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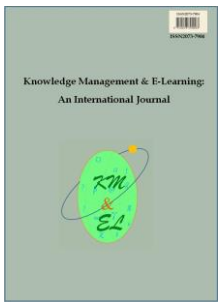

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Enhancing customer satisfaction through open innovation communities: A comparison of knowledge management approaches

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Abstract: Organizational learning integrates core specialized tacit resources and knowledge to facilitate development of strategic interdisciplinary knowledge development, integration, management and innovation. To promote open innovation within a gig economy, we address three problems: first, to identify which knowledge management view may contribute more in deriving, creating and increasing value and customer satisfaction; second, to educate users to learn, improve, and transfer the value to his/her designs via the user innovation community's (UIC) feedback; third, from the reviews and findings, to identify implications/factors that we should pay more attention to when synergizing strategies and technology amidst co-evolving markets. Scoping our research to individual and additive/incremental Resource-based view (RBV-KM), Knowledge-based view (KBV-KM), and Mixed-based view (MBV-KM) knowledge management approaches, the UIC are framed (positioned) as novice product designers-customers learning via HerAll, a Malaysian B2C niche card design e-commerce website. Hypothetically, RBV-KM may evidence more participation; KBV-KM more meaningful knowledge-sharing, moderated by the leader's design and leadership skills; MBV-KM better design outcomes, knowledge sharing and the highest designer-customer satisfaction. Findings indicate 75.85% overall average customer satisfaction for RBV-KM, 71.40% KBV-KM and 81.35% MBV-KM. These correspond with the Diamond model and Customer Relationship Models. With perceived value in the midst of inter-connected, co-evolving business models as motivator, customer satisfaction is influenced most by familiarity with the learning environment and tasks, followed by the type and quality of leadership, feedback/comments from the UIC, which influence the development of community and identity, ability, and cultural fit. Findings on the type and timing of rewards and (intelligent) guidance concur with prior literature.

Keywords: Knowledge management; Design factors; Crowdsourcing; Customer satisfaction; Card design niche industry; Customer relationship management

Biographical notes: Dr. Chien-Sing Lee is a Professor in Sunway University.

Her 24+ years of design discovery/adventure, include multimedia systems, Artificial Intelligence, knowledge management, and creativity in computing and informatics (Multimedia University), the Learning Sciences (2008/9 Fulbright Visiting Scholar Fellowship in Georgia Tech, Lehigh University), Mathematics for grades 1-3 students (National Central University), design-computational thinking in the creative industries (Universiti Tunku Abdul Rahman), and computing and information systems (Sunway University). She applies lessons learnt to e-learning, e-commerce, and e-health research.

Ms. Lee-Yin Yew, graduated from Sunway University in December 2018, with a first-class Bachelor (Hons) Information Systems degree. Since graduation, she has been a project manager and solutions consultant for an enterprise HR solution provider, People Quest Pte. Ltd. She is passionate in providing innovative solutions for clients' challenges in day-to-day HR processes while improving employee satisfaction. She is still in love with Art & design.

1. Introduction

E-Commerce provides opportunities for businesses to engage with online audiences across the world. E-commerce's success depends on several significant factors, i.e., sustainable business models, the ability to scale, evaluate and manage resources, and knowledge and capability development (Porter, 1979; Prahalad & Hamel, 1990; Barney, 1991; Porter, 1996; Grant, 1996; Debowski, 2006; Hunt, 2013; Garcia-Alvarez, 2015; Yang, Xun, & He, 2015). Porter's (1979) five forces, for instance, highlight some key mechanisms to be considered, i.e., the threat of new entrants, and the threat of substitute products, balanced by the bargaining power of suppliers and buyers. These highlight the importance of differentiation. Subsequently, Porter (1990), suggests extending these five forces to consider chance, factor conditions and related and supporting industries, in his Diamond model (Theory of National Competitive Advantage of Industries.

The importance of organizational learning, due to dynamic and co-evolving market conditions and supply chains, is echoed by many key knowledge management (KM) researchers. Prahalad and Hamel (1990) posit that firms must develop their own specific core competencies, to enable them to think and act differently, and to create sustainable competitive advantage. Similarly, Barney's (1991) resource-based knowledge management view (RBV-KM), stresses that sustained competitive advantage, requires heterogeneous mixes amongst internal resources, to create diverse strategies and to develop new/refine existing heterogeneous mixes. Grant's (1996) knowledge-based view (KBV-KM) extends RBV-KM, to highlight mechanisms, which encourage/develop experimental integration of the individual's specialized tacit knowledge into broader, and more cross-functional organizational capabilities. A mixture of different KM views and evaluation would result in Mixed-based View KM (MBV-KM), where specialized tacit knowledge is integrated/synergized. All three approaches are in line with Nonaka and Takeuchi's (1995) Socialization, Externalization, Combination and Internalization (SECI) spiral model.

As interdisciplinary knowledge and competencies take a longer time to develop, especially amidst dynamic co-evolutions, and complex markets, it is more effective and efficient to acquire, use and develop core-relevant strategic resources and knowledge. Hence, Barney (1991) proposes evaluating the uniqueness of knowledge, based on the criteria valuable, rare, imperfectly imitable and not substitutable. However, the problem is, such uniqueness is difficult to develop. Porter (1996) thus suggests focusing on

strategic positioning, while developing resources, knowledge and competencies. He recommends that organizations should consider not only how to uniquely position itself (its fit) within markets, and how to align the organization's activities to consolidate each strategy, but also, how not to compete in certain areas. Identifying the fit and what is core are thus critical. To further identify foci, in information systems studies, design and assessment factors are assigned different weightage, to cater to different challenges and contexts, such as via Analytical Hierarchical Processing and weighted criteria analyses. An example is Lim and Lee's (2008) study.

