Advances in Consumer Research
https://acr-journal.com/
Volume-2 | Issue-5 | Nov 2025
Original Researcher Article

The Development Of Design Framework On Outdoor Fitness Equipment (OFE) At Urban Parks In Klang Valley, Malaysia For Product Design Planners.

Mohd Farhan Ahmad Shukri[1*2], Ahmad Rizal Abdul Rahman[1], Nik Shahman Nik Ahmad Ariff[2]*, Mohamad Fairuz Abdul Rahim[2]
[1]Faculty of Design and Architecture, Universiti Putra Malaysia 43400 UPM Serdang Selangor, Malaysia.
Email ID : gs56233@student.upm.edu.my Email ID : rizalrahman@upm.edu.my
[2]Program of Industrial Design, Department of Creative Artificial Intelligence, Faculty of Artificial Intelligence, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia.
Email ID : mohdfarhan.as@utm.my , Email ID : nikshahman@utm.my , Email ID : mohamadfairuz.ar@utm.my

Acceptance- 22/10/2025
Received - 18/10/2025

ABSTRACT
The rapid urbanization of the Klang Valley, Malaysia, has led to increased provision of Outdoor Fitness Equipment (OFE) in urban parks to support active living and community well-being. Despite their proliferation, existing OFE installations often lack a systematic design framework that integrates user perception, usability, and freetime considerations. This study, situated within a Design and Development Research (DDR) methodology, aims to propose a comprehensive design framework that enhances OFE usability for middle-aged urban park users. Using a mixed-methods approach involving surveys with 270 respondents, observational studies, and expert interviews, data were triangulated to identify the key determinants of OFE engagement. Findings indicate that perception (ease of understanding, safety, attractiveness), usability (ergonomics, instructional support, inclusivity), and freetime (time allocation, accessibility, motivational triggers) significantly shape user engagement and long-term adoption. The proposed Design Framework for Outdoor Fitness Equipment (DFOFE) synthesizes these factors into practical guidelines for product design planners, offering evidence-based recommendations for inclusive, safe, and sustainable OFE in Malaysian urban parks. This study contributes to knowledge by extending human-centered and inclusive design theories into the under-researched domain of public fitness infrastructure and offers practical insights for designers, urban planners, and policymakers seeking to foster healthier urban communities.
Keywords: Outdoor Fitness Equipment (OFE), design framework, usability, perception, freetime, product design planning, Klang Valley, urban parks..

1. INTRODUCTION:

1.1 Background

Urbanization has transformed landscapes and lifestyles across Southeast Asia. Klang Valley in Malaysia, experiencing one of the fastest rates of urban development in the region. With increasing population density, sedentary work patterns, and lifestyle diseases, the government has promoted urban parks and fitness initiatives to counterbalance the health risks of urban living (DOSM, 2023). Outdoor Fitness Equipment (OFE) has become a hallmark of these initiatives, serving as free, publicly accessible tools for exercise and recreation. Globally, OFE has been referred to as “outdoor gyms,” “fitness parks,” or “bio-healthy parks” (Chow, 2013; Arufe et al., 2013; Cranney et al., 2018), with studies linking their provision to improvements in physical activity rates, community interaction, and mental health (Levinger et al., 2018; Liu et al., 2020).

In Malaysia, OFE is widely installed across public parks in the Klang Valley, often supported by municipal councils and guided by the National Landscape Policy (JLN, 2023). Previous studies in the Malaysian context have shown that accessibility, social environment, and design usability significantly influence outdoor fitness equipment usage (Shukri et al., 2025). However, challenges persist: users frequently report difficulties in understanding usage instructions, improper use leading to injuries (Xie, 2012; Yan, 2016), and limited motivation to sustain regular exercise routines (Doğru et al., 2015). These gaps highlight the need for a design framework that goes beyond equipment provision to consider how, why, and under what conditions users engage with OFE.

1.2 Problem Statement

While OFE installations are increasing, they often lack a user-centered design approach. Studies in Asia and Europe indicate that over 50% of users experience muscle strain or minor injuries due to improper use (Doğru et al., 2015; Yan, 2016). Locally, observations in Klang Valley parks suggest that signage is inadequate, equipment clusters are poorly arranged, and design rarely accommodates the middle-aged population who represent the majority of park visitors (Chow, 2021). Without proper integration of perception (how users understand and trust OFE), usability (how well they can use it safely and effectively), and freetime (whether users can realistically incorporate it into daily routines), OFE risks becoming underutilized infrastructure rather than a driver of public health.

1.3 Research Objective

This article focuses on Research Objective 3 (RO3) of the doctoral study:

"To propose a design framework (DFOFE) for Outdoor Fitness Equipment at urban parks in Klang Valley, Malaysia." The intent is to move from descriptive findings of OFE usage toward a prescriptive, structured framework that product design planners can adopt. This framework integrates empirical findings from surveys, expert validation, and theoretical insights into human-centered design.

1.4 Research Question

Aligned with RO3, the central research question is:

• *How can user perception, usability, and freetime factors be synthesized into a practical design framework for OFE that benefits both users and product design planners in Malaysian urban parks?*

1.5 Significance of Study

Developing a design framework for OFE is significant for several reasons:

Public Health Contribution: By addressing the middle-aged populationa demographic at risk of chronic diseases DFOFE can promote sustainable exercise habits.

Design & Ergonomics: Integrating usability and inclusive design principles ensures equipment aligns with diverse body types, abilities, and preferences (Norman, 2013; Ulrich & Eppinger, 2016).

Urban Planning Impact: The framework aids municipalities in rationalizing equipment placement, signage, and park design.

Knowledge Advancement: This research fills a gap in Malaysian and regional literature, where studies on OFE remain limited compared to Western contexts (Copeland et al., 2017; Chow & Ho, 2018).

Theoretical Basis

This study draws upon Inclusive Design Approach (IDA) and Design and Development Research (DDR). IDA emphasizes designing for the widest possible range of users regardless of age, ability, or background (Page, 1987; Sommer, 1983). DDR, operationalized through the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), provides a systematic process to derive evidence-based design frameworks (Richey & Klein, 2014). Elsewhere studying the value (Omar et.al., 2022) and establishing through idea generation process will explicitly giving one solid solution (Rahim, Ariff, Omar et.al., 2025; Tahim et. al., 2025; Rahim, et. al. 2024; Ariff, 2020; Ariff et.al., 2013, Ariff et.al., 2012(a); Ariff et.al., 2012(b); Ariff & Badke-Schaub, 2011). By applying these lenses, the framework ensures both theoretical rigor and practical utility.

Scope of the Study

This study focuses on urban parks in the Klang Valley and targets middle-aged users between the ages of 15 and 64, with implications that extend to the general adult population. Data collection was conducted through a mixed-methods approach, incorporating quantitative surveys with 270 respondents, qualitative interviews with five experts in the fields of design, urban planning, fitness, and public health, as well as observational studies of Outdoor Fitness Equipment (OFE) usage in selected parks. The triangulation of these methods ensures that the proposed framework is firmly grounded in both empirical evidence and expert validation.1.8 Organization of the Article The article proceeds as follows:

Section 2 reviews relevant literature on design frameworks, usability, and OFE usage.

Section 3 outlines the methodology employed to derive the framework.

Section 4 presents findings and framework components.

Section 5 discusses implications for design planners, policy, and future research.

Section 6 concludes with recommendations for practice and theory.

