Comparing User Preference for AI-Assisted Search bar, AI+VR Search-Interaction, Gamified Quiz-Driven Product Bundling: Towards Cross-Disciplinary Intelligence and Sustainability

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Abstract. There are interests in chat-based (and voice-based) search, without filters. But it is not clear which may be preferred. This study aims to compare perceived ease of use, perceived usefulness and perceived acceptance for gamified quiz-based bundling recommendation, AI-assisted search recommendation and AI+VR interactive visualization in a Figma MUJI mobile application. Framed within the circular economy, the International Requirements Engineering Board's Requirements Engineering and Madani frameworks, analyses, design and development are guided by strategic group map, PESTLE, Sustainability Awareness Framework, TAM 1, 2, 3. Alpha beta testing findings are positive. The averages for all three are almost similar but gamified bundling edges first. Data from a survey of 70 active MUJI customers reveal ease of use and usefulness as significant predictors shaping engagement. Cluster means for AI search recommendations and AI + VR differ from 2.2 to 4.9/5. Age and gender are not significant. Highly accurate/useful product-preference matching/ bundling, and AI + VR highly correlate with and significantly predict intention to adopt the technology, confirming Venkatesh, Speier-Pero and Schuetz's drivers for online shopping. Some circular economy-values-based personalization examples conclude.

Keywords: search · shopping experiences · MUJI mobile app · gamified quiz-based bundling interactions · AI-driven search recommendation · AI+VR immersive interaction · cluster analysis · correlation · linear regression · design thinking

1 Introduction

In today's evolving retail landscape, personalization has become a key element of digital success, as consumers expect intelligent, intuitive, and visually engaging/ emotionally connected/enjoyable shopping experiences. [1] have suggested that conjunctive aggregation forms a triangle (a t-norm) in rule-based systems. There are possibilities of t-conorm

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refactoring with t-norms and h-norms. Hence, identifying the t-conorm may provide rich probabilistic mixtures, if upper/lower bounds are known.

For the circular economy, [2] highlight cross-disciplinary intelligence and redesign. [3] suggest extending beyond ease of maintenance/upgradability and repair, durability and (dis)assembly to attachment and trust. Such possibilities have provided building blocks to the Learning Sciences' seeds for a more creative society vision and corresponding emphasis on imagination, [4]'s creative analogy and [1]'s cross-selling/ market basket analysis. Subsequently, [5] has proposed simplifying design through design thinking, identifying significant influencing variables and relationships, and how users would like to interact visually and dynamically with the system. Furthermore, with technological advancements, there are interests in voice-based and chat-based search, i.e., without filters. This has motivated our research into comparing gamified quiz-based bundling (the most direct requirements elicitation method) with AI-assisted search recommendation (de facto) and AI + VR interactive visualization (emerging).

MUJI Malaysia is chosen for this case study, as MUJI Malaysia is relatively new to both Malaysian F&B and retail sectors, having less than 20 years of presence in both. Second, it has always focused on minimalist design, functionality, and lifestyle coherence. This presents a valuable opportunity for us to explore how MUJI Malaysia can enhance engagement through digital strategy and innovation.

Our hypotheses are: first, users may prefer the AI-assisted search recommendation, more than the leaner quiz-based recommendation. As such, we gamified the latter to investigate the efficacy of gamification. Gamification is included because in Malaysia, many aspects of life (not only online shopping), are gamified via loyalty points. Second, users may be attracted to AI + VR but only if it remains useful, easy to use, affordable.

Our research questions are:

RQ1: To what extent do age and gender among our sampled respondents influence adoption intentions of AI-assisted recommendation and AI+VR visualization?

RQ2: How will respondents perceive gamified quiz-based bundling compared to AI-driven search recommendations and AI+VR recommendations?

RQ3: To what extent can AI + VR become more localized in terms of circular economy frameworks and values?

We next present related work, which ground our requirements elicitations, validation and refinement.

2 Related Work

2.1 Frameworks

The International Requirements Engineering Board's (IREB) Requirements Engineering (RE) framework (Fig. 1) elicits requirements corresponding to the system, and development contexts. System context includes subject facet (users' characteristics), usage facet (how users use the system) and IT systems facet (the IT capacity/capability environment). These are analyzed and negotiated in terms of goals, corresponding scenarios and solution-oriented (non)functional requirements. Validation is via user testing.

To guide sustainable design, [6]'s Sustainability Awareness Framework (SusAF) (Fig. 2) covers five dimensions, i.e., individual, social, economic, technical and environmental. Each has immediate, enabling and structural/architectural impacts.

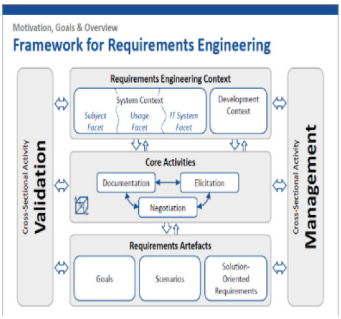


Fig. 1. IREB's RE framework

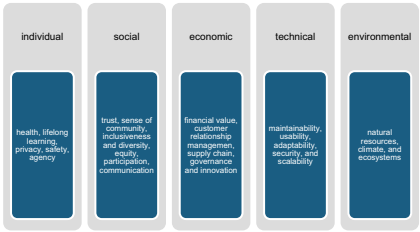


Fig. 2. [6]'s SusAF

2.2 Technology Acceptance Models 1, 2 and 3 and Online Shopping Drivers

The Technology Acceptance Model (TAM) first started with system usability in terms of perceived usefulness and perceived ease of use [7]. Then, [8] extend it to TAM 2 on social factors and [9] further extend it to TAM 3, to include intrinsic human factors. TAM 1, 2 and 3 are illustrated in Fig. 3a. Subsequently, [10] abstract findings to a model illustrating drivers for online shopping (Fig. 3b). These models are chosen as they are globally-established and accepted.