Examples of successful RBV-KM, KBV-KM and MBV-KM, sharing of tacit-explicit knowledge and strategic positioning, are Tik Tok and Instagram. Buzz and AirBnB, are also successful in developing thriving communities; especially, during the pandemic (Lee & Wong, 2020). The internal drive to develop capability, in line with the Capability Maturity Model (CMMI), and technological synergies corresponding to diverse human-factor rubrics such as Davis's (1989), Ventakesh and Bala's (2008) Technology Acceptance Model (TAM) 1 (perceived ease of use, perceived usefulness, attitude and intention to use), TAM 2 (social/external factors), and TAM 3 (user factors) would and have complemented KM's four processes (acquisition, analysis, transfer and dissemination) to a great extent. These four examples also confirm Wagner and Jiang's (2012) review findings, i.e., drawing on social media's collective intelligence, to improve needs analysis, idea generation, as well as idea evaluation, is no longer an option.

1.1. Objectives

Due to the pandemic, slower economic recovery and more tech-savvy citizens, social technologies within a gig economy may become a part of the future of work (Di Gangi, Wasko, & Hooker, 2010). This improves not only product innovation, but also customer satisfaction. With Porter's (1990) Diamond model, the European Union's (EU) open innovation framework, and Ikeda and Bernstein's (2016) Human-Computer Interaction (HCI)-grounded crowdsourcing initiative as context, we continue from prior work by Lee and Wong (2015, 2016, 2017) on gamified learning-cum-design, towards sustainable community engagement and mashable innovations in Smart Cities.

Scoping our research to three KM approaches, i.e., RBV-KM (Barney, 1991; Garcia-Alvarez, 2015; Yang, Xun, & He, 2015), KBV-KM (Grant, 1996; Porter, 1996) and MBV-KM, our pedagogical foundations are grounded in Bloom's (Anderson & Krathwohl, 2001) revised taxonomy, within the context of the broader Capability Maturity Model. These KM approaches are additive/incremental and provide triangulated insights into users' designs and/or underlying beliefs.

The website portal, *HerAll*, aspires to design every lady's wishlist. We hypothesize that if we develop motivation and ability, i.e., include self-development in the open innovation design process, to young people who have never participated in crowdsourcing or total virtual learning or open innovation, higher user participation and higher user/customer satisfaction may result. Hence, we frame/position the UIC as product designers-cum-consumers and encourage them to consider customer satisfaction more deeply based on authentic feedback from other designers in the system. We hope this would help them to transform knowledge from the customer to knowledge about the customer and to knowledge for the customer (Gibbert, Leibold, & Probst, 2002; Debowski, 2006; Kong & Cai, 2008), more meaningfully.

Subsequently, we encourage the user, to improve his/her designs via the UIC. Similar to Buzz and Ideastorm, we hypothesize that besides self-development,

community development functions, e.g., likes, comments, share, and rewards, would encourage self-reflection and more comments (sharing of tacit knowledge). Consequently, we may be able to extend KM beyond capturing tacit knowledge, to knowledge acquisition and transfer; along a designer – consumer journey.

Our research questions are specified in the following:

1. Which approach (RBV-KM/KBV-KM/MBV-KM) would be more useful and satisfying to the individual or user innovation community (UIC) in a simulated Malaysian B2C e-commerce niche card design industry?
2. Will an additive RBV-KM-KBV-KM-MBV-KM approach be more effective?
3. Which factors will boost customer satisfaction more?
4. What are the implications since technology and strategies often co-evolve rapidly? Are there factors we should take further note of and to a greater extent?

1.2. Significance

Thus far, we have not found prior research utilizing RBV-KM, KBV-KM and MBV-KM for a niche market. Hence, there is still room to explore the effectiveness of RBV-KM, KBV-KM, as well as an additive synergy of these approaches, i.e., the MBV-KM, in increasing the UIC's perceptions and satisfaction with regards to a simulated niche card design market. We have chosen a niche market, as it involves small segments of the market and is less explored. Furthermore, small firms sometimes, prefer niche markets as the firm does not need to manufacture products on a large scale, but based on demand.

Second, in relation with Alavi and Leidner's (2001) observation that RBV-KM does not differentiate between different types of knowledge-based capabilities, we refer to Bloom's (Anderson & Krathwohl, 2001) revised taxonomy, as the golden standard to generically guide capability development from resource-based RBV-KM to knowledge-based KBV-KM to their synergy, i.e., MBV-KM, across disciplines and backgrounds. Third, Bloom's revised taxonomy is applied in relation with Lee's (2009) spiral cascading curriculum, which simulates the iterative deepening search strategy.

2. Related work

2.1. E-commerce innovation

Innovation is characterized by the originality of the products, enhanced via creative knowledge application (Shapira, Youtie, Yogeesvaran, & Jaafar, 2006). However, the traditional product/service innovation process relies heavily on internal organizational research and development teams. Some of the core economic performance measurements include gain in market share, increased turnover, improved product value, and/or lower operating cost. Since e-commerce is an ever-growing industry unfolding at a very fast pace and is highly competitive due to low barriers to market entry (Laudon & Traver, 2016), we need to constantly identify knowledge management enablers, to motivate efficient, effective and sustainable outcomes.

2.2. Knowledge management enablers

In the Knowledge Economy, knowledge management promotes an integrated approach to identify, capture, evaluate, retrieve and share all information available in an organization (Debowski, 2006; Jashapara, 2010; Kiu & Tsui, 2011). To improve performance, new knowledge needs to be generated or applied, corresponding to external factors. Complementing the review of key KM enablers in the introduction section, Shapira, Youtie, Yogeesvaran, and Jaafar (2006) highlight four knowledge enablers, i.e., human capability, leadership, technