshops for combined service providers and service users; co-creation design groups, and celebratory events (Donetto et al., 2014). Touchpoint is a core concept in experience based co-design, concerned with identifying those critical moments or events pivotal to a user's service experience (Bate & Robert, 2007a). Considered the epitome of personalization, a touchpoint encompasses those instances where people recall an emotional or cognitive connection (Bate & Robert, 2007b). Experience based co-design places particular

emphasis on the emotional aspects of touchpoints. By articulating these emotions and analyzing these touchpoints, more profound comprehension is cultivated among other participants. Once these points of interaction or contact are discerned and understood, the process of melding design concepts with service users and stakeholders in the co-design process is simplified. Integrating the patient's experience into the service design process does more than just highlight specific strengths and weaknesses of the services provided to enhance healthcare quality. It also fosters interaction amongst multiple stakeholders through co-creation and design, ensuring that the most efficacious results are established for service consumers (Pollitt et al., 2023).

This method hinges on the active participation of all involved parties, bridging the gap between patients' actual experiences and the design of healthcare interventions. Its strength lies in its capacity to comprehend patients' needs more effectively by involving them and other stakeholders in the design process. This methodology ensures that healthcare providers understand the experiences, viewpoints, and conditions of those they serve, enhancing the outcomes and quality of care. It enables the generation of more effective and sustainable medical interventions, better tailored to meet patients' needs and improve their health while promoting stakeholder engagement. By empowering patients to co-design solutions, experience based co-design cultivates a sense of ownership and participation amongst patients, resulting in superior outcomes and improved overall quality of care. The inclusivity of this approach ensures a holistic perspective when crafting healthcare solutions. It also advocates for continual evaluation and assessment of design solutions to ensure they remain pertinent and responsive to the dynamic needs of patients.

A prevalent challenge encountered by the majority of experience based co-design initiatives is the need for mechanisms for co-designing and refining through collaboration. Current research indicates that collaborative design methodologies can be used with other participatory methods (Boyd et al., 2012). An increasing body of research is collaboratively designing healthcare services with patients, caregivers, and other stakeholders, employing techniques such as experience based co-design and design thinking. These methodologies' foundational principles involve incorporating the end user's venture into the design process (van der Wal et al., 2018), focusing on the end user and designing solutions that enhance individuals' personal experiences of products or services. It also advocates for continual evaluation and assessment of design solutions to ensure they remain pertinent and responsive to the dynamic needs of patients. While Experience Based Co-Design capitalizes on a more tailored approach, specifically addressing healthcare and integrating patients' and stakeholders' unique experiences, there exists another universally acclaimed method that widens this participatory scope. When it comes to designing solutions across a broader range of contexts, beyond just healthcare, the "Design Thinking" methodology steps into the limelight. Not limited to any specific industry, it offers a generalist, hu-

man-centric approach to problem-solving.

2.2. Design Thinking

Design thinking has been recognized as a formal approach to creative problem-solving, and its application is rapidly proliferating across diverse organizations (Magistretti et al., 2022). This approach, fundamentally people-centered, employs empathy, experimentation, and iteration to generate solutions that align with the needs and expectations of the end-users (Brown, 2008; Gibson & Brown, 2009; Lockwood, 2010). The emphasis lies in understanding users' challenges to craft innovative, practical solutions. It encompasses a series of steps: problem definition, user research, ideation, prototyping, testing, and enhancement. Through experimental exploration within this process, designers can validate presumptions, identify issues, refine solutions, and stimulate novel insights, leading to innovative products and services (Hampel et al., 2020). Many researchers find design thinking versatile, fostering creativity across diverse contexts (Jaskyte & Liedtka, 2022; Magistretti et al., 2022).

Central to design thinking is the development of skills crucial for creative problem-solving, catering to diverse organizational challenges. This hands-on approach transforms learners into confident innovators (Goldman & Zielezinski, 2016). Presently, design thinking enjoys considerable favor among innovation practitioners and academics, many of whom advocate for design thinking as an exceptionally relevant method for innovation (Gibson & Brown, 2009; Liedtka, 2015). Design thinking primarily aims to cultivate innovators capable of utilizing the design thinking paradigm to translate ideas into tangible outcomes, transform organizations, and effect change in all facets of life (Wolniak, 2017). As a problem-solving methodology, design thinking has emerged as a guiding approach for industrial design instruction, training, and practice in numerous higher education institutions. The fundamental essence of design thinking extends beyond the basic people-oriented and user-centric principles proposed by the industrial design methodology. In university education, industrial design students, through systematic and professional learning, are anticipated to develop three abilities. First, a robust professional capability at a foundational level enables them to independently conceive product plans using a mature thinking process. Second is the capacity for interdisciplinary thinking, empowering them to confront and resolve diverse problems using a creative mindset. Third, possessing other social abilities allows them to form complex social empathetic thinking. In this educational context, teachers often act more as facilitators, kindling students' creativity (Scheer et al., 2012; Pande & Bharathi, 2020; Kelley & Kelley, 2013).

Building on these foundational principles and the role of facilitation in education, the broader benefits of design thinking in various sectors become evident. Design thinking's advantages encompass:

1) User-centricity: Tailoring solutions to specific end-user requirements.

2) Fostering Creativity: A broad application across industries, nurturing innovative outcomes.

3) Collaboration: Merging diverse expertise to produce unique solutions.

4) Iterative Evolution: Continuous refinement based on feedback. Such a method yields solutions that resonate with user needs, enhancing their chances of success and wider impact.

2.3. Elder and Youth Co-Creation

With the rising trend of an aging population, seniors' demand for products and services is increasing. Presently, the dominant paradigm of product and service design and development emphasizes meeting the actual needs of users, advocating a user-centered design concept and model (Wilkinson & De Angeli, 2014). As a result, the design has changed from a single-oriented product to a diversified system and service, and the definition of users and designers has become more diversified. The concept has also changed from designing for users to designing with users. The design process also emphasizes that stakeholders' ideas should be included in the design and development.

User-centered design has thus progressively developed into a participatory design, fostering the co-creative design concept. This approach encourages the collaborative participation of individuals from different disciplines, promoting collective ideation and action, while providing a platform for expressing creativity and facilitating communication. It rests on the belief that everyone possesses design creativity and can partake in the co-creative design practice. In co-creative design, the roles of users, researchers, and designers intermingle. As experts of their own experiences, users are more actively involved in the ideation phase and the development of concepts. Researchers and designers, on the other hand, provide tools for users to generate and express ideas, working together to glean insights through these tools. Embracing co-creation as a mindset represents the most widely utilized approach with the greatest potential to impact people's lives positively. From this perspective, the practice of value co-creation can be employed by individuals with varying design capabilities. From design experts with extensive design experience to seniors or children without design experience, they can play a significant role in the early design stage. The co-creative design emphasizes user participation during the decision-making stage and user involvement when generating creative ideas. Throughout the design process, design experts and researchers collaborate to develop design tools that aid user-type designers in expressing their personal perspectives (Sanders & Stappers, 2008).

Merkel and Kucharski's (Merkel & Kucharski, 2019) review indicates that existing research on participatory design for older adults often involves older adults only partially or even in a single phase, with little research involving older participants throughout the process and with actual decision-making power. Similarly, designers should not merely treat senior participants as a "data source".

When older individuals are fully engaged, greater emphasis should be placed on the entire design process to genuinely cater to their diverse expectations and needs (Beimborn et al., 2016). Various studies illustrate the potential for generating numerous valuable ideas and solutions when seniors or users are provided with appropriate guidance (Greenhalgh et al., 2015; Joshi & Bratteteig, 2016). Blanchard-Fields (Blanchard-Fields et al., 2007) propose that effectively addressing individuals in managing everyday tasks can enhance their physical and psychological well-being. Given these insights, it is essential to champion a holistic approach in participatory design that actively involves the elderly throughout the design process. This empowers older individuals to contribute their unique perspectives and ideas, ensuring that the end products or solutions meet their needs and expectations and ultimately improve their quality of life.

Intergenerational co-creation, represented by the collaboration of young people and the elderly, showcases an innovative approach emphasizing the mutual benefits of knowledge exchange, shared experiences, and collective problem-solving (Newman & Hatton-Yeo, 2008). The method of elder and youth co-creation enables individuals from diverse age brackets to learn from one another and contribute toward mutual understanding.

Huang, Xiao, and Zheng research on elder and youth co-creation has shown that it can increase the general self-efficacy of some elders and the level of empathy of youth designers (Huang et al., 2021). A study by George & Reddy explored the issues in implementing youth and elderly co-creation within an educational setting (George & Reddy, 2019). The findings revealed that cooperation between the youth and the elderly enhanced learning outcomes for both demographics, increasing participation and satisfaction levels. Abeyaratne applied the youth and elderly co-creation to healthcare programs. Their research demonstrated that this method improved health outcomes for older individuals and fostered greater empathy and understanding among younger participants (Abeyaratne et al., 2020).

Moreover, a study by Palmieri merged anthropological design methods with participatory design approaches through workshop models, collaboratively producing, curating, and reconfiguring activities for future housing (Palmieri et al., 2021). The outcomes indicated that this approach supported individuals in discussing housing issues and expanded their imagination, encouraging them to reconsider how their lifestyles are formed and how they may differ. This growing body of evidence suggests that youth and elderly co-creation is a promising approach for fostering intergenerational understanding and collaboration, enhancing educational and health outcomes, and encouraging innovative thinking in various contexts, from housing to healthcare.

In the design field, there has been a growing emphasis on encouraging non-professionals to take an active part in the design process rather than playing a passive role. However, the existing participation of elderly people in design development tends to be more of a passive, consultative role, with few partici-

pating in the product design process. This may result in the resultant design output deviating from user needs. Sanders & Stappers points out that the user is a passive research subject in traditional user-centered design (Sanders & Stappers, 2008). Researchers glean knowledge from theory and construct additional user information through observation and interviews. Designers passively receive this knowledge through reports and generate ideas and concepts based on this data. Sanders & Stappers stress the need to shift from designing for users to co-designing with users. In the fuzzy front end of product and service development, it's essential to get closer to the object of your design (Sanders & Stappers, 2008). Researchers and designers should provide tools for users to ideate and express ideas and then co-design together, with designers completing the subsequent design details. Especially when designing for the elderly, including them in the design process and co-design together is even more important. This avoids the gap caused by generational differences and age factors (Wilkinson & De Angeli, 2014). This suggests a shift from traditional user-centered design approaches to a more collaborative and inclusive model in which all stakeholders, including older adults, actively participate in the design process.

Collaborative design methods promise increased adoption, relevance, and sustainability. By viewing older adults as co-creators rather than just consumers, we unlock their potential to significantly influence and enrich the design process (Lee et al., 2016; Harrington et al., 2018).

3. Methods

3.1. Research Framework

Building upon the foundational research by Huang et al. (2021), this study further explores the Elder and Youth Co-Creation (EYCC) model's potential. The prior research, predominantly quantitative, shed light on the limitations in current medication bag designs and highlighted the often passive roles the elderly played in the design process. Transitioning to a more qualitative focus, the present study aims to provide a holistic view into the perspectives of both elderly and young designers. By employing focus group methods, we seek to delve deeper into the design needs and considerations of these two demographic groups.

The research stems from the elderly's perspective on medication usage, blending experience based co-design with design thinking methods. This union aims to offer a comprehensive understanding of the elderly's experiences while also addressing the limitations of the former method. The five steps of empathy, definition, ideation, prototyping, and testing in design thinking ensures a more immersive understanding of the elderly's requirements.

To foster collaboration and active participation between the young designers and the elderly, a series of workshops were designed:

1) Engage Workshop: Here, the focus was on promoting mutual understanding, trust-building, and amplifying the confidence of the elderly participants.

2) Empathy Workshop: These sessions deepened mutual empathy and honed

in on a shared design vision.

    3) Define Workshop: They crystallized the core design challenges and the specifics to address.

    4) Ideate Workshop: These were dedicated brainstorming sessions where participants engaged in collaborative design ideation and consensus-building.

    5) Prototype and Test Workshop: These iterative sessions facilitated the evaluation of prototypes, allowing for feedback exchange and design refinement.

    Throughout these workshops, the elderly were encouraged to play an active role, ensuring their lived experiences and insights became integral to the design outcomes.

    The combined methodologies and workshop series led to a comprehensive design approach, encapsulating the unique perspectives and considerations of both demographic groups. The research framework is shown in Figure 1.

3.2. Research Subjects

The subjects of this study are nine elderly women aged 61 to 74 who either have chronic diseases and have been on long-term medication or have taken care of individuals in such conditions, along with eight young designers with design expertise from universities and master's programs, and one teacher with rich experience in leading design thinking to guide the execution of each workshop. Before the experiment began, all participants signed an informed consent form.

3.3. Workshop Process

3.3.1. Engage Workshop

The workshop begins with an explanation of its objectives by the design teacher.
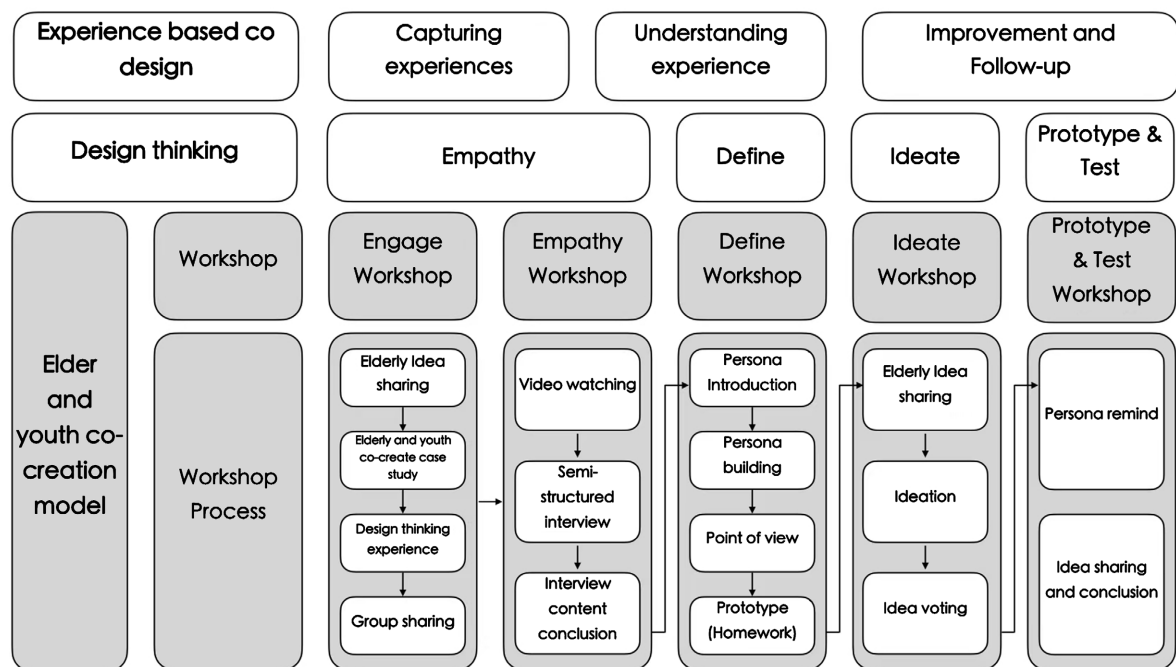

Figure 1. The research framework.

The need for medicine packaging design and its importance is explained, and the participants are introduced. Subsequently, cases of intergenerational co-creation are shared. Through existing relevant issues, the confidence of the elderly in their creativity is enhanced. Also, by analyzing these cases, young designers and the elderly understand the importance of intergenerational co-creation. Next, a design thinking experience activity is initiated, where the design thinking process is introduced. The training involves designing medicine bags or boxes through design thinking. This enables participants to understand the five steps of design thinking quickly. Elderly participants create medicine packaging for each other with the help of young designers. Through the design thinking process, elderly participants interview each other and empathize, define the problem, and then explore and ideate various possible solutions. After creating a concept prototype, the final concept presentation is conducted individually. Finally, the workshop concludes with the sharing of outcomes. Elderly participants who participated in the workshop each share the design they made for another elderly participant, elaborating on the type of medicine packaging design they created.

3.3.2. Empathy Workshop

This stage of the workshop is aimed at helping young designers resonate with the medication habits and problems of the elderly. By employing empathy, they can unearth potential needs of the elderly that may not have been discovered and subsequently categorize the identified problems. The participants first watch a safety video on proper medication usage from the Department of Health and Welfare, which familiarizes the elderly with the correct way to take medications. This also encourages them to reflect on potential issues of medication misuse in their daily lives. Next, a semi-structured interview is conducted between one young designer and one to two elderly participants. Questions from capabilities two and three of the "Five Core Competencies for Correct Medication Use" scale are used as the interview outline. After the interview, each group's young designer consolidates and discusses the sticky notes of the three elderly participants. They summarize and mark all the notes with the same attributes and share the final results with the elderly participants in their group. This process is done to verify the accuracy of the content or make necessary adjustments.

3.3.3. Define Workshop

After the initial two workshops, the elder and the young designers discussed defining a target persona. They combined the personal experiences of the seniors (their medication use, assisting others with medication, etc.) with the results from the previous workshop to develop a character. Before creating the persona, a short video clip and a presentation about medication problems were watched. This guided the seniors and young designers to identify the character's traits and create a representative persona. The elderly and young designers then decided on the persona they wanted to focus on and documented it in the persona dossier. The contents of the persona dossier include the persona's features and es-

sential attributes (portrait, introduction, family situation), medication habits, medication timing, source of medication, pain points, and so on. After creating the persona dossier, they empathetically considered the persona's feelings, pain points, and unmet needs and noted the design viewpoints. Finally, before the concept formation workshop, the elderly independently selected one design and depicted or described a concept using drawings or words.

3.3.4. Ideate Workshop

This workshop aims to have young designers present multiple concepts, sketch out ideas based on the design concepts previously established by the elder, and ultimately allow the group to share and select the idea they wish to transform into a prototype. Initially, the elderly share their design ideas and the outcome of these concepts within the group, while young designers note the corresponding design concepts. Then, the young designers begin to create several images, each based on the ideas of the seniors. These concepts are presented through drawings or written descriptions. Finally, the group shares the design concepts they have formulated. Both elder and young designers vote on all design concepts, selecting one or more to proceed with. The elder and young designers divide the work, selecting different design concepts to work on and completing them before the prototype testing workshop.

3.3.5. Prototype and Test Workshop

Each group presents its design concepts to gather feedback from each of the elders. This feedback will serve as a reference for subsequent modifications to the idea. The session begins with a review of the personas; before sharing, each group's persona and the pain points they aim to solve are explained. Then, each elder shares their prototype based on their chosen design perspective, describing their thoughts, concepts, and the reasons behind their design. During this process, other participating elders suggest prototype modifications and young designers record and organize this feedback on sticky notes. This iterative process allows for a thorough consideration of various perspectives and potential improvements, ensuring that the final design addresses the needs and preferences of the elder effectively.

3.4. Data Collection and Analysis

First, the construction process and tool operation are verified. After participating in five workshops, the focus group method is used to conduct interviews with elder and young designers from different groups. The interview content is transcribed into verbatim transcripts for extraction and induction. The process adopts the viewpoints of credibility, transferability, dependability, and confirmability (Guba & Lincoln, 1989) for review. The second part focuses on the results of the workshops. Nine elders who have never participated in this research workshop and have more than one year of experience in taking medication long-term are recruited for medication bag design testing. Seven tasks are set to

the safety of the medication, side effects, and other aspects of the medication bag questionnaire design. The execution method is to provide the elder with the results of the medication bag design. Then the researcher asks task questions in order (such as next visit time, etc.), and the seniors answer the corresponding answers after reading the medication bag information. During the process, the time it takes for seniors to complete the task is recorded, and scores from 0 to 2 are given based on the correctness of the answer (0 for wrong, 1 for partially correct, and 2 for entirely accurate).

4. Results

4.1. Workshop Results

This study conducted five workshops in different stages, recruiting nine elderly participants and eight young designers. Each workshop lasted about 2 hours. The participants were divided into three groups: three elderly and 2 - 3 young designers. The results of each workshop are as follows:

Engage Workshop: The design teacher explained the workshop's purpose, and the elderly participants understood the importance of medication packaging design and mentioned the inconvenience of the existing packaging for them. Through the elder and youth co-creation cases, the elderly participants understood that there were already examples of elderly people participating in co-creation in Taiwan, and they believed that they could also participate in the design. Then, the elderly were paired up to design a medicine box or bag that meets the other's needs. The elderly interviewed each other for empathy, and the young designers assisted in recording critical points on the side. The recorded content included that the box for placing the medicine was too small, and it would be more convenient to pack in bags, and they also needed graphic symbols to help read the precautions. Then they drew the concept defined by the needs. Finally, the elderly participants each presented their packaging design ideas to each other.

Delving deeper into the outcomes of the Engage Workshop, the central findings were multifaceted. First, the elderly participants recognized the inherent flaws and inconveniences in the current medication packaging system, suggesting an existing gap in design catered to their needs. Through understanding prior co-creation cases in Taiwan, they also grew confident in their ability to actively contribute to the design process. From the empathy interviews, a clear consensus emerged on the packaging's size issue and the preference for bags over boxes, highlighting the elderly's practical considerations. Moreover, there was an expressed need for graphic symbols to facilitate medication understanding. The culmination of these insights led to the idea of incorporating graphic indications on medicine bags, streamlined according to medication schedules. This idea not only addressed their practical concerns but also underscored the importance of intuitive design for the elderly, ensuring safety and adherence. The proposed designs are illustrated in Figure 2.

Empathy Workshop: The focus of this stage was to understand the medication habits and problems of different elderly participants in each group. By watching the correct medication videos from the Ministry of Health and Welfare, some elderly participants realized they have some medication habits that could be improved. Through semi-structured interviews, the elderly and designers further understood the needs or medication experiences of the elderly in the same group, whether as themselves or in the role of caregivers. In the process, young designers actively listened and dug deep into the issues, subsequently turning the needs and pain points of the elderly into opportunities for innovation.

Delving into the tangible outcomes, taking the results of one group as an example, this group delineated their insights into 16 clear-cut categories such as consulting doctors, nuances of medication bag information, and established practices of medication storage. Two pivotal findings emerged: Firstly, before administering medication, the elderly typically consulted with doctors when they sensed any health anomalies. Secondly, there was a consistent pattern where the elderly stored their repackaged medication in a designated location, underscoring the significance of routine in their medication habits. These crucial behavioral patterns emphasize the imperative for design solutions that are not just innovative but also intuitive to the elderly's established practices, as shown in Figure 3.

Define Workshop: Based on the results of the empathy phase or the personal experiences of the elderly, each group of young designers and the elderly jointly set up personas, allowing young designers to understand the elderly from a more objective perspective and clarify their possible needs and pain points. In this
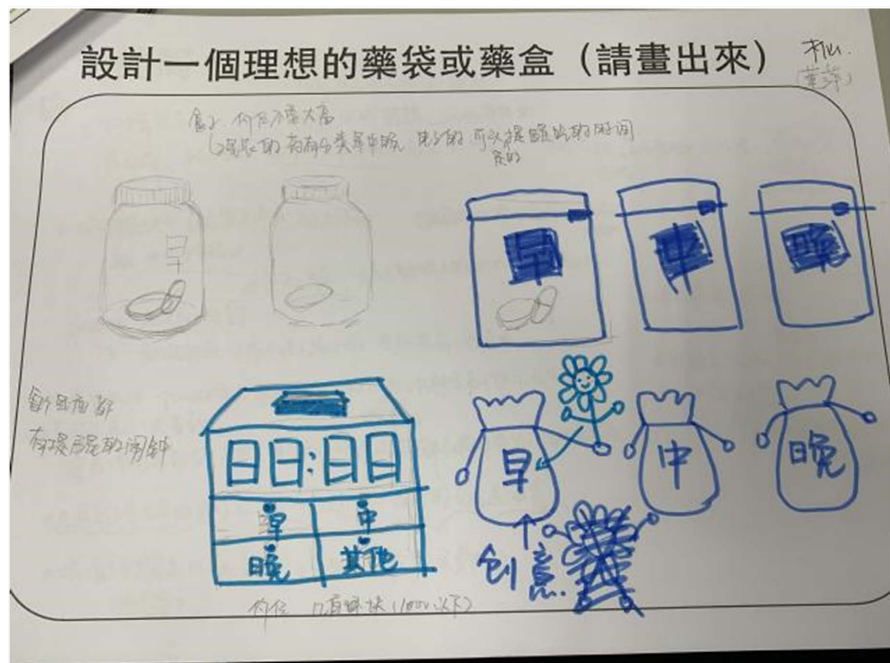

Figure 2. Design thinking process experience results.

Going abroad	The rest of the medicine	Consult a doctor	How they take medicine	Receive medicine situation	The reason for taking medication	Pay attention to the precautions of medicine	Avoid multiple medications
Maintain the habit of taking medications	Don't buy over-the-counter drugs	Fixable dosage	Pay attention to the body's blood pressure and blood sugar	Fixable medicine taking time	The information on medicine bag	easy to carry with separate packing	The medicine is placed in a fixed position

Figure 3. Single-group interview results consolidation.

case, an 80-year-old Mr. Dai is the representative character. Because of dementia after surgery, he easily believes in the medications recommended by others, and he can't understand the precautions of the medicines. He doesn't have good medication habits, the timing of taking the medication is irregular, and he needs family members or caregivers to remind him to take the medicine. In addition, the caregiver helps repack the medicine but is worried that the box or bag for holding the medication cannot be adequately sealed, quickly dampening the prescription.

After detailing the persona of Mr. Dai, the results from the workshop illustrated the very real challenges many elderly face, magnifying the urgency of design interventions. The persona shed light on common hurdles elderly individuals face - susceptibility to misleading medication information, inconsistent medication schedules, and a heavy reliance on caregivers. Moreover, the design concerns raised by caregivers regarding the quality of storage solutions, such as poor sealing leading to potential moisture damage, highlighted overlooked areas in current design methodologies.

Drawing upon Mr. Dai's persona, the collaborative effort between the young designers and elderly was crystallized into four focused design viewpoints. These viewpoints were not just theoretical concepts; they embodied real-world concerns and needs. It is essential to note that these viewpoints represent a significant evolution from the preliminary understanding, informed by hands-on interaction and empathetic engagement with the elderly. These synthesized viewpoints, anchored in real-life challenges, set the stage for pragmatic design solutions, as shown in Figure 4.

Ideate Workshop: This workshop focused on transforming the insights gained from earlier stages into tangible design solutions. Collaboratively, the elderly and young designers took the high-voted concepts from the previous workshop and began the process of ideation. Using simple prototyping methods, participants were encouraged to utilize paper and any available materials to bring their ideas to life.

For instance, the elderly tailored their concepts specifically to address the primary and secondary design viewpoints identified earlier. One such innovation was in response to the highlighted need for "correct and convenient re-

packaging of medicines". Recognizing the crucial role that clear classification and preservation of medicines played for the elderly, they introduced a graphical approach to help users swiftly discern the time of medication intake. Symbols like the sun were used to signify morning doses, and the moon was used for the evening. These intuitive symbols were seen as a bridge, connecting the design to the daily lives of the elderly, ensuring that the end solutions were not just innovative but rooted in real life applicability, as shown in Figure 5.

Prototype and Testing Workshop: The primary objective of this stage was to rigorously evaluate the usability of the initial design concepts. Each group initiated the session by revisiting the personas and pain points they had identified, ensuring a rooted context. Subsequently, prototypes crafted by group members were presented for examination.

A dynamic feedback loop was incorporated. Members from other groups were engaged to assess these prototypes, offering a fresh and diverse perspective. Young designers diligently documented all feedback, employing Post-it notes as
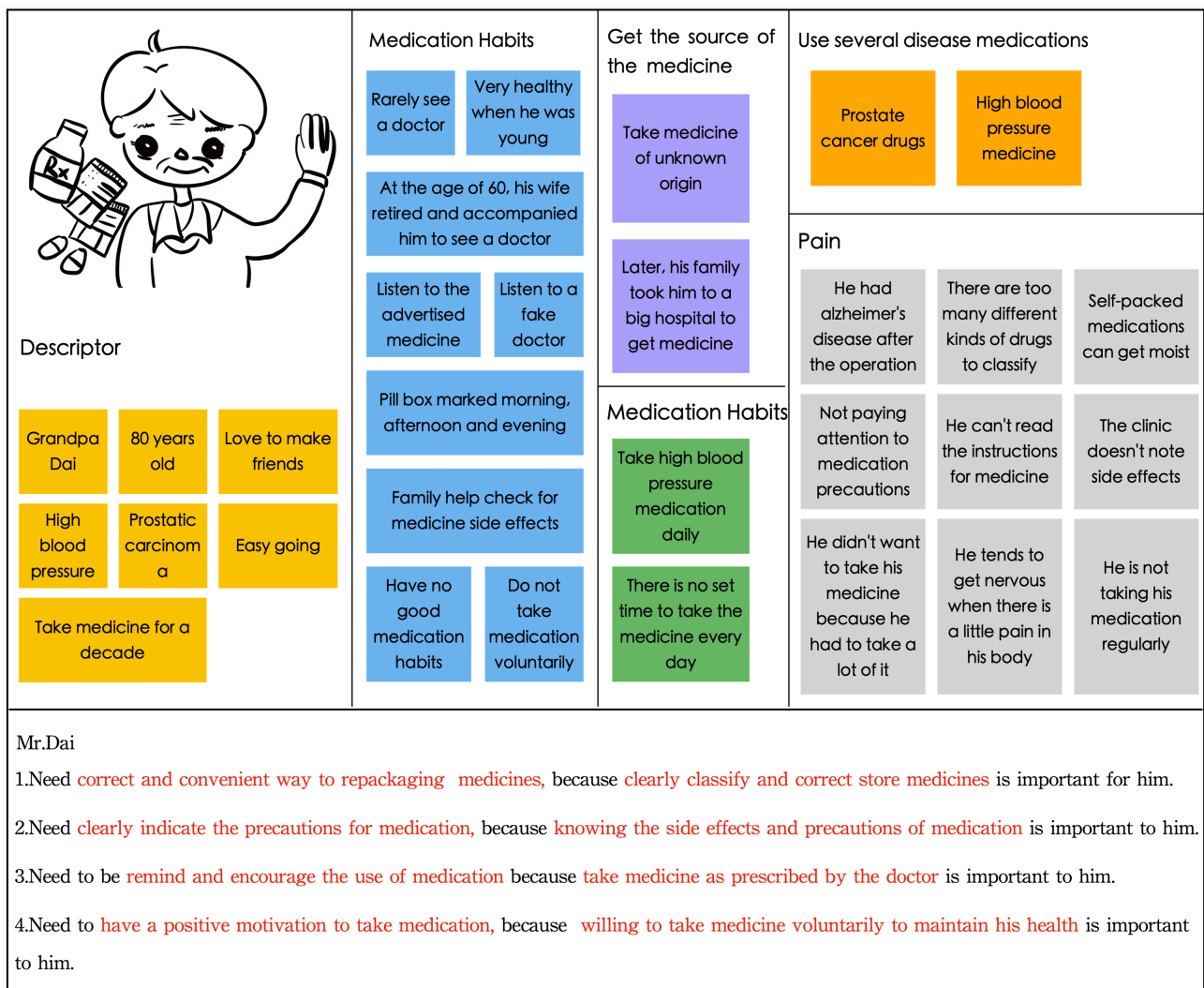

Figure 4. Single group blog and design viewpoints results.

a visual tool to capture the evolving design narrative.

A notable outcome emerged from the prototype evaluations. Young designers gravitated towards a color-coding system to demarcate medication times, complemented by varying medicine bag sizes for packing. The elderly, reflecting on these designs, underscored the potential of making them more user-centric. Their suggestions encompassed the introduction of eye-catching packaging or even a parent-child packaging format. This, they believed, would not only make the medication experience more engaging but could also motivate the elderly to be proactive about their medication schedules, as shown in Figure 6.

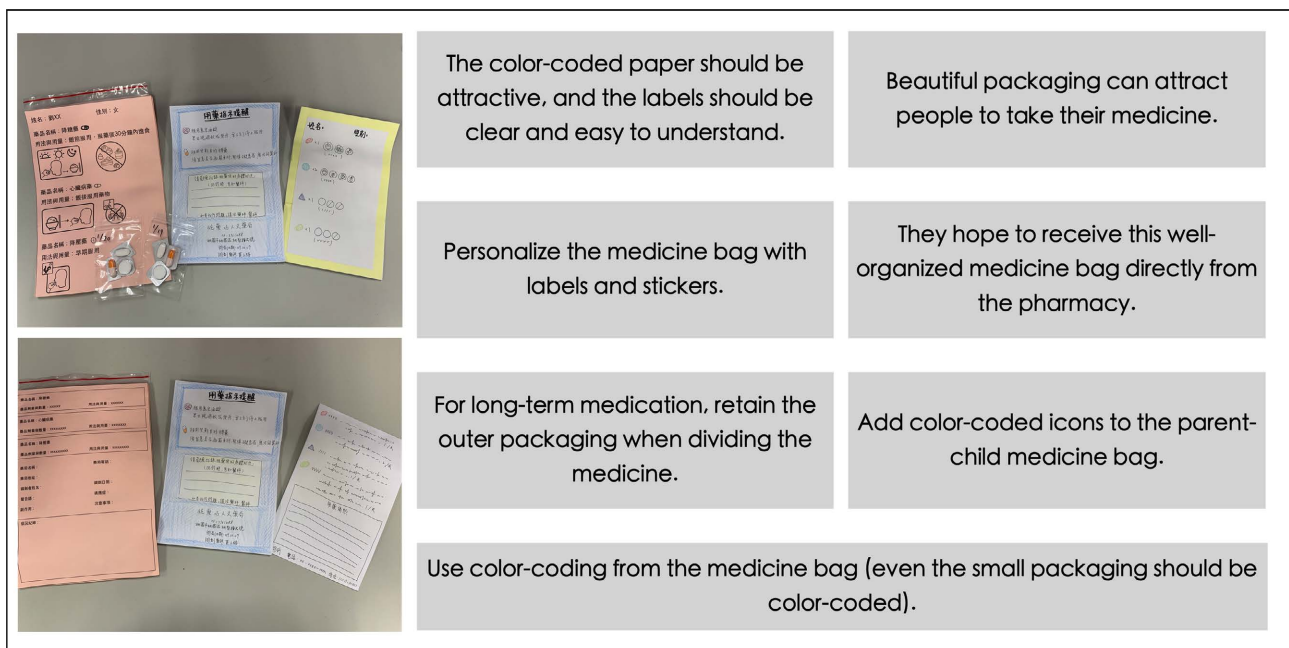**Figure 5.** Single group elderly design results.

The color-coded paper should be attractive, and the labels should be clear and easy to understand.	Beautiful packaging can attract people to take their medicine.
Personalize the medicine bag with labels and stickers.	They hope to receive this well-organized medicine bag directly from the pharmacy.
For long-term medication, retain the outer packaging when dividing the medicine.	Add color-coded icons to the parent-child medicine bag.
Use color-coding from the medicine bag (even the small packaging should be color-coded).	

Figure 6. Single group design concept feedback results.

4.2. Examination Results of Medication Packaging Design

Upon the culmination of our workshop, this study aspired to hone the designs produced to align with existing medication bag design standards. Drawing guidance from the National Health Insurance Act, Good Pharmacy Dispensing Practice Guidelines, and the National Health Insurance Medical Act, we refined the design outcomes depicted in Figure 6, as showcased in Figure 7. Owing to the physiological decline that accompanies advanced age, a majority of our elderly participants necessitate the long-term ingestion of a variety of medications. To facilitate the swift identification of these medications, we implemented symbolic representations of each drug on the front of the medicine pouches. Moreover, the visual cues of the drug, instructions for use, dosage, and potential side effects were strategically consolidated into a single section, incorporating an additional feature for the elderly to record their medication symptoms. This feature serves to enhance their dialogue with their physicians during follow-up visits. Furthermore, during the workshop, we noted a common practice among the elderly to self-divide their medication by meal, leading us to design the pouches accordingly. This arrangement empowers our elderly participants to conveniently administer their medication at various times of the day, depending on the symbolic illustration of each drug.

This stage invited nine elderly women, none of whom had previously participated in this study, ranging in age from 66 to 84 years old and routinely consuming 1-2 varieties of medication to evaluate the outcomes jointly. The researchers randomly selected one type of medication pouch for testing, with the results as shown in Table 1 and Table 2. Participants took the longest average time of 61.3 seconds to identify the medication (Question 1), while they spent an average of 7.4 seconds determining how many times a day they should take the drug (Question 4). Regarding accuracy, Question 4 had the most correct results, while Question 6 had the least. It was found during the study that the reason some participants took a longer time to answer questions (such as Question 1)
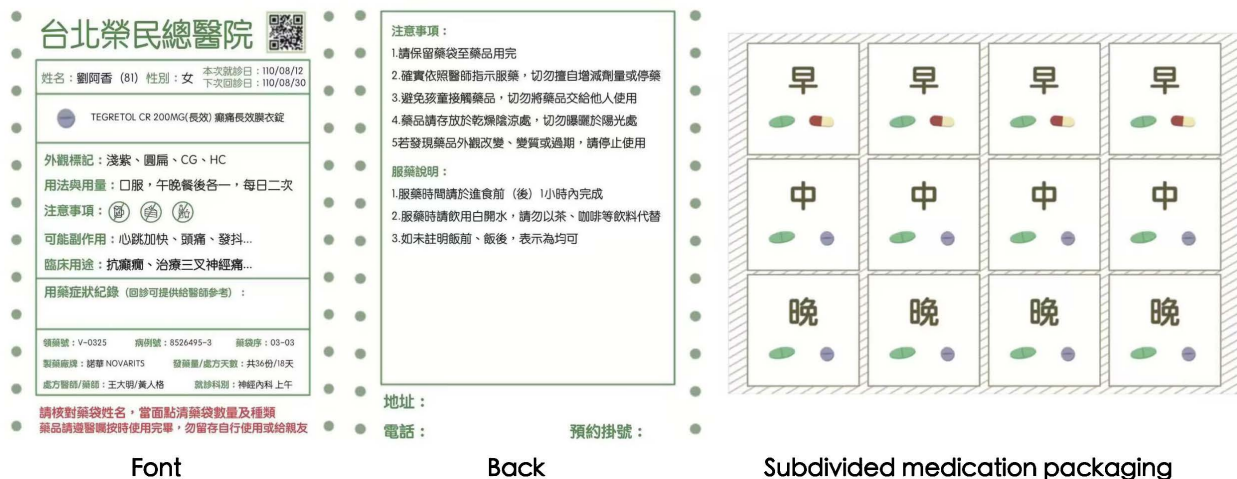

Font　　　　Back　　　　Subdivided medication packaging

Figure 7. Design optimization results.

Table 1. Medication packaging design results validation (Questions 1 - 4).

Number	1. Could you identify the specific medication?		2. When should this particular medication be consumed?		3. What are the potential side effects of this medication?		4. How many times a day should this medication be taken?	
	Seconds	Correctness	Seconds	Correctness	Seconds	Correctness	Seconds	Correctness
1	9	2	146	0	7	2	7	2
2	88	1	60	1	12	2	3	2
3	95	1	7	2	35	1	7	2
4	16	2	4	2	4	2	2	2
5	132	2	3	2	45	2	30	2
6	/	0	/	2	/	2	/	2
7	/	2	/	2	/	2	/	2
8	82	2	4	2	1	2	2	2
9	7	2	3	2	7	2	1	2
Mean	61.3	1.6	32.4	1.7	15.9	1.9	7.4	2.0

Table 2. Medication packaging design results validation (Questions 1 - 4).

Number	5. When is the subsequent consultation scheduled?		6. If discomfort is experienced after medication, where on the pill package could you document this?		7. Distinguish between morning, midday, and evening medication.
	Seconds	Correctness	Seconds	Correctness	Correctness
1	11	2	17	2	38
2	3	2	54	2	33
3	/	0	/	0	42
4	7	2	1	2	24
5	15	2	50	2	60
6	/	0	/	1	/
7	/	0	/	0	/
8	49	2	4	2	48
9	80	2	/	0	153
Mean	27.5	1.3	25.2	1.2	56.9

was that the appearance of the medication set for the study was the same as the medication the elderly were currently taking, causing their answers to be based on their current medication instead of the information on the medication pouch. However, after several prompts by the researchers, most participants could answer the questions correctly.

Participants stated that compared to the current design, the optimized medication pouch design is more readable due to fonts and colors. They suggested

enlarging the symptom record field and adjusting the size of the medication pouch according to the amount of medication for environmental conservation. The segmented design of the information on the medication pouch makes it easier for users to find the corresponding information. As for the segmented medication pouch design, they have bags with medication illustrations and words that can clarify how to distribute the medication, when to take which pouch, and that medicine is more convenient to carry after being segmented.

4.3. Interview Results

Focus group interviews were conducted by the researcher in small groups at the end of the workshop according to the interview outline. Upon executing five workshops, this study concentrated on conducting focus group interviews with young designers and senior participants, subsequently coding the results. The results show that through co-creation between young and old, mutual understanding and trust can be built, and design solutions can be inspired through mutual stimulation of core needs and problems of common goals. The process enhances empathy and boosts creative confidence in the elderly. The following discusses each session from the perspectives of young designers and the elderly:

Engage Workshop: Young designers expressed that through the workshop, they could grasp the interaction patterns (such as the critical points of medication use hidden in the conversation), thoughts, and attitudes of the elderly, simultaneously helping to establish a trust-based interaction model. The elderly believed that interviewing each other among the elderly could help them deeply understand each other's medication habits.

Empathy Workshop: After participating in the interactive workshop, questionnaires as interview outlines helped young designers understand the needs and pain points of the elderly contextually. It also served as a basis for extending the conversation. This approach helped to unify the design goals of the elderly and quickly understand tasks to stimulate more ideas. The record of post-it notes during the workshop helped the elderly to remember.

Define Workshop: By depicting the character in detail, the real needs of the target users were discovered, and it also promoted empathy and communication towards the users. When discussing with the elderly, it could be more focused and point out the existing problems in a targeted manner. The elderly believed that through equal interaction, they could stimulate interaction enthusiasm and depth.

Ideate Workshop: The experiences of the elderly and the creativity of young designers helped young designers break through the thinking framework and jointly stimulated innovative results across generations. It was found that if young designers helped the elderly to present their ideas, it could encourage more participation from the elderly.

Prototype and Testing Workshop: As the users of design results, the elderly could help young designers to propose aspects that need optimization more in-

tuitively. In prototype production, young designers could better understand the troubles and difficulties of the elderly with medication.

Views on elder and youth co-creation after the workshop: Young designers, in their interaction process with the elderly, would explain first and then compromise to avoid misunderstandings, respect the thoughts of the elderly, and try to solve and communicate. Some participants pointed out that the elderly's thinking tended to be conservative, and the degree of change following generations was less. The elderly believed that their thinking and problem-solving methods in the past tended to be individual, but through teamwork, the solution could be more complete. Through these workshops, young designers could empathize more with the elderly around them, understand the existing problems and needs in their lives, and try to help them improve. On the other hand, the elderly gained confidence in completing tasks at each stage, increasing their ability to do hands-on production and willingness to brainstorm. They also began to apply the knowledge about medication learned in the process to their lives and pay attention to the medication conditions and changes in the medication bag designs of people around them.

5. Discussion

From the viewpoint of elderly medication, this study combines experience based co-design and design thinking. It examines how the elder and youth co-creation model impacts senior citizens and young designers. We then compare our findings with participant designs, international studies, and theories of experience based co-design.

5.1. Delving into the Discussion of the Elder-Youth Co-Creation Paradigm versus Traditional Participatory Design Processes

Experience based co-design involves patients in refining the medical process. However, it can be limited by inadequate training for patients and medical staff, and often neglects to evaluate the co-design process. This can intensify imbalances and conflicts between patients and medical personnel (Andersson & Olheden, 2012; Bate & Robert, 2006; Iedema et al., 2010). Integrating design thinking can improve collaboration. By fostering exploration and iteration, design thinking produces outcomes tailored to genuine needs. It equips people with creative tools to tackle diverse challenges, even if they aren't trained designers. To ensure that the outcomes truly resonate with the target group, involving stakeholders in the participatory design is essential (George & Reddy, 2019). It is crucial to involve end-users, ensuring their specific needs are understood and satisfied through their experiential contribution, positioning them at the design process's core (Martin et al., 2020). The interviews revealed that both elderly participants and young designers noted that incorporating seniors into the design process led to outputs more aligned with user needs. Besides deeply understanding stakeholder needs and daily life, stakeholders must also comprehend

the technological possibilities and implementation opportunities (Trettin et al., 2021). Research suggests that designs co-created by the elderly and young designers are more user-centric. By engaging seniors alongside young designers, older participants become more confident in their creative abilities. This collaboration also offers younger designers invaluable insights into the elderly's experiences, promoting knowledge exchange. Elderly participants shifted from passive roles to active knowledge-sharing co-creators. Past participatory design initiatives have encountered empowerment disagreements, which might influence stakeholders if their ideas are not recognized or lack sufficient discourse power, resulting in ideas not being adopted (Schneider et al., 2018). The elder and youth co-creation model champions a shift from designing for users to co-designing with them. It values everyone's input, boosting inclusivity in the design process. An inclusive design strategy ensures everyone's aspirations and concerns are taken into account, enhancing the final outcome (Murdock et al., 2023). Regular, respectful communication is the backbone of co-design. Holding frequent workshops ensures all co-creators can contribute equally, share their viewpoints, and engage in evaluation.

5.2. Exploring Elder-Youth Co-Creation Tools

Co-creation design tools stimulate the creativity and ideas of participants, facilitate direct communication and exchange, encapsulate the incremental achievements of the design phase, and present the final prototypes (Madrigal-Cadavid et al., 2020; Singanamalla et al., 2019). These tools have proven to help both young designers and the elderly articulate their needs and perspectives. Such mutual learning fosters understanding between these two groups. Trust and respect within these relationships ensure that design aligns closely with user needs (King, 2020; Woodcock et al., 2020). The co-understanding of the design process and content aids in attaining broader common goals (Kleinsmann & Valkenburg, 2008).

Design thinking focuses on tools and methods such as simulations, brainstorming, design sprints, role-playing, drawing, and visualization (Carlgren et al., 2016; Liedtka, 2015). The intergenerational model in this study deepened understanding through direct engagement with the elderly, revealing their unique needs and perspectives. Methods like semi-structured interviews, often steeped in empathy, shine a light on real-life experiences, ensuring designs meet genuine user demands (Kolko, 2015). Conception and definition are crucial design thinking processes for cultivating creativity and innovation in any field (Loewe, 2019).

Intergenerational co-creation, facilitated by questionnaire and interview outline tools, understands users' demands and identifies pain points through the elderly's stories. Discussion and sharing ideas with the elderly result in unique insights, leading to a better understanding of precise needs. Persona building helps communicate with other stakeholders, guiding design decisions, and eva-

luating design concepts (Chang et al., 2008). During the problem definition phase, personas are created based on the life experiences of the elderly in their group or as caregivers. This contributes to the realism of the persona characters, and through interviews, the establishment of personas can help the elderly converge target customers and clarify pain points. Elderly interviewees mentioned that persona character development can help respondents design for specific roles. Brainstorming is instrumental in invigorating creativity. It cultivates an environment where diverse ideas flourish and obstacles are overcome (Tu et al., 2018). In this study, the elderly and young designers brainstormed together. Traditionally, the elderly have been somewhat sidelined in design processes. Their active participation in co-creation workshops, however, showcases their invaluable life experiences and offers a fresh perspective. Their inclusion alongside younger designers brings a multifaceted dynamism to the design process, truly embodying the essence of intergenerational innovation.

5.3. The Influence of the Elder and Youth Co-Creation Model on Young Designers

Research indicates that after the workshop, students reported being more likely to understand and empathize with the issues faced by the elderly (Abeyaratne et al., 2020). Empathy can help designers better understand the problem (Harrington et al., 2019). This study also shows that in the elder and youth co-creation model, due to the participation of the elderly, young designers, during the interview, mentioned that sharing their own experiences with the elderly allowed for a more empathetic problem-solving perspective. In prototyping, understanding the pain points of the elderly becomes more accessible, and the young designers felt that participating in elder and youth co-creation with the elderly improved their ability to empathize with the elderly around them. Intriguingly, the elderly, even without prior design experience, brought fresh, unexpected insights to the table. These unique viewpoints often aligned closely with user needs, providing a reservoir of user-centric solutions (Mansson et al., 2020). Young designers expressed that such collaborations enabled them to diverge from conventional thinking, thereby fostering a multi-faceted approach to problem-solving.

Research by Zamenopoulos & Alexiou suggests that stakeholders with different experiences, skills, knowledge, and needs can collaborate in co-creative design (Zamenopoulos & Alexiou, 2020). Students realize they can provide support, even with limited technical abilities. This study also shows that a team collaboration model can generate more ideas, allowing everyone to present their views for discussion. During co-creation, each elderly participant's ideas and creativity are collected and organized, combined with the concepts of design students, and presented collectively in the phase-based results display to affirm internal team trust and perfect the outcome.

Co-creation in design can help cultivate creative thinking in students and serve as a catalyst, motivating creativity through active participation and involvement of different people (Balamuralithara et al., 2021). In the elder and

youth co-creation model, young designers stated that the elderly used readily available materials for prototyping to present their ideas quickly. Traditionally, young designers pursue perfection and use detailed models for presentation. The involvement of the elderly has brought a different mode of thinking to young designers.

5.4. The Influence of the Elder and Youth Co-Creation Model on the Elderly

The elderly participate in every design stage in the elder and youth co-creation model. It was found that, with practical guidance, creativity isn't affected by age. Previous literature indicated that when the elderly participated in the design of mobile healthcare applications, creativity analysis studies showed that the elderly participants, despite having no experience, not only participated in the design process but also developed relatively creative design ideas (Davidson & Jensen, 2013). Furthermore, interviews revealed that after participating in the elder and youth co-creation workshop, the elderly felt that their creativity was unearthed, and they gained a sense of accomplishment.

There is a frequent failure to acknowledge the distinct necessities of the elderly population, and their expertise remains untapped mainly in making critical design decisions (Wilkinson & Cornish, 2018). In the current study, the elderly, stepping into novice designer roles, thrived on timely affirmations from their team. Such support significantly bolstered their zeal for co-creation. Their journey from empathetic ideation to prototyping reflected their growing confidence, further fueled by encouragement from younger designers. They felt validated, witnessing their ideas come to fruition.

Co-creation elevates the elderly's knowledge and skills, enabling them to effectively impart knowledge. Through delineated roles, they collectively align towards a shared vision, fostering collaboration and innovation among peers. Such engagements bolster their self-worth and sense of achievement. Past literature has mentioned that the contribution of participants to the development of a specific product is crucial to the success of the product. Users can see their suggestions implemented before the product is completed and feel their value in this process (Bellei et al., 2020; Biduski et al., 2020). Interviews further highlighted the importance of celebrating the elderly's ideas and contributions in the co-creation process. Recognizing their novel designer role bolsters their confidence, facilitating trust-building with the younger generation. Such harmonious relationships amplify group cohesion, laying a robust foundation for future designs.

6. Conclusion

This study, conducted against an aging society, focuses on designing medication assistance for the elderly, using the elder and youth co-creation as the intervention method. After five co-creation workshops, the study explored the impact of
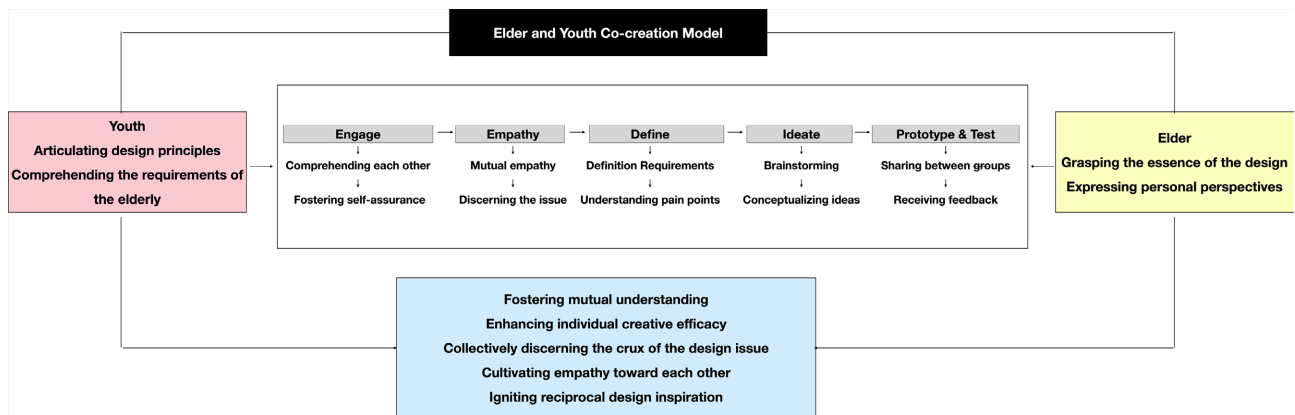
Figure 8. Elder and youth co-creation model.

the elder and youth co-creation model on the elderly. The results showed that this model could enhance the empathy of young designers towards users, serve as a method to stimulate diversified design ideas in young designers, and shift the role of the elderly from passive to active participation. This model enhances the creativity and confidence of the elderly and encourages their active participation in discussions. This study illustrates the cooperation and construction method of the elder and youth co-creation model, as shown in **Figure 8**.

In addition to researchers, young designers, and elderly users, stakeholders related to the issue can also be included in the elder and youth co-creation model. Medical staff, pharmacy workers, and caregivers can be had for medical-related issues. With the arrival of an aging society, the elderly often suffer from multiple chronic diseases and need to take various medicines. Therefore, the researchers chose the design topic of "medication assistance design" for discussion. In the future, more themes can be considered for a talk, using the elder and youth co-creation model to solve some problems an aging society brings. This study only combines experience based co-design and design thinking. Although it has gone through practice and optimization, there are still limitations in applying theory during the practice process. In the future, other participatory design theories, such as actor-network theory, distributed participatory design, and social innovation theory, can be incorporated, continuously adjusting and optimizing in line with actual conditions.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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