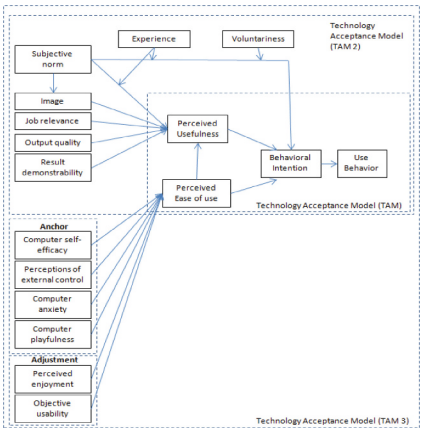


Fig. 3a. [7–9]'s TAM 1, 2 and 3

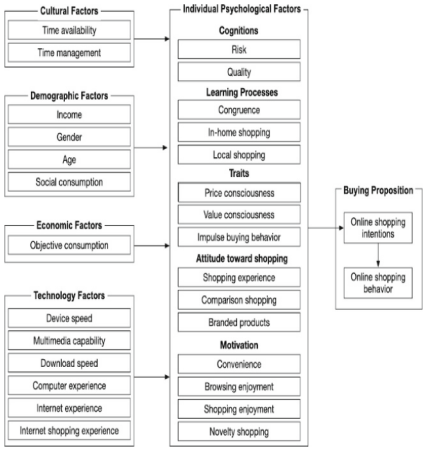


Fig. 3b. [10]'s online shopping drivers

Table 1. [12]'s Integrated TAM-Madani framework.

TAM 1 [7]	**TAM 2** [8]						Likely to recommend to others
Perceived usefulness	Experience	Voluntariness	Subjective norm	Image	Job relevance	Output quality	Result demonstrability
	TAM 3 [9]						
Perceived ease of use	**Anchor**				**Adjustment**		
	Computer self-efficacy	Perception of external control	Computer anxiety	Computer playfulness	Perceived enjoyment	Objective consumption	
Customer satisfaction	Product/ service Q	Customer service	Price/ **value**	Brand image	Conve-nience	Overall experience	
Madani [11]							
Values	Respect	Innovation	Trust	Compassion	Prosperity	Sustainability	

2.3 Malaysia's Madani Framework

The Malaysian Madani [11] framework (Table 1) is a values-based framework proposed by the Malaysian government. The TAM-Madani framework is proposed by [12] to investigate perceptions towards the design of some additional services for Sunway University's SuperApp. Perception outcomes are promising. A SuperApp transfer of findings is relevant, as a SuperApp hosts multiple subsystems, leading to possible cross-disciplinary intelligence/ecosystems.

3 Methodology

As part of Information Systems Analysis and Design, and in line with design thinking and the Software Development Lifecycle (SDLC), we have carried out the following (Table 2). Each strategy in Table 2 ideates according to the IREB RE's goals, scenarios and (non)functional requirements.

Table 2. Information Systems Analysis and Design to extend MUJI Passport/mobile app

Analysis			Design	Mining
Pre-proposal (competitor analyses) [iteration 1]	Proposal [iteration 2]	Impact/feasibility [iteration 3]	Figma [iteration 4]	Clustering, Regression
• The strategic group map highlights the two most important factors (x- y axes) for market positioning • [13]'s Politics, Economics, Social, Technology, Law, Environment (PESTLE) assess feasibility/ viability, competitor analyses [14]	Propose strategies/ value propositions based on market basket analysis [1]	• [6]'s SusAF • [15]'s weighted criteria analysis to prioritize strategies	Alpha-beta user testing (TAM 1, 2, 3) [7–9]	

Five strategies are first proposed based on strategic group map analyses. To assess feasibility of the proposed five MUJI strategies, weighted criteria analyses is carried out to choose the top three. Subsequently, a pilot survey is carried out via Google form, to

assess/confirm the sampled customers' preferences towards these five strategies. Likert scale is 1 to 5. The survey questionnaire consists of 15 questions. Each strategy is assessed by three questions: Perceptions to the Digital Flywheel strategy (Q1–3), Online Lifestyle Quiz (Q4–6), AR Product Try-On (Q7–9), Subscription Box (Q10–12) and Smart Home Integration (Q13–15). Next, SusAF impact analysis is carried out.

With these feasibility/impact analysis outcomes, a Figma prototype is designed/developed, and alpha and beta user testing carried out. The questions for the pilot, Figma alpha-beta user testing are based on Technology Acceptance Models 1, 2 and 3.

For the next round of research via data mining, data originates from a structured survey of 101 respondents, targeting active online shoppers and MUJI customers, distributed via social media. The survey explores demographic variables (Q1–Q2) and user perceptions of AI and VR-based features (Q3–Q8). Since 31 forms contain missing data, we have 70 valid observations. Gender, AI search, and AI + VR are coded as binary. Age group is coded using an ordinal scale, e.g. 1 for respondents aged < 18 and $5 > 45$. To test our hypotheses, we use SAS analytical tools such as clustering, correlation and regression, to evaluate/predict users' perceptions.

3.1 Pre-design Analyses

Competitor/Value Analysis: Strategic Group Map. MUJI stands out among its competitors, in terms of perceived quality and product variety (Fig. 4a). Perceived quality measures the customer's overall impression in terms of emotional and practical value. Product variety reflects the range, functionality, and innovation/differentiation, critical in a saturated market.

Competitor/Feasibility Analysis: PESTLE. This subsection extends from the product variety-perceived quality strategic group map analysis to macro-micro influencing factors, via [13]'s Political, Economic, Social, Technological, Legal and Environmental (PESTLE) dimensions (Fig. 4b).

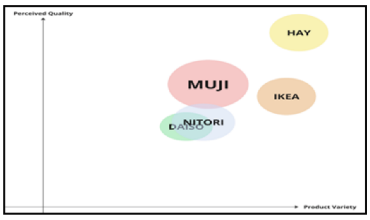


Fig. 4a. Strategic group map (variety vs. quality)

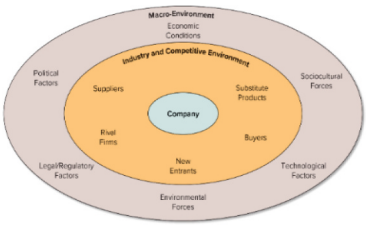


Fig. 4b. [13]'s PESTLE and [14]'s Five Forces (inner circle)

Political: *MUJI* operates primarily in politically stable countries such as Japan, the European Union, and Southeast Asia. This allows *MUJI* to focus on long-term retail and lifestyle expansion strategies. However, the company faces trade-related risks due to its reliance on global sourcing and cross-border manufacturing. Geopolitical tensions

especially between Japan and China can impact its operations, especially when China remains one of *MUJI's* largest overseas markets [16]. Despite these risks, *MUJI* maintains a neutral brand stance, steering clear of political controversy through its minimalist, "No-Brand" philosophy.

Economics: *MUJI* has benefited from the rise of the middle class and growing disposable income in Asian markets, especially in Malaysia and Singapore. In 2021, the company had global revenue of approximately 451 billion yen (about US$4.2 billion), accounting for approximately 10% of the Japanese home furnishings market and approximately 5% of the China market [17]. *MUJI'S* products are generally considered more expensive than some of the local competitors' such as *Daiso* and *Miniso*. This is challenging in the price-sensitive market.

Social: *MUJI's* "no brand" minimalist design concept resonates with consumers who are seeking simple, authentic, and environmentally-friendly living. *MUJI* has expanded its business beyond the retail sector, increasing its brand influence by opening concept cafes, galleries, and even its hotel in Ginza, Tokyo [16]. However, with the growing trend of "consumption downgrade" in China cities and consumers paying more attention to cost-effectiveness, *MUJI*'s high-end positioning and Japanese aesthetics sometimes fail to cater to the preferences of the mass market.

Technology: *MUJI* has been actively expanding its digital footprint, launching e-commerce platforms and digital membership systems. However, in the application of modern technologies such as artificial intelligence, augmented reality and personalization tools, *MUJI* still lags behind major competitors such as IKEA and *UNIQLO*. Although its Ginza flagship store provides an immersive offline experience through in-store workshops and curated exhibitions, *MUJI* has not yet fully integrated interactive technology into its UX [18].

Legal: Setbacks related to intellectual property (IP) rights, e.g. brand name [19], highlight the need for proactive adherence to IP in global markets.

Environmental: Environmental sustainability is a core element of *MUJI's* business model. *MUJI* actively promotes the circular economy through the "ReMUJI" project, e.g. recycling and launching a clothing line made of recycled PET materials.

3.2 Proposed Strategies

Based on the strategic group map and PESTLE's analysis, we propose 5 strategies that allows *MUJI* to further expand their business. *MUJI's* current mobile application lacks functional digital experience as its current version only showcases what products they are selling. Despite having a variety of products for customers to purchase, they could only view it in their mobile devices and are required to buy the products in MUJI's physical stores. Therefore, the proposed strategies include:

Digital online shopping enhancement: Mobile first, online lifestyle quizzes leading to personalized product bundles and real-time update/refinement of customer preferences. *MUJI* should advance its digital shopping experience by enabling mobile

first access so that users can explore product variability/availability, make purchases from anywhere and top up balance directly via an in-app wallet. Top-up promotions e.g. bonus credits can encourage repeat purchases and deepen customer engagement. Furthermore, analysis of customer data e.g. browsing behaviour, purchase history, customer needs and preferences, can lead to real-time personalized deals, future purchase forecast, customer re-segments, and targeted marketing/ automate follow-ups/reminders for abandoned carts optimization.

To refine recommendations, *MUJI's* image as a lifestyle brand can be enhanced by introducing interactive quizzes that generate personalized product bundles across categories such as beauty, fashion, food and beverage. Each quiz response is mapped to corresponding product attributes such as skin type, scent preference, or dietary needs, to form a foundation for personalized bundling. This data is then processed through Salesforce's Einstein Analytics, which scores potential combinations and recommends optimal bundles in real-time. Einstein's AI models assess the likelihood of conversion and suggest product pairings based on current trends, user behaviours, and past purchases. This ensures that bundles are relevant and effective.

New data from each quiz, creates a feedback loop that improves future recommendations especially cross-selling across product categories and smarter inventory decisions across demographics. A cloud-based Customer Relationship Management 360 platform e.g. Salesforce Cloud, can aid scalability, flexibility, and real-time syncing across all channels.

Digital online shopping enhancement: AR try-on for beauty and furniture via the *MUJI* app. *MUJI* can implement an Augmented Reality (AR) feature within its mobile application that enables users to virtually try products before purchasing. This strategy will also enhance the user's buying confidence and reduce product return rates. The AR system can be supported by 2 technologies. First, Einstein's AI-powered Knowledge Graph can create a contextual understanding of user behaviour by mapping out customer preferences, interaction history, and product characteristics into a structured data graph. This can enhance cross-category discovery. Recommendations can also be sent if users subscribe to the App. Second, Salesforce Service Cloud can offer real-time chat or assistance for styling tips or product alternatives during a virtual try-on, insitu.

Smart home integration via the *MUJI* App. This initiative follows the development of smart furniture and home accessories that merge design with functionality. For instance, aromatherapy diffusers that adjust to user-defined schedules and posture-monitoring furniture that provides wellness feedback. Hence, *MUJI* should take the opportunity to launch Internet of Things (IoT)-enabled furniture [20], in partnership with companies e.g. OGAWA and other lifestyle companies e.g. holographs, with optional habit-based reminders via Salesforce IoT Cloud. The incorporation of smart home technology can enhance *MUJI's* product offerings and consolidate the company's standing in the expanding lifestyle-tech sector, adding competitive advantage in innovation and well-being.

Table 3. Weighted criteria analysis of the proposed *MUJI* enhancements

Criteria		Digital Flywheel		Lifestyle Quizzes		Subscription Boxes		AR to Try On Products		Smart Home Integration	
Requirement	Weight	Rating	Weighted score	Rating	Weighted score	Rating	Weighted score	Rating	Weighted score	Rating	Weighted score
Customer engagement	20	5	100	4	80	3	60	3	60	2	40
Return on investment	20	5	100	4	80	3	60	3	60	2	40
Differentiation	10	4	40	4	40	3	30	5	50	4	40
			240		**200**		**150**		**170**		**120**
Constraints											
Software cost	15	3	45	2	30	2	30	2	30	1	15
Operating, maintenance cost	15	3	45	2	30	2	30	2	30	1	15
Ease of staffing, training	10	4	40	5	50	2	20	3	30	2	20
Operational complexity	10	4	40	3	30	2	20	3	30	1	10
			170		**140**		**100**		**120**		**60**
	Total Mark		**410**		**340**		**250**		**290**		**180**
	Rank		**1**		**2**		**4**		**3**		**5**

3.3 Feasibility Assessment via Weighted Criteria Analysis (WCA)

Based on the above initial analyses and proposals, weighted criteria analysis (Table 3) is carried out, in order to prioritize the design, development and evaluation of the proposed *MUJI* app via Figma. There are different ways to carry out the analysis (depending on the project manager's degree of experience). This study follows [15]'s weighted criteria analysis, which promotes 50%-50% requirements-constraints.

Based on Table 3, the Digital Flywheel strategy has the highest total weighted score of 410, placing it at rank 1. Next are the Online Lifestyle Quizzes with 340 points (ranked second), while AR Product Try-On scores 290 (third). The Subscription Box strategy earns 250 points (fourth), and Smart Home Integration 180 (fifth).

Confirmation of WCA assessment via pilot testing. The weighted criteria analysis in Table 3 reflects our internal perspective and may not fully capture customer expectations. Thirty respondents' answers are complete. Based on the results, the Digital Flywheel strategy has the highest overall average of 4.8 (ranking first). This is followed by the Online Lifestyle Quiz with an overall average of 4.46 (second), the AR Product Try-On strategy with an overall average of 4.2 (third), Subscription Box an overall average of 2.62 (fourth) and Smart Home Integration an overall average of 2.27 (fifth). As a rule of thumb, averages above 4.5 indicate high interest, between 4.00–4.49 moderate interest and less than 4.0, may need further refinement to better meet customer expectations. These findings concur with our weighted criteria analysis, where Digital Flywheel ranks highest in terms of strategic value, followed by Online Lifestyle Quiz and AR Product Try-On.

3.4 Feasibility Assessment/impact Analysis of WCA Outcomes Based on SusAF

Based on the WCA and customer feedback above, the top three strategies are digital flywheel strategy, online lifestyle quizzes with personalised product bundles and augmented reality (AR). These strategies demonstrate strong alignment with *MUJI*'S brand values of simplicity, sustainability, and personalization. Next, we venture into impact analysis via [6]'s SusAF. Due to space constraint, we present only the individual and economic dimensions and their immediate, enabling and structural effects/impacts.

Individual dimension. *Immediate Effect:* When the three strategies are implemented into *MUJI* mobile app, the users are immediately being placed in a guided experience. This is because they are asked to respond to quizzes that assess their lifestyle, needs and preferences, and in return, they receive curated product suggestions. These can complement data from their past purchasing behaviours and interactions and enable suggestions to be refined over time, especially when it comes to personalised product bundles.

Enabling Effect: When customers continue to engage with these personalised tools, they might rely more on machine-curated suggestions rather than their own discovery or comparison. Hence, customers might stop developing independent product knowledge or awareness or their own evaluative criteria, because they feel that the system already knows their preferences. Consequently, customers' preferences may be shaped by similar data patterns and predictive logic. Over time, this may reduce critical engagement, limit

exposure to diverse products or ideas, and narrow the scope of what users consider "relevant."

Structural Effect: As customer choices converge, more structural partnerships are necessary to attract, acquire and retain customers. Furthermore, *MUJI* would need scalable microservices, cloud-native APIs and real-time databases across *MUJI's* omnichannel collaborative/ competitive business model.

Economic dimension. *Immediate Effect:* The immediate economic impact of the implementation of the top three strategies are enhanced value creation, customer engagement, and transaction efficiency. Launching AR strengthens *MUJI'S* market image as an innovative and forward-looking brand. As customers feel that *MUJI* is trying to "understand" them and they are personally addressed, it can strengthen a sense of trust/emotional connection between customers and *MUJI*. This increases sustainable competitiveness in a fast-evolving retail landscape.

Enabling Effect: Continuous interaction with customers will allow *MUJI* to refine its pricing strategies, promotional offers, and product bundles based on their actual purchasing behaviour. *MUJI* can gain deeper value through data-driven decision-making, business and system partnerships. Additionally, governance processes can be improved, as all the digital workflows embedded compliance with data protection laws e.g. PDPA and GDPR.

Structural Effect: In the long run, fostering a shared sense of identity and belonging within the *MUJI* community by transforming the role of the customer from passive buyer to active participant in *MUJI'S* development, will shift *MUJI's* value creation from product-based to experience-based ecosystems. As *MUJI'S* ability to test, iterate, and deploy new ideas becomes a part of its core economic engine, it can expand across regional markets. Moreover, features such as multilingual interfaces and simplified navigation can allow customers from diverse backgrounds and ages to easily interact with *MUJI'S* services.

4 Design: Use Case Diagram

The use case diagram (Fig. 5) illustrates the key interactions between stakeholders. Sample goal-scenario-(non)functional requirements/requirements structure is on the right. Scenario 1 presents sample system logic.

4.1 Figma Prototype

Having confirmed the potential and feasibility of the top three strategies, we proceed to design the Figma prototype. It is based on [9]'s research agenda, involving TAM 1, 2, and 3 and possibilities of findings, which may concur with [10]'s model. There are several components to the Figma prototype: Signup/login, virtual try-on for beauty products and furniture, floating hints (so that newcomers will not get lost) and capture look; search pages, cart pages, chatbot pages, quiz pages, member/reward pages. We present some screenshots in Figs. 6a–b below.



Goal: View product categories

Scenario1: Chat with chatbot to search

Functional requirement:

a. Upon login, chatbot will greet the user by name.
b. Then the chatbot will present a menu of options for the user to choose from.

Scenario 2: Browse catalogue

Functional requirement:

a. Upon login, the user will be able to browse the catalogue based on past purchases and preferences.

Fig. 5. Overall use case diagram of enhanced *MUJI* App, sample functional requirements

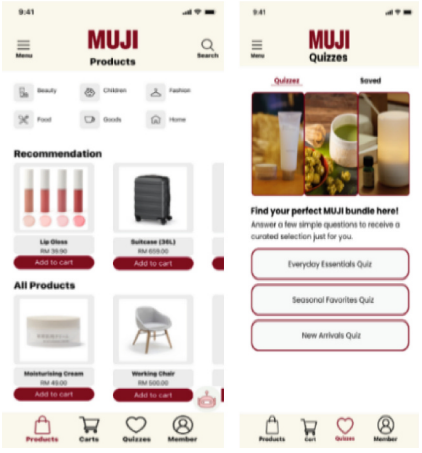


Fig. 6a. Main page

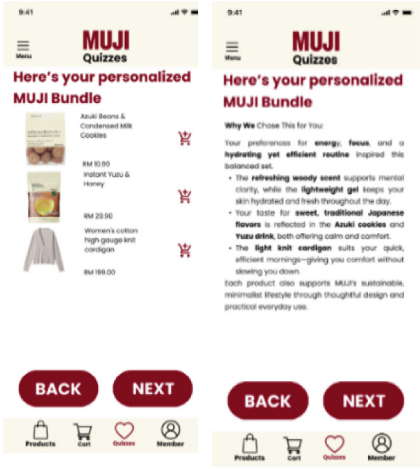


Fig. 6b. Personalized bundle

4.2 Alpha-Beta User Testing Results and Discussion

RQ1: To what extent will perception towards gamified quiz-based bundling compare with AI-driven search recommendations and AI + VR recommendations?

To observe if the proposed enhanced MUJI app meets expectations, we have carried out alpha and beta user testing with a group of 30 respondents using a Google Form. For both alpha and beta user testing, after interacting with the prototype, they answer questions assessing usability, layout clarity, satisfaction, ease of navigation, and feature usefulness on a 5-point Likert-scale (1 Strongly Disagree, 5 Strongly Agree).

The questions test several sections, i.e., Search pages, AR product pages, Quiz pages, Cart pages. The final question is an optional open-ended section, where users can provide their suggestions on improvements. The average for each question and for each section are then calculated and compared. The difference between the alpha and beta user testing survey questions are the *profile information page* in alpha. The question is not included in the beta questionnaire, as it has an average of 4.54/5 in alpha.

Alpha testing (Figma prototype + survey questionnaire). Overall, the acceptance towards the proposed enhancements obtained an average of 3.85. The most positive acceptance arises from the profile pages with transaction history and member page, reflecting the importance of identity associated with branding (category's average of 4.54), followed by the rewards page arising from the transaction history, bundled recommended products and referral (category's average of 4.03), the AR pages (category's average of 3.84), cart checkout pages (category's average of 3.46), and the search pages (category's average of 3.14). Areas to be improved on (in bold) are the search efficiency and relevance, the need for an AR tutorial, the cart checkout experience especially with regards to applying discounts/vouchers (Table 4).

Table 4. Category, questions, averages per question and per section, ranking per section (alpha testing)

Category	Question	Avg.	Avg.	Rank
Search	**The search bar helped me find products efficiently.**	**3.07**	3.32	5
	The search results and suggestions were relevant.	**3.20**		
	The "History" section was clear and useful.	3.70		
AR	The AR feature made it easier to understand the product.	4.60	3.84	3
	I was able to use the AR feature without any tutorial.	**3.07**		
Reward page + history, **bundled products,** referral	The purpose of the Reward Page was clear.	3.73	4.11	2
	Bundled products on the Reward Page were easy to view.	4.37		
	I could interact with the reward system without confusion.	3.87		

(*continued*)

Table 4. (*continued*)

Category	Question	Avg.	Avg.	Rank
	The process to refer a friend was clear and functional	4.47		
Cart checkout	I was able to review and manage the items in my cart easily.	4.40	3.46	4
	The process of applying discount or voucher codes was direct.	**2.83**		
	I could clearly view the total amount, item breakdown before checkout.	3.70		
	The cart checkout experience felt smooth and simple overall.	**2.90**		
Profile info. With history, member page	I was able to easily edit my profile information.	4.60	4.54	1
	I could access my transaction history without issues.	4.50		
	Overall, the Member Page was well-organised and user-friendly.	4.53		
	Overall average	**3.85**		

Beta testing (Figma prototype + survey questionnaire). The enhancements are the inclusion of an AI-driven search (Scenario 1 in Fig. 6a), a wizard-like tutorial for the AR, and quiz-based product bundling. Overall, there is an improvement of 0.68 (Table 5). There are improvements in all four categories (delta). The quiz-based product bundling ranked the highest, followed by the AI-driven search with recommendations, and AR with wizard-like tutorials. The findings confirm that the improved *MUJI* prototype app has met user expectations in terms of aesthetic appeal, intuitive navigation, and engagement.

Table 5. Feature, questions, AB average differences, averages per feature (beta testing)

Feature	Question	Avg. (delta)	Avg
Search	The search bar helped me find products efficiently	4.87 (+1.80)	4.84 (+1.52)
	The search results and suggestions were relevant	4.81 (+1.81)	
AR	The AR feature made it easier to understand the product	4.90 (+0.30)	4.84 (+1.00)
	I was able to use the AR feature without any tutorial	4.77 (+1.70)	

(*continued*)

Table 5. (*continued*)

Feature	Question	Avg. (delta)	Avg
Reward page w history, **quiz/ bundled products**	The quiz page was easy to navigate	4.87	4.86 (+0.75)
	The recommended bundle match my personal preferences, needs	4.87	
	I enjoyed the experience of discovering products through the quiz	4.94	
	I am more likely to purchase products after using the quiz feature	4.84	
	Applying MUJI points via the toggle switch is convenient, easy	4.81	
	The app automatically suggested the most suitable vouchers	4.84	
Cart checkout	I was able to review and manage the items in my cart easily	4.40 (+0.00)	4.06 (+0.6)
	The process of applying discount/voucher codes is straightforward	2.83 (+0.00)	
	I could view the total amount/item breakdown before checkout	3.70 (+0.00)	
	I find the Contact Seller option helpful when I had questions/issues	4.87	
	The cart shows my shipping details, so I can cancel/modify anytime	4.94	
	I appreciate the confirmation message before completing payment	4.81	
	The cart checkout experience feels smooth and simple overall	2.90 (+0.00)	
	Overall average	**4.53**	

5 Mining Results and Discussion

RQ1: To what extent do age and gender among our sampled respondents influence adoption intentions of AI-powered recommendation and AI+VR visualization?

RQ1: How will respondents perceive gamified quiz-based bundling compared to AI-driven search recommendations and AI+VR recommendations?

Having determined the feasibility/possible adoption of the proposed strategies/*MUJI* app enhancements, we proceed to the clustering and subsequently, linear regression. Questions are:

1. What is your gender?
2. What is your age?
3. Would you find an AI-powered recommendation/search bar useful when shopping online?
4. On a scale of 1 to 5, how likely are you to use an AI recommendation/search bar when shopping?
5. On a scale of 1 to 5, how satisfied would you be if the AI could suggest products that match your preferences?
6. Would you be interested in using a feature where you snap a picture and AI recommends related items?
7. On a scale of 1 to 5, how likely are you to try the AI + VR feature if available?
8. On a scale of 1 to 5, how helpful do you think this feature would be in improving your shopping experience?

5.1 Age/Gender Demographics

Out of the 101 respondents, there are more females (58.42%) than males (41.58%). Furthermore, most (77.23%) are from the 18–24 age group, followed by 13.8% from the $<$ 18 age group, and the 25–34 age group (5.94%) and 45 + age group (2.97%).

5.2 Cluster Analyses on Preference for AI Search Recommendation and AI + VR

The survey has explored demographic variables (Q1–Q2) and user perceptions of AI and VR-based features (Q3–Q8). Cluster analysis reveals the existence of 4 clusters (Fig. 7a). The cluster means (Fig. 7a) indicate a range from 2.2 to 4.9. Cluster 1 with cluster mean 4.92–4.98, comprise of respondents who are very positive and highly supportive of both AI-driven features. This is followed by Cluster 4 with cluster means from 3.8–4.46). These respondents are generally positive but less enthusiastic compared to Cluster 1. Cluster 2 demonstrates moderate interest (3.3–4.65). Cluster 3 records the lowest means (2.2–3.2) reflecting users who are less interested/indifferent towards these technologies. Overall, the results suggest that user preferences are segmented into distinct groups ranging from strong supporters to low-interest users of AI and VR.

5.3 Correlation Analyses

We do not measure causal improvement, because the study is short term. Evidence of causal improvements are usually possible only for long-term studies. Hence, we depend more on correlation for this preliminary study. With a chi square (effect size) of 13.78 (Fig. 7b), age is positively correlated with the 2 technologies but does not explain the

other variable to much extent. It hints at other variables as more important/significant. The probability of 0.13 indicates that they are not significantly interested and DF of 9 implies that they are open to persuasion given sufficient reasons/incentives. This may apply especially for respondents < 18 years old (13.8%) and 19–24 years old (77.23%).

Cluster Means

Cluster	Q4	Q5	Q7	Q8
1	4.923076923	4.980769231	4.865384615	4.923076923
2	4.400000000	4.650000000	3.300000000	3.350000000
3	3.200000000	3.200000000	2.200000000	2.400000000
4	3.833333333	3.750000000	4.458333333	4.458333333

Fig. 7a. Means across clusters

Statistics for Table of CLUSTER by age_group_encoded

Statistic	DF	Value	Prob
Chi-Square	9	13.7771	0.1305
Likelihood Ratio Chi-Square	9	11.7903	0.2254
Mantel-Haenszel Chi-Square	1	0.2237	0.6363
Phi Coefficient		0.3693	
Contingency Coefficient		0.3465	
Cramer's V		0.2132	

Fig. 7b. Chi-square, DF, age probability

As for gender, a chi square of 1.9846 (Fig. 7c), and a probability of 0.58, implies there is not much difference between gender. The degree of freedom of 3 further implies that respondents can be persuaded slightly, given usefulness/value. Value in [10]'s online shopping drivers (an abstraction of longitudinal studies), is congruence.

Building on [10, 21]'s findings on an almost similar demographic concur. Hence, new business models, and cooperative value chains should persuade/build on individual/social psychological factors e.g., congruence, value consciousness, trust, enjoyment and adapt strategies to each cluster's attracting and sustaining factors.

Statistics for Table of CLUSTER by gender_encoded

Statistic	DF	Value	Prob
Chi-Square	3	1.9846	0.5756
Likelihood Ratio Chi-Square	3	1.9798	0.5766
Mantel-Haenszel Chi-Square	1	0.1555	0.6933
Phi Coefficient		0.1402	
Contingency Coefficient		0.1388	
Cramer's V		0.1402	

Fig. 7c. Chi-square, DF, gender probability

5.4 Regression

Figure 8 indicates that likelihood to use an AI recommendation/search bar when shopping (Q4) and intention to use are strongly correlated (chi square of 0.73). However, its dependent mean is 4.63. At p 0.22, the AI search bar is thus not significant. However, respondents would certainly be (DF1) satisfied if the AI could suggest products that match their preferences (Q5). With a $p < 0.001$, highly successful matching significantly predicts the likelihood of using the AI search bar.

The REG Procedure
Model: MODEL1
Dependent Variable: Q4

Number of Observations Read	101
Number of Observations Used	70
Number of Observations with Missing Values	31

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	19.35350	9.67675	92.76	<.0001
Error	67	6.98936	0.10432		
Corrected Total	69	26.34286			

Root MSE	0.32298	R-Square	0.7347
Dependent Mean	4.62857	Adj R-Sq	0.7268
Coeff Var	6.97805		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.62234	0.30758	2.02	0.0470
ai_search	1	0.32447	0.25965	1.25	0.2158
Q5	1	0.79255	0.06868	11.54	<.0001

Fig. 8. Likelihood of customers using the AI search bar

To predict AI + VR adoption, the multiple linear regression analysis in Fig. 9 informs us that age and gender are not significant at p 0.0640 and p 0.0191 respectively. This indicates that, demographic factors do not significantly predict attitudes toward the proposed technology adoption. However, correlation between AI + VR and intention to adopt AI + VR is strong at 0.69 and dependent mean of 0.89. This is supported by likelihood to try's (Q7) and likelihood of improving shopping experience's (Q8) $p <$ 0.05, with a variability of 13–15% respectively. It is not conclusive at this stage, whether findings for AI-assisted recommendations will be similar for AI + VR, i.e., ease of use, and highly accurate/useful recommendations, sustain.

The REG Procedure
Model: MODEL1
Dependent Variable: ai_vr

Number of Observations Read	101
Number of Observations Used	66
Number of Observations with Missing Values	35

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4.34672	1.08668	34.69	<.0001
Error	61	1.91085	0.03133		
Corrected Total	65	6.25758			

Root MSE	0.17699	R-Square	0.6946
Dependent Mean	0.89394	Adj R-Sq	0.6746
Coeff Var	19.79889		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.20869	0.14986	-1.39	0.1688
gender	1	-0.10941	0.04545	-2.41	0.0191
age_group	1	-0.06439	0.03414	-1.89	0.0640
Q7	1	0.13584	0.04392	3.09	0.0030
Q8	1	0.15023	0.04496	3.34	0.0014

Fig. 9. Likelihood of customers adopting the AI + VR

5.5 Limitations of the Study

The first limitation of this study is that the sample size is small, as the data is collected at the end of the school semester, as part of the course requirements. Hence, findings cannot be generalized. Second, the perception study is based on a Figma prototype. We do not know how users will perceive an actual system.

6 Circular Economy, SusAF, TAM, IREB RE Frameworks, Design Thinking

RQ3: To what extent can our AI + VR become more localized in terms of circular economy frameworks and values?

The design of strategies in the methodology section, indicates positive mapping between system functions/value. User testing findings have also indicated high averages, implying technology acceptance towards all three search/visualization methods, i.e., gamified quiz bundling, AI recommendations and AI + VR, though respondents prefer gamified quiz bundling most.

Furthermore, ontology in its diverse representations, e.g. XML, RDF and OWL are part of the Semantic Web. Finding suitable t- and h-conorms [1], and [22]'s aspect/ feature learning e.g. via [23]'s *apriori* can simplify design across SDGs [5]. Contextualizing these within frameworks and respective metrics in Table 2, e.g. SusAF [6], PESTEL [13], drivers for online shopping [10] and designing/developing based on the IREB's RE would provide more holistic guidelines/assessments.

Aggregation and optimization e.g. [24]'s global-local ontological matching and [25]'s imperfect-information games based on exponential counterfactual regret minimization, can balance/optimize tradeoffs to enhance unsupervised learning, agility. However, these are beyond our ability.

Furthermore, [2]'s emphasis on cross-disciplinary intelligence and redesign leads us creative analogies. Exemplary enablers are *Lazada* and *Shopee's* successful aggregation via cross-brand filters and *Starbucks' Ideastorm's* idea-generation/voting/shaping gamified community respectively. [3]'s attachment points us to gamification, critical in sustaining traffic and sales in Asia's *Lazada* and *Shopee* and to propose opt in/out quiz-based AI-personalized AR/VR extending externally from live streaming; simplified from Meta's Google Glass vision, for developing economies. Trust via serious security/privacy and fulfilling terms and conditions of sales/use.

In terms of localization, from Fig. 7a, cluster 3 has the lowest mean across Q4 to Q8, especially Q7 on possibility of trying the AI + VR feature. This indicates that we need to tap into TAM 3's adjustment, i.e., perceived enjoyment and objective consumption (Table 3). Considering that they are mostly young, cost is primary. Hence, AI + VR search may be improved if they can gain points to redeem items related to their studies/hobbies. This emulates Lazada/Shopee, where points are given for any task across brands/ products (objective consumption) the user chooses to carry out in the system at the point collection page. These points can be applied upon checkout. Community service (Madani's compassion) or tasks reducing climate change (Madani's sustainability) can be factored in among these tasks.

Moreover, the promotion of objective consumption can also apply to Cluster 2. However, Cluster 2's means for Questions 4 and 5 are very high at 4.40 and 4.65 respectively. Hence, the game/point system can include the number of likes/shares and consequent likes/shares to update the AI model and to refine AI recommendations.

7 Conclusion

MUJI operates across multiple product categories with a focus on cohesive design and usability. This captures a vital aspect of its market identity. It has partnered with Salesforce, SAP, Microsoft to improve data integration, customer engagement, analytics and scalability. Through diverse design frameworks, e.g. the IREB's RE framework, strategic group map, PESTLE, Sustainability Awareness Framework, TAM 1, 2, 3 and Venkatesh, Speier-Pero, and Schuetz's online shopping model, analyses, design and development are guided, validated and managed. Our gamified quiz-based real-time bundling is ranked highest compared to AI solutions, mainly because gamifying sales and services (loyalty points) is expected in Malaysia, as a means to increase inclusion/affordability. Since congruence and enjoyment are key deciders, depending on regions and respective cultures, prioritizing individual/societal values-based design (design thinking) may increase relevance/congruence and thus sustainability; bridging across all 5 SusAF dimensions.

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