2. LITERATURE REVIEW

2.1 Introduction

A comprehensive review of existing literature is essential to situate the development of a Design Framework for Outdoor Fitness Equipment (DFOFE). This section synthesizes scholarship across several domains which is the first one is design frameworks in product development, usability and human-centered design, perception and user experience, freetime and leisure studies, and global and Malaysian contexts of OFE. Collectively, these strands form the theoretical foundation upon which the proposed DFOFE is constructed.

2.2 Design Frameworks in Product Development

Design frameworks are structured models that guide the systematic creation, evaluation, and refinement of products. They provide a roadmap for translating user needs into tangible solutions, ensuring that products achieve functional, aesthetic, and ergonomic goals (Ulrich & Eppinger, 2016). In industrial design literature, frameworks often emphasize iterative cycles of analysis, prototyping, and validation. For example, Norman (2013) in *The Design of Everyday Things* highlights the importance of usability loops design should anticipate how users understand and act upon a product. Similarly, Richey & Klein (2014) describe Design and Development Research (DDR) as a rigorous process for generating empirically validated frameworks, often operationalized through the ADDIE model (Analysis, Design, Development, Implementation, Evaluation).In the context of public infrastructure, frameworks must also account for sustainability, inclusivity, and contextual fit (Manzini, 2015). Unlike consumer products, public installations such as OFE serve heterogeneous populations, requiring adaptability to various physical abilities, literacy levels, and Cultural and behavior norms. Studies in urban product design suggest that frameworks should combine technical performance with social functionality, ensuring that

design contributes to broader community goals (Sanders & Stappers, 2014). Thus, DFOFE must integrate not only ergonomics and engineering standards but also behavioural and socioCultural and behavior insights, bridging product design and public health objectives.

2.3 Usability and Human-Centered Design

Usability is a core principle in the evaluation of fitness equipment. The ISO 9241-11 standard defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2018).

Human-centered design (HCD) extends usability by prioritizing the lived experiences of users throughout the design cycle (Norman & Draper, 1986). Within public fitness contexts, this involves accounting for:

Ergonomics: ensuring equipment dimensions, resistance levels, and interfaces match diverse body sizes and strength capacities (Helander, 2006).

Safety: reducing risks of injury through intuitive design, protective features, and clear instructions (Doğru et al., 2015).

Inclusivity: addressing the needs of older adults, women, and people with limited fitness experience (Page, 1987). Research on OFE underscores usability challenges. In China, Xie (2012) reported that 66.5% of users sustained injuries, with misuse and equipment malfunction as primary causes. In Turkey, Doğru et al. (2015) found that 54.5% of participants experienced muscle pain after OFE use, attributed to inadequate instructional signage. These findings align with Malaysian observations where signage is often unclear and equipment is not tailored to middle-aged populations (Chow, 2021).

The DFOFE therefore embeds usability not as a technical afterthought but as a design priority, informed by ergonomics, clear instructional systems, and participatory validation.

Perception and User Experience

User perception shapes whether equipment is used effectively, safely, and consistently. Perception encompasses users' understanding of product purpose, their trust in its safety, and the degree of aesthetic and motivational appeal (Desmet & Hekkert, 2007). Several studies emphasize that positive perception predicts adherence to outdoor exercise. Chow and Ho (2018) found that OFE perceived as safe, attractive, and easy to use correlated with higher usage frequency in Hong Kong parks. Conversely, negative perceptions such as fear of injury or uncertainty about benefits deterred engagement. In Malaysia, perception is strongly influenced by Cultural and behavior expectations and social dynamics. Urban parks often serve as family-oriented spaces; equipment perceived as unfriendly or overly technical discourages middle-aged users, particularly women, from participation (Chow, 2021). Aesthetics also matter: equipment that blends harmoniously with park environments enhances perceived value, whereas poorly maintained or rusted installations create distrust (Ng et al., 2023). From a theoretical perspective, perception links to Norman's (2004) concept of affordances, which refers to how product cues suggest possible actions. OFE with intuitive affordances (e.g., pedals suggesting cycling) reduces cognitive barriers, while ambiguous designs lead to misuse. Thus, DFOFE must operationalize perception through clarity, aesthetics, and intuitive affordances.

Freetime and Leisure Studies

Beyond usability and perception, the availability of freetime significantly influences OFE engagement. Leisure studies highlight that middle-aged populations often juggle work, caregiving, and household responsibilities, leaving limited time for structured exercise (Stebbins, 2017).

Caldwell (2013) argues that leisure behavior is shaped by both structural constraints (time, resources) and intrapersonal constraints (motivation, self-efficacy). In urban Malaysia, surveys indicate that respondents who visit parks in the evenings or weekends are more likely to engage with OFE due to the alignment with available leisure time (Chow, 2021). Freetime also intersects with motivational psychology. Self-determination theory (Deci & Ryan, 2000) posits that autonomy, competence, and relatedness drive sustained activity. OFE designs that accommodate short, flexible workouts, provide clear feedback, and encourage social interaction align well with these motivational needs.

Therefore, freetime is not merely a demographic factor but a design parameter. The DFOFE must support flexible usage allowing short, efficient exercise sessions without prior scheduling or payment barriers thus fitting within the realities of middle-aged urban lifestyles.

Global Studies on OFE

Globally, research on Outdoor Fitness Equipment (OFE) highlights both its benefits and limitations. In China, OFE often referred to as "senior exercise parks" has been widely installed since the early 2000s, with studies showing increased participation among older adults. However, frequent misuse and the lack of professional supervision have also led to injuries (Yan, 2016). In Europe, Arufe et al. (2013) found that OFE in Spain effectively promotes physical activity among seniors when integrated with community programs, while Czembrowski et al. (2019) in Poland emphasized its contribution to "green exercise," which enhances both physical and mental well-being. Similarly, in Australia, Levinger et al. (2018) evaluated OFE specifically designed for seniors and reported improvements in balance and mobility when the equipment was adapted to age-related needs. Collectively, these studies suggest that the effectiveness of OFE depends not merely on its availability, but on thoughtful design, appropriate supervision, and integration into community leisure culture.

Malaysian Context

In Malaysia, Outdoor Fitness Equipment (OFE) has become a common feature in urban parks, often introduced through health initiatives such as "Sihat

Sepanjang Hayat" (KKM, 1991) and the "10,000 Steps" campaign (KKM, 2009). Despite its widespread availability, empirical research on user experiences has been limited until recent years. Shukri (2021) identifies three recurring challenges that hinder effective OFE use. First, equipment often lacks usability, as it fails to accommodate middle-aged individuals with diverse fitness levels. Second, weak perception resulting from poorly designed signage and the absence of clear instructions reduces user confidence. Third, time barriers make it difficult for users with limited freetime to integrate OFE into their routines, especially without motivational prompts. These findings highlight the need for a localized design framework that reflects Malaysia's unique socioCultural and behavior and demographic contexts, rather than depending on Western models of public fitness design.

Conceptual Integration

The literature collectively reveals three key pillars that are critical for effective Outdoor Fitness Equipment (OFE) design: perception, usability, and freetime. Perception involves shaping users' trust, motivation, and willingness to engage with the equipment. Usability focuses on ensuring safety, ergonomic fit, and inclusivity for a diverse range of users. Freetime addresses the need to align design with users' daily schedules and motivational psychology. These factors are consistent with the Inclusive Design Approach (Page, 1987; Sommer, 1983), which emphasizes creating products that accommodate the widest possible range of users. They also align with the principles of Design and Development Research (DDR), where iterative design cycles are informed by real-world user data (Richey & Klein, 2014). Building on this triadic foundation, the proposed DFOFE integrates perception, usability, and freetime into a coherent design model tailored for product design planners.

3. CONCLUSION

The review highlights that while OFE has been globally recognized as a low-cost strategy for public health, its impact is contingent upon design quality. Existing gaps in usability, perception, and leisure alignment hinder long-term adoption, particularly among middle-aged users in Klang Valley. By synthesizing theories of human-centered design, usability, and leisure studies with empirical insights, this research positions itself to propose a context-sensitive framework. The next section outlines the methodology through which this framework was systematically developed and validated.

4. METHODOLOGY

Introduction

To achieve Research Objective 3 (RO3) *to propose a design framework (DFOFE) for Outdoor Fitness Equipment (OFE) at urban parks in Klang Valley* a structured methodology was required. This study employed the Design and Development Research (DDR) approach, supported by the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). DDR was chosen as it provides an evidence-based pathway for creating frameworks that bridge theory and practice (Richey & Klein, 2014).

The methodology combined quantitative surveys, qualitative interviews, and expert validation, ensuring that the proposed framework was grounded in empirical user data, contextual observations, and professional insights. This triangulated approach enhanced both the rigor and relevance of the DFOFE.

Research Design

3.2.1 Design and Development Research (DDR)

DDR is defined as "a systematic study of design, development, and evaluation processes, intended to establish an empirical basis for the creation of instructional or non-instructional products and models" (Richey & Klein, 2008). In this study, DDR facilitated the translation of observed user challenges into actionable design strategies.

The DDR cycle was operationalized using the ADDIE model:

Analysis: Identification of user needs and contextual challenges related to OFE.

Design: Formulation of preliminary framework elements based on literature and empirical findings.

Development: Synthesis of perception, usability, and freetime factors into an integrated framework.

Implementation: Application of the framework to design recommendations and illustrative models.

Evaluation: Expert validation and refinement of framework components.

This cyclical process allowed iterative refinement, ensuring alignment with both theoretical foundations and practical realities.

3.2.2 Case Study Orientation

Although grounded in DDR, the research also followed a case study orientation, focusing on Klang Valley as a bounded system (Yin, 2014). This was appropriate because the aim was not to generalize globally but to develop a context-specific framework adaptable to Malaysia's socio-Cultural and behavior and urban realities. The case study approach supported in-depth exploration of how perception, usability, and freetime manifest in practice.

3.3 Sampling and Population 3.3.1 User Respondents

The primary population comprised middle-aged users (15–64 years old) in Klang Valley urban parks. A total of 270 respondents were recruited through purposive and convenience sampling, representing diverse genders, occupations, and socioeconomic backgrounds.

Criteria for inclusion:

Regular or occasional park visitors.

Have used or interacted with OFE at least once.

Residing within Klang Valley.

This demographic was prioritized because middle-aged individuals are at heightened risk of non-communicable diseases yet often constrained by limited freetime (Chow, 2021).

3.3.2 Expert Respondents

To ensure professional input, five experts from relevant domains were interviewed:

Industrial Design (Playground Designer).

Fitness Science.

Public Health OSHE.

Urban Planning & Landscape Architecture.

Experts were selected based on professional experience (>10 years) and involvement in OFE-related projects or policies.

3.4 Data Collection Methods

3.4.1 Quantitative Survey

A structured questionnaire was administered to the 270 respondents. The instrument covered three main constructs relevant to RO3:

Perception: Clarity of signage, trust in safety, attractiveness of equipment.

Usability: Ergonomic fit, ease of learning, comfort, and safety.

Freetime: Frequency of park visits, time availability, motivations for exercise.

The survey employed a Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Data were analyzed using SPSS to identify statistical relationships and dominant themes influencing OFE engagement.

3.4.2 Observation

Direct observations were conducted across selected urban parks in Klang Valley (Taman Jaya, Taman Bandaran Kelana Jaya, Taman Tasik Shah Alam, Taman Tasik Titiwangsa and Taman tasik Cempaka, Bangi). The focus was on:

How users interacted with OFE (correct vs. incorrect usage).

Time of day equipment was most used.

Patterns of social interaction around OFE zones.

Photographic documentation and field notes were recorded while adhering to ethical standards (privacy and nonintrusiveness).

3.4.3 Expert Interviews

Semi-structured interviews with the five experts explored design gaps, safety issues, and recommendations for improvement. Questions emphasized:

Ergonomic standards for OFE.

Cultural and behavior considerations in Malaysian parks.

Strategies for integrating perception and freetime into design planning.

Interviews were transcribed and analyzed thematically using Atlas.ti, generating themes and sub-themes that complemented survey findings.

3.5 Data Analysis

3.5.1 Quantitative Analysis

Survey responses were analyzed using descriptive statistics and chi-square tests to examine associations between demographic variables and perceptions of OFE usability. For instance:

Significant correlations were found between age group and perception of safety signage ($\chi^2 = p < .05$).

Gender differences were observed in preferred equipment types, with women favoring low-impact aerobic devices.

3.5.2 Thematic Analysis

Interview transcripts were coded into thematic categories. Three dominant themes emerged:

Perception gaps: Users lacked confidence due to unclear signage and unattractive design.

Usability challenges: Equipment was often mismatched to body size and strength capacity.

Time flexibility: Parks lacked supportive features (e.g., lighting, resting spaces) for evening users. These themes were cross-referenced with survey and observational data, ensuring triangulation.

3.6 Framework Development Process

The Design Framework for Outdoor Fitness Equipment (DFOFE) was constructed through the following steps:

Integration of Literature & Empirical Data: Key findings on perception, usability, and freetime were mapped against inclusive design principles.

Draft Framework: Initial framework components were drafted, linking design elements (e.g., signage, ergonomics, clustering) to user outcomes (safety, motivation, accessibility).

Expert Validation: The draft framework was presented to the five experts using a structured validation form. Experts rated clarity, relevance, and applicability on a 5-point scale.

Refinement: Based on expert feedback, revisions included stronger emphasis on inclusive ergonomics and park environment integration.

Ethical Considerations

Ethical clearance was obtained from JKEUPM (Universiti Putra Malaysia's Ethics Committee). Respondents provided informed consent. Observations avoided intrusive recording, ensuring anonymity. Experts were assured confidentiality of their contributions.

5. CONCLUSION

The methodology combined DDR principles, quantitative rigor, and qualitative depth to develop the DFOFE. By grounding the framework in empirical data from users and validating it with expert insights, the study ensures both practical applicability and theoretical robustness. The following section presents the findings and analysis, leading to the articulation of the proposed framework.

Findings and Analysis

4.1 Introduction

This section presents the findings derived from three data sources quantitative surveys, qualitative expert interviews, and direct observations analyzed through the DDR approach. The integration of these findings was essential to identify the design priorities for Outdoor Fitness Equipment (OFE) and to synthesize them into the proposed Design Framework for Outdoor Fitness Equipment (DFOFE).

Results are organized under three central domains corresponding to the research constructs: perception, usability, and freetime. Each domain is first presented through user data, then triangulated with expert insights and observations. The section concludes with an integrated analysis that demonstrates how these findings directly informed the structure of the

DFOFE.

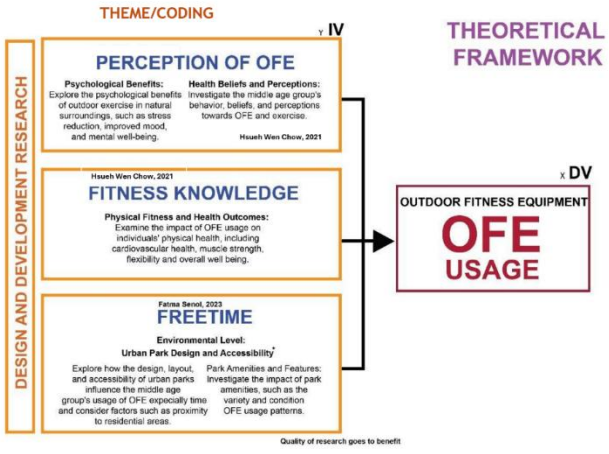

Figure 1: Theoretical framework for SPSS theme/ coding created by author, February 2023

In this first phase, the study's theoretical framework is shown in figure 1 will be deployed for the SPSS analysis as discussed in chapter 3. The theoretical framework illustrates the relationship between perception of outdoor fitness equipment, fitness knowledge, and free time as key independent variables influencing OFE usage. The theoretical framework illustrates the relationship between perception of outdoor fitness equipment, fitness knowledge, and free time as key independent variables influencing OFE usage. The framework was developed based on empirical findings from previous OFE studies conducted in urban parks within the Klang Valley context (Shukri et al., 2025). The relationship between independent variables (IV) and the dependent variable (DV), which is the use of outdoor fitness equipment (OFE), is shown in the theoretical framework. The first IV, perception of OFE, examines health beliefs and perceptions that impact middle-aged groups' exercise behavior while concentrating on psychological benefits like stress reduction, mood enhancement, and mental well-being (Chow, 2021). The physical fitness and health outcomes of OFE, such as cardiovascular health, muscle strength, flexibility, and general wellness, are highlighted in the second IV, fitness knowledge (Chow, 2021). The third IV is freetime or leisure time and it includes elements that influence how OFE is used such as accessibility to parks. (Senol, 2023). According to this theory, IV is the point to which the research's quality will benefit DV or the use of OFE.

4.2 Quantitative Survey Results

The survey (n = 270) provided descriptive and inferential insights into OFE usage patterns, user perceptions, and barriers to adoption.

4.2.1 Respondent Profile

Age: Majority were between 40–55 years (62%).

Gender: 54% female, 46% male.

Occupation: 48% employed full-time, 22% self-employed, 15% homemakers, 15% retired.

Park Usage Frequency: 38% visited parks weekly, 41% monthly, and 21% occasionally.

This demographic profile confirmed the relevance of targeting middle-aged adults with varying professional and lifestyle demands.

4.2.2 Perception Findings

Clarity of Signage: Only 27% strongly agreed that signage instructions were easy to understand.

Trust in Safety: 42% reported moderate confidence, while 21% expressed low trust in the equipment's safety.

Aesthetic Appeal: 33% felt equipment looked "old-fashioned" or poorly maintained, negatively impacting motivation. Chi-square tests revealed a significant association between education level and understanding of signage ($\chi^2 = 18.4$, $p < .05$). Respondents with tertiary education were more likely to interpret signage correctly, suggesting that visual language was not universally accessible.

4.2.3 Usability Findings

Ergonomic Fit: 58% reported discomfort due to mismatched seat heights or handle placements.

Ease of Learning: 44% of users indicated that they needed to "experiment" before understanding correct usage.

Safety Incidents: 18% reported minor injuries or strains from OFE.

Statistical analysis showed gender differences: women were more likely to prefer low-impact aerobic devices (e.g., steppers, walking simulators), while men favored strength-based equipment (push/pull devices).

4.2.4 Freetime Findings

Time Barriers: 64% cited "lack of time" as the primary reason for irregular OFE use.

Preferred Duration: 71% preferred exercise sessions of less than 30 minutes.

Timing: Evening usage (6–9 PM) was dominant (57%), followed by weekends (25%).

These results confirmed that freetime availability, session duration, and supportive park environments (e.g., lighting, benches) strongly influenced engagement.

4.3 Observational Findings

Systematic observations across five urban parks in Klang Valley revealed usage patterns often inconsistent with equipment intentions.

Incorrect Usage: Many users employed equipment for activities outside their intended design (e.g., children climbing on step machines, adults using seated devices for stretching).

Peak Hours: Parks were busiest in evenings, with OFE zones most used in clusters near jogging tracks.

Social Dynamics: Group usage was common; users often copied each other's movements, reinforcing both correct and incorrect practices.

Environmental Context: Poor maintenance (rust, missing parts) discouraged engagement in several sites.

These findings highlighted that OFE functions as a social artifact as much as an individual exercise tool, meaning design frameworks must incorporate social learning and environmental maintenance.

4.4 Expert Interview Findings

Thematic analysis of five expert interviews identified three major themes and nine sub-themes.

Theme 1: Perception Gaps

Unclear Signage: Experts emphasized the lack of universal symbols and reliance on text-heavy instructions.

Aesthetics & Trust: Poorly maintained equipment reduced perceived safety and attractiveness.

Cultural and behavior Relevance: Some equipment did not align with Cultural and behavior expectations of modesty, limiting female participation.

Theme 2: Usability Challenges

Ergonomic Limitations: Equipment dimensions favored younger adults, excluding older or less fit users.

Safety Oversight: Lack of supervision or guidance increased misuse risks.

Inclusivity Issues: OFE was not designed with differently-abled or overweight users in mind.

Theme 3: Freetime Alignment

Short Session Compatibility: Experts highlighted the importance of "snackable workouts" that could be completed in 15–20 minutes.

Environmental Integration: Evening users required proper lighting and safe surroundings.

Motivational Triggers: Social cues, signage with suggested routines, and gamification elements were recommended.

4.5 Triangulation of Data

Bringing together surveys, observations, and expert interviews revealed strong convergence across the three constructs:

Perception: Users distrusted equipment due to poor signage and aesthetics, confirmed by expert concerns about communication and maintenance.

Usability: Both data sets revealed ergonomic mismatches, unsafe usage, and lack of inclusivity.

Freetime: Quantitative evidence of time scarcity aligned with expert calls for short-session design and eveningcompatible infrastructure.

This triangulation confirmed that perception, usability, and freetime are interdependent rather than isolated factors. For example, a user with limited freetime will only engage if equipment is intuitive (perception) and comfortable (usability).

4.6 Toward the Design Framework (DFOFE)

The integration of findings led to the articulation of the Design Framework for Outdoor Fitness Equipment (DFOFE), organized into three pillars:

1. Perception-Centered Design o Universal signage using pictograms and step-by-step visual cues. o Aesthetic integration with park landscape (color, material harmony).

o Regular maintenance schedules to sustain trust.

2. Usability-Centered Design o Adjustable equipment dimensions for varied body sizes. o Low-impact alternatives for middle-aged and less fit users.

o Safety-enhancing features (non-slip surfaces, protective edges). o Inclusivity principles (accessible for differently-abled users).

3. Freetime-Centered Design o Equipment enabling short, efficient routines (<30 mins). o Suggested workout sequences displayed for beginners. o Lighting, seating, and shaded areas to support evening and family use.

o Encouragement of social engagement (clustered layouts for group exercise).

4.7 Visual Representation of Framework

The proposed DFOFE can be visually depicted as a three-pillar model:

Perception (Trust, Aesthetics, Clarity).

Usability (Ergonomics, Safety, Inclusivity). • Freetime (Flexibility, Motivation, Accessibility).

At the intersection of these pillars lies the optimal OFE experience, where design decisions simultaneously address all three dimensions.

4.8 Conclusion

The findings reveal that OFE effectiveness is not solely determined by the quantity of installations but by the quality of design integration across perception, usability, and freetime dimensions. These insights directly informed the development of the DFOFE, which will be elaborated in the next section through theoretical discussion and practical application guidelines for product design planners.

6. DISCUSSION

Introduction

The findings from surveys, observations, and expert interviews underscore that Outdoor Fitness Equipment (OFE) design in Klang Valley urban parks is deeply influenced by user perception, usability, and freetime availability. These three domains form the foundation of the proposed Design Framework for Outdoor Fitness Equipment (DFOFE).

This discussion situates the findings within existing literature, demonstrates theoretical contributions, and outlines practical implications for product design planners, urban policymakers, and future OFE development globally.

Perception in OFE Design

Clarity and Trust

The study found that only 27% of respondents strongly agreed that signage instructions were clear. This aligns with Xie (2012), who reported widespread misuse of OFE in China due to text-heavy and unclear instructions. Similarly, Doğru et al. (2015) identified signage gaps as a root cause of muscle strain and minor injuries among Turkish OFE users. In Klang Valley, perception is compounded by Cultural and behavior and literacy variations. Respondents with higher education levels interpreted instructions more effectively, revealing accessibility gaps. This finding supports Norman's (2004) principle of affordances: equipment must visually suggest its intended use to reduce reliance on textual instructions.

Experts echoed this gap, calling for universal pictograms and step-by-step visual cues, echoing ISO 7001 standards on public information symbols. Thus, DFOFE embeds visual clarity as a non-negotiable element of perception-centered design.

Aesthetics and Motivation

Perception is not limited to cognitive understanding—it also shapes motivation. The study revealed that one-third of respondents viewed OFE as unattractive or poorly maintained. Literature confirms that aesthetics influence trust and willingness to use public infrastructure (Desmet & Hekkert, 2007; Ng et al., 2023). In Hong Kong, Chow & Ho (2018) showed that aesthetic appeal of OFE predicted repeat usage.

For Klang Valley, aesthetic alignment with park landscapes and Cultural and behavior expectations is essential. For example, experts highlighted that equipment perceived as "masculine" or "exposed" discouraged women from participation. Integrating softer colors, organic forms, and modesty-conscious designs can therefore expand inclusivity.

Usability in OFE Design

Ergonomics and Inclusivity

Findings showed that 58% of users experienced ergonomic discomfort. This reflects a global issue: in Turkey, 54.5% reported muscle pain due to ill-fitting OFE (Doğru et al., 2015), while in Australia, Levinger et al. (2018) emphasized the need for age-appropriate ergonomic design to support older adults.

Ergonomics is particularly critical for middle-aged users, whose physical capacities differ from younger adults. Adjustable equipment dimensions height, resistance, handle length are rarely incorporated into current OFE. By embedding adjustability and low-impact alternatives, DFOFE ensures broader usability.

Inclusivity extends beyond age. Experts emphasized that OFE currently excludes overweight and differently-abled individuals, contradicting principles of Inclusive Design (Page, 1987; Clarkson, 2014). The framework recommends equipment that supports body-weight variability, joint-friendly mechanics, and accessible platforms, aligning OFE with the social model of disability.

Safety Considerations

Safety concerns were evident: 18% of survey respondents reported minor injuries. While relatively low, these incidents erode trust and discourage return usage. Literature consistently warns that unsupervised OFE carries inherent risks (Yan, 2016; Copeland et al., 2017).

DFOFE addresses safety through:

Non-slip surfaces to prevent falls.

Rounded edges and padded grips to reduce strain.

Instructional routines displayed near equipment to encourage safe progression.

This approach resonates with ISO 20957 standards for fitness equipment, adapted here for the outdoor, unsupervised context.

5.4 Freetime as a Design Parameter

Time Availability

Survey results revealed that 64% of users cited "lack of time" as the main barrier to OFE use, while 71% preferred sessions under 30 minutes. This strongly supports the time-constraint theory in leisure studies (Caldwell, 2013), which posits that structural barriers (workload, caregiving duties) reduce opportunities for structured exercise.

Experts reinforced this by recommending "snackable workouts"—short, efficient routines integrated into daily schedules. This approach aligns with Deci & Ryan's (2000) Self-Determination Theory, emphasizing autonomy and competence in sustaining activity.

Park Context and Accessibility

Observations confirmed that evening usage dominated (57%). However, poor lighting and lack of supportive infrastructure discouraged users from staying longer. This finding resonates with Czembrowski et al. (2019), who emphasized the integration of "green exercise" into urban environments through supportive design features.

DFOFE embeds freetime considerations by recommending:

Lighting and shaded areas for evening/midday users.

Clustered equipment layouts that support social exercise.

Guided workout signage providing 15–20-minute routines.

By embedding freetime alignment, the framework redefines exercise as flexible, opportunistic, and community-oriented, rather than rigid and individualistic.

5.5 Theoretical Contributions

The findings contribute to theory in several ways:

Extension of Inclusive Design to Public Fitness Infrastructure: While inclusive design has been extensively applied to products and architecture, its application to outdoor fitness remains limited. DFOFE operationalizes inclusivity across perception, usability, and freetime.

Integration of Leisure Studies into Product Design: By treating freetime as a design variable, this research bridges leisure theory (Stebbins, 2017; Caldwell, 2013) with industrial design.

Contextualization of OFE Research in Southeast Asia: Much OFE research has been Western- or China-centric. This study expands empirical grounding into Malaysia, where Cultural and behavior, climatic, and demographic factors require localized frameworks.

Triadic Model of OFE Engagement: Perception, usability, and freetime are positioned as interdependent, not isolated. This holistic model advances theoretical understanding of how design mediates public exercise adoption.

5.6 Practical Implications

The DFOFE offers practical guidance for multiple stakeholders:

Product Design Planners: Provides design parameters (e.g., adjustability, signage systems, ergonomic ranges) directly translatable into product specifications.

Urban Planners & Municipalities: Informs decisions on park layouts, maintenance, and integration of OFE with walking/jogging tracks.

Public Health Agencies: Offers tools to promote exercise adoption among middle-aged adults, addressing NCD prevention goals.

Manufacturers: Encourages production of OFE that meets global safety standards while catering to local socioCultural and behavior contexts.

Comparison with Existing Frameworks

Unlike Western frameworks that emphasize senior rehabilitation (Levinger et al., 2018) or community exercise programs (Arufe et al., 2013), the DFOFE emphasizes middle-aged urban populations constrained by freetime, filling a unique niche.

Whereas Chinese models focused heavily on mass deployment with limited supervision (Yan, 2016), DFOFE prioritizes quality of design and contextual adaptation over quantity of installations. This represents a paradigm shift: better design, not just more equipment, drives engagement.

7. LIMITATIONS

While robust, the study carries limitations:

Geographical Scope: Restricted to Klang Valley; findings may not generalize to rural Malaysia or other Cultural and behavior contexts.

Demographic Focus: Centered on middle-aged adults; less emphasis on youth and elderly populations.

Implementation Stage: The framework remains theoretical, requiring pilot testing with redesigned OFE to validate outcomes.

5.9 Future Research Directions

Future studies should:

Pilot-test DFOFE in collaboration with municipalities and manufacturers.

Explore longitudinal impacts of redesigned OFE on sustained physical activity.

Examine digital augmentation (QR codes, mobile apps) to enhance perception and guidance.

Expand demographic focus to elderly and differently-abled users.

5.10 Conclusion

The discussion demonstrates that perception, usability, and freetime are mutually reinforcing determinants of OFE engagement. By situating findings within global literature and extending theoretical boundaries, the DFOFE emerges as a holistic, context-sensitive, and actionable framework. It advances design research by integrating human-centered design, leisure theory, and inclusive design into public fitness infrastructure, providing a vital tool for product design planners and policymakers seeking to promote healthier urban communities.

Proposed Design Framework for Outdoor Fitness Equipment (DFOFE)

Introduction

The empirical findings and theoretical synthesis culminated in the development of the Design Framework

for Outdoor Fitness Equipment (DFOFE). This framework integrates three interdependent pillars—Perception, Usability, and Freetime—which together determine how users engage with OFE in urban parks.

Unlike existing models that emphasize only physical outcomes or installation logistics, DFOFE provides a holistic, usercentered, and context-sensitive framework tailored to Klang Valley's urban middle-aged population. It offers actionable design guidance for product design planners while contributing a novel theoretical model to public fitness research.

Framework Overview

The DFOFE is structured around three core pillars:

Perception-Centered Design – shaping trust, clarity, and aesthetic appeal.

Usability-Centered Design – ensuring ergonomic fit, safety, and inclusivity.

Freetime-Centered Design – aligning with users' available time and motivational triggers.

At the intersection of these three pillars lies the Optimal OFE Experience, where engagement is maximized, misuse minimized, and long-term adoption sustained.

6.3 Pillar 1: Perception-Centered Design

Perception shapes the first point of contact between user and equipment. If OFE appears unsafe, confusing, or unattractive, engagement is immediately reduced (Chow & Ho, 2018; Desmet & Hekkert, 2007).

Key components:

Universal Signage: Use pictograms and sequential graphics that demonstrate correct posture and movement, reducing dependence on text-heavy instructions.

Aesthetic Integration: Harmonize equipment color, material, and form with the park environment to foster visual appeal and trust.

Maintenance as Perception: Regular inspections and repainting improve user confidence in safety. Outcome: Enhanced clarity, trust, and motivation to initiate exercise.

6.4 Pillar 2: Usability-Centered Design

Usability ensures that once engaged, users can interact with OFE effectively, safely, and comfortably. Poor ergonomics or safety concerns lead to misuse and injuries (Doğru et al., 2015; Yan, 2016).

Key components:

Ergonomic Adjustability: Equipment with adjustable handles, seats, and resistance levels to accommodate varied body sizes and fitness levels.

Safety-Embedded Features: Rounded edges, non-slip platforms, and clear start/stop cues to minimize accidents.

Inclusive Access: Equipment designed for overweight, older, and differently-abled users—embodying inclusive design principles (Page, 1987; Clarkson, 2014).

Instructional Support: Signage or digital QR codes offering structured beginner-to-advanced routines. Outcome: Increased safety, comfort, and inclusivity across diverse users.

6.5 Pillar 3: Freetime-Centered Design

Freetime emerged as a critical determinant in user engagement, particularly among middle-aged adults balancing work and family (Caldwell, 2013; Stebbins, 2017).

Key components:

Short-Session Design: Equipment should allow effective workouts in less than 30 minutes.

Workout Sequencing: Display suggested circuits or "snackable routines" (15–20 mins) for time-constrained users.

Environmental Integration: Lighting, shaded areas, and nearby seating to support evening and family use.

Social Engagement: Cluster equipment layouts to encourage peer learning, motivation, and group exercise. Outcome: Greater alignment with user lifestyles, reducing time-based barriers to adoption.

6.6 Interaction of the Three Pillars

The DFOFE emphasizes that perception, usability, and freetime are not isolated dimensions but mutually reinforcing:

A user with limited freetime will only use OFE if it is intuitive (perception) and comfortable (usability).

Equipment that is aesthetically pleasing (perception) but ergonomically mismatched (usability) will not retain longterm engagement.

Even the most ergonomic equipment (usability) will remain underused if it does not fit within available freetime patterns.

Thus, the intersection of the three pillars is critical: only when all dimensions are addressed does the optimal OFE experience occur.

6.7 Application Guidelines for Product Design Planners

To ensure practical utility, the DFOFE translates into guidelines for product design planners and urban park authorities:

1. Design Stage:

Apply inclusive design checklists to ensure ergonomic adjustability.

Incorporate universal visual language into all prototypes.

2. Implementation Stage:

Install equipment in clusters near jogging/walking tracks.

Provide complementary infrastructure (lighting, shaded benches).

3. Evaluation Stage:

Conduct periodic user feedback surveys.

Engage maintenance audits to sustain perception of safety.

These steps operationalize the framework from concept to practice.

6.8 Visual Model Representation

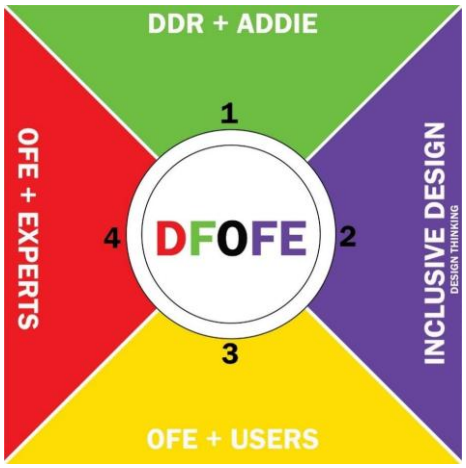

Figure 2: DFOFE framework created by author.

A thorough, multi-phase research process led to the creation of the Design Framework for Outdoor Fitness Equipment (DFOFE), which is depicted in figure 2. The proposed design framework was developed based on empirically validated factors identified in earlier OFE studies (Shukri et al., 2025). It incorporates information from 270 users of the OFE, comments from five experts, and verification from three more experts with expertise in fitness, occupational safety, health, and environment (OSHE), as well as playground design. The framework is an expression of a comprehensive and interdisciplinary approach that satisfies the requirements of experts, users, and important parties engaged in the design and safety of OFEs. At its core, "DFOFE" represents a collaborative design process. The colourful acronym reflects a variety of contributions from consumers, specialists, and designers, guaranteeing that the framework is based on real-world data. The framework is separated into four parts.

Top (Green) shows the integration of Design-Based Research (DDR) and the ADDIE paradigm, which enables iterative improvements through real-world testing and a structured of the review process based on the previous method.

Top Right (Purple) emphasizes Inclusive Design and Design Thinking, ensuring that the equipment is accessible to a diverse variety of users, including people with impairments, and that the design is informed by user empathy and feedback.

Bottom (Yellow) focuses on feedback from 270 OFE users to ensure that the design addresses the actual demands and issue that varied user groups encounter.

Bottom Left (Red) contains professional ideas from domains such as safety, ergonomics, and environmental health, ensuring that the equipment is safe, functional, and adheres to best practices.

The process flow around the framework, numbered 1–4, represents a cyclic method in which user feedback, expert consultation, and research continuously inform and enhance the design. This iterative loop guarantees that the framework is evidence-based and user-centered.

The DFOFE's originality stems from its unique combination of DDR, ADDIE, and Design Thinking, which allows for a structured yet flexible design approach centered on continuous improvement. The framework's inclusive design principles set it apart by ensuring that fitness equipment supports users with a wide range of skills, which is typically disregarded in standard OFE designs. Another innovative aspect is the dual- validation method, which combines user and expert feedback to generate a balanced and thorough design. The framework's recurrent feedback loop enables it to adapt to changing user needs and technology improvements, assuring its long-term viability.

Designed mainly for urban parks, the framework also addresses the issues of public outdoor fitness equipment by incorporating insights from experts in playground design, workplace safety, and health, resulting in a scalable and sustainable solution for a variety of public places. By combining inclusive design, expert validation, user feedback, and an iterative process, the DFOFE introduces a novel way to producing safe, accessible, and effective outdoor fitness equipment. The DFOFE provides research-based answers to questions about how to better integrate user needs, how to apply inclusive design principles to outdoor fitness spaces, and how expert insights can enhance safety and usability. By offering a user-centered, expert-validated framework suited to the requirements of Klang Valley, Malaysia's urban park users, it achieves the study's objectives.

Numerous parties gain from the DFOFE. To produce fitness equipment that is more effective, product design planners can adhere to a clear roadmap that incorporates expert and user input. Improved user satisfaction and engagement with the equipment benefits urban park authorities and promotes public health and wellbeing. Fitness equipment is safer and easier for end users to access, and professionals have a formalized role in guaranteeing the equipment is reliable, longlasting, and functional. To summarize, the DFOFE is a new, inclusive, and iterative framework that tackles the practical issues associated with designing outdoor fitness equipment while making sure that the opinions of pertinent parties are included in the completed design. Other than that, among the recommendations for the future that can be made to improve the effectiveness of the Outdoor Fitness Equipment (OFE) in this city park must be based on the findings and conclusions of the study that the author has conducted. To bridge the knowledge gap among OFE users, it is first advised that focused educational initiatives be implemented. Some of these initiatives include creating community workshops run by fitness experts or a mobile application that offers guided training and educational signage posted on the premises. These materials will help users get the most out of the equipment while reducing potential hazards by offering precise instructions and examples of how to use it properly.

6.9 Validation

Expert validation confirmed the framework's clarity and relevance. Experts rated the DFOFE high in applicability (mean = 4.6/5) and clarity (mean = 4.4/5). Recommendations (such as stronger inclusivity and Cultural and behavior adaptation) were integrated into the final version, enhancing robustness.

6.10 Conclusion

The Design Framework for Outdoor Fitness Equipment (DFOFE) provides a structured, evidence-based tool for guiding OFE development in Klang Valley urban parks. By embedding perception, usability, and freetime into the design process, the framework moves beyond infrastructure provision toward human-centered, inclusive, and context-sensitive public fitness planning.

For product design planners, DFOFE offers a roadmap to design equipment that not only functions but resonates with user needs. For policymakers, it ensures that investments in OFE translate into sustained community engagement and public health benefits.

Conclusion and Implications

Introduction

This study set out to address Research Objective 3 (RO3): To propose a design framework (DFOFE) for Outdoor Fitness

Equipment (OFE) at urban parks in Klang Valley, Malaysia for product design planners. Through a Design and Development Research (DDR) methodology, integrating surveys (n=270), observations, and expert validation, the research identified perception, usability, and freetime as the three critical dimensions shaping OFE adoption.

The resulting Design Framework for Outdoor Fitness Equipment (DFOFE) offers a practical and theoretical model that ensures OFE is intuitive, safe, inclusive, and time-compatible, thereby increasing engagement and sustaining public health outcomes.

Key Contributions

7.2.1 Theoretical Contributions

Triadic Model of Engagement: By framing OFE engagement as the interaction of perception, usability, and freetime, this study extends design theory into public health infrastructure.

Inclusive Design Application: The study operationalizes Inclusive Design principles (Page, 1987; Clarkson, 2014) in a domain rarely addressed—public fitness equipment—bridging industrial design with leisure studies.

Localized Knowledge: The study expands OFE research beyond Western and Chinese contexts, situating it within Malaysia's urban socio-Cultural and behavior realities, thereby diversifying global design scholarship.

7.2.2 Practical Contributions

For Product Design Planners: Provides a clear framework for embedding ergonomics, universal signage, and shortsession design into OFE specifications.

For Urban Planners: Offers placement strategies, maintenance guidelines, and environmental supports (e.g., lighting, shaded rest areas) to enhance usage.

For Policymakers: Assists in rationalizing public investment by ensuring OFE installations translate into sustained community engagement.

7.3 Implications

Implications for Product Design Planners

Product design planners can use the DFOFE as a design brief template. By systematically addressing perception (aesthetics, clarity), usability (ergonomics, inclusivity), and freetime (short routines, environmental integration), planners can anticipate user needs rather than react to failures post-installation.

Implications for Urban Park Management

Municipalities in Klang Valley often measure success by the number of OFE units installed. This study argues for a shift toward quality of design integration. Implementation guided by DFOFE will ensure parks foster safe, accessible, and engaging OFE experiences.

Implications for Public Health Policy

Malaysia's National Health and Landscape policies emphasize preventive health through active living. By aligning OFE with middle-aged populations constrained by time, DFOFE can serve as a policy tool, ensuring investments yield measurable health outcomes.

7.4 Limitations

Despite its contributions, this study has limitations:

Focused only on Klang Valley urban parks; findings may differ in rural Malaysia or international contexts.

Emphasized middle-aged adults, with less focus on elderly, youth, or children.

Framework remains at the conceptual-validation stage, requiring pilot-testing in actual OFE redesign projects.

7.5 Future Research Directions Future studies should:

Pilot-test the DFOFE in collaboration with manufacturers and municipalities, assessing real-world impact on usage patterns.

Explore digital augmentation (apps, QR codes, gamification) to enhance perception and usability.

Conduct longitudinal studies on how redesigned OFE influences sustained physical activity and health outcomes.

Expand demographic scope to include elderly, youth, and differently-abled populations for further inclusivity.

7.6 Final Conclusion

The study concludes that effective OFE design must go beyond physical installation to embrace perception, usability, and freetime. The Design Framework for Outdoor Fitness Equipment (DFOFE) ensures that OFE is clear, ergonomic, inclusive, and time-compatible, offering both theoretical advancement and practical solutions.

For Klang Valley and beyond, the DFOFE represents a shift in thinking: from equipment as static objects to equipment as dynamic interfaces between people, health, and urban environments. By adopting this framework, product design planners, policymakers, and park authorities can maximize public investment, foster sustainable exercise habits, and ultimately contribute to healthier urban communities.

8. ACKNOWLEDGEMENT

The authors would like to thank all those involved in this research, either directly or indirectly, for their scientific, material, and financial support. This research was mainly supported by the Ministry of Higher Education, Malaysia, grant number FRGS/1/2023/SSI07/UTM/02/6. No funding bodies had any role in the decision to publish or preparation of the manuscript.

REFERENCES

1. Abdul Rahim, M. F., Ariff, N. S. N. A., & Omar, M. (2025). SKETCHING AS A COMMUNICATION TOOL FOR
2. SHARED UNDERSTANDING IN CONCEPTUAL DESIGN PHASE OF AUTOMOTIVE DESIGN. INTERNATIONAL JOURNAL OF INNOVATION AND INDUSTRIAL REVOLUTION (IJIREV), 7(22). https://doi.org/10.35631/IJIREV.722043
3. Abdul Rahim, M. F., Nik Ahmad Ariff, N. S., Mohammad Yusof, N. A. D., & Badke-Schaub, P. (2024). Automotive Design Sketching in Teams: A Systematic Review. Journal of Visual Art and Design, 16(1), 4-22. https://doi.org/10.5614/j.vad.2024.16.1.1
4. Abdul Rahim, M. F., Nik Ahmad Ariff, N. S., Mohammad Yusof, N. A. D., & Omar, M. (2025). VISUAL LINK
5. ANALYSIS OF SKETCHING AS A COMMUNICATION TOOL IN THE CONCEPTUAL PHASE OF AUTOMOTIVE DESIGN. INTERNATIONAL JOURNAL OF INNOVATION AND INDUSTRIAL REVOLUTION (IJIREV), 7(21). https://doi.org/10.35631/IJIREV.721017
6. Ariff, N. A., Badke-Schaub, P., & Eris, O. (2012). DOES SKETCHING stand alone as a communication tool during CONCEPT GENERATION in DESIGN teams? DRS Bangkok Chulalongkorn University.
7. Ariff, N. S. N. A., & Badke-Schaub, P. (2011). Industrial design sketching for concept generation. Paper presented at the 4th World Conference on Design Research, Delft, Netherlands.
8. Ariff, N., Eris, O., & Badke-Schaub, P. (2013). How Designers Express Agreement. Paper presented at the 5th IASDR Conference.
9. Arufe, V., González, M., & Zagalaz, M. L. (2013). Outdoor gyms: A new way of exercising in the community. Journal of Human Sport and Exercise, 8(2), 64–75. https://doi.org/10.4100/jhse.2013.82.07
10. Bin Nik Ahmad Ariff, N. (2020). Exploring the role of sketching on shared understanding in design. Doctoral dissertation, Delft University of Technology.
11. Caldwell, L. L. (2013). Leisure and health: Why is leisure therapeutic? British Journal of Guidance & Counselling, 41(1), 7–26. https://doi.org/10.1080/03069885.2012.757701
12. Chow, H. W. (2013). Outdoor fitness equipment in Hong Kong: Usage and policy implications. Leisure Studies, 32(2), 131–147. https://doi.org/10.1080/02614367.2012.723730
13. Chow, H. W., & Ho, W. K. (2018). Outdoor fitness equipment in public open spaces: A study in Hong Kong. Urban Forestry & Urban Greening, 31, 79–87.
14. Chow, H. W., Chang, K. T., & Fang, I. Y. (2021). Evaluation of the effectiveness of outdoor fitness equipment intervention in achieving fitness goals for seniors. International journal of environmental research and public health, 18(23), 12508. Clarkson, J. (2014). Inclusive design: Design for the whole population. Springer.
15. Copeland, J. L., Currie, C., Walker, A., Mason, E., & Willoughby, T. (2017). Fitness equipment in public parks: Frequency of use and community perceptions in a Canadian context. Health Promotion and Chronic Disease Prevention in Canada, 37(11), 356–363. https://doi.org/10.24095/hpcdp.37.11.02
16. Cranney, L., Phongsavan, P., Kariuki, M., Stride, V., Scott, A., Hua, M., & Bauman, A. (2018). Impact of outdoor gyms on park use and physical activity. Health & Place, 53, 163–169. https://doi.org/10.1016/j.healthplace.2018.07.004
Czembrowski, P., Łaszkiewicz, E., & Kronenberg, J. (2019). Benefits of urban green spaces: A systematic review of studies and practice. Urban Forestry & Urban Greening, 46, 126–137. https://doi.org/10.1016/j.ufug.2019.126476
17. Deci, E. L., & Ryan, R. M. (2000). Self-determination theory and the facilitation of intrinsic motivation. American
18. Psychologist, 55(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68
19. Department of Statistics Malaysia (DOSM). (2023). Population and housing census 2023 highlights. Putrajaya: DOSM.
20. Desmet, P., & Hekkert, P. (2007). Framework of product experience. International Journal of Design, 1(1), 57–66.
21. Doğru, H., Koçak, S., & Aydin, E. (2015). Injuries and complaints due to outdoor fitness equipment use in Turkey.
22. International Journal of Human Movement and Sports Sciences, 3(4), 55–63.
23. JLN. (2023). National Landscape Policy. Putrajaya: Department of Landscape Malaysia.
24. Levinger, P., Panisset, M., Dunn, J., & Haines, T. (2018). Exercise interventions for older adults using outdoor exercise equipment. Journal of Aging and Physical Activity, 26(4), 650–658. https://doi.org/10.1123/japa.2017-0103
25. Liu, Y., Wang, R., & Zhao, J. (2020). Evaluating outdoor fitness equipment in China's urban parks: Public

health perspectives. Journal of Environmental Psychology, 68, 101393. https://doi.org/10.1016/j.jenvp.2020.101393
26. Nik Ahmad Ariff, N., Badke-Schaub, P., Eris, O., & Suib, S. (2012). A framework for reaching common understanding during sketching in design teams. Paper presented at the DS 70: Proceedings of DESIGN 2012, the 12th International Design Conference, Dubrovnik, Croatia.
27. Norman, D. (2004). Emotional design: Why we love (or hate) everyday things. Basic Books.
28. Omar, M., Hamat, S., Abdullah, F., Anuar, N. H., Faudzi, Y. M., & Nawawi, N. M. (2022). REVISIT SHOPHOUSES
29. IN KOTA BHARU: A CULTURAL STUDY. INTERNATIONAL JOURNAL OF INNOVATION AND INDUSTRIAL
30. REVOLUTION (IJIREV), 4(11), 56-65. doi:10.35631/ IJIREV.411005
31. Page, B. (1987). Designing for all: Inclusive design practice. London: Design Council.
32. Richey, R. C., & Klein, J. D. (2008). Design and development research: Methods, strategies, and issues. Routledge.
33. Richey, R. C., & Klein, J. D. (2014). Design and development research: Retrospective review and future directions.
34. Educational Technology Research and Development, 62(2), 221–235.
35. Sommer, R. (1983). Social design: Creating buildings with people in mind. Prentice-Hall.
36. Stebbins, R. A. (2017). Leisure and the motive to volunteer: Theories of serious, casual, and project-based leisure.
37. Palgrave Macmillan.
38. Ulrich, K. T., & Eppinger, S. D. (2016). Product design and development (6th ed.). McGraw-Hill.
39. Xie, H. (2012). Fitness parks in China: User experiences and safety issues. Journal of Physical Education and Sport, 12(2), 214–221.
40. Yan, J. (2016). Community exercise and risks in outdoor gyms in China. Journal of Public Health Policy, 37(2), 215– 227. https://doi.org/10.1057/jphp.2015.51
41. Shukri, M. F. A., Rahman, A. R. A., Mohd Ali, N. A., Aminuddin, B.,Nik Ahmad Ariff, N. S., & Abdul Rahim, M. F. (2025).The factors influencing outdoor fitness equipment usage for the middle age group at urban parks in Klang Valley, Malaysia.Advances in Consumer Research, 2(5), 813–821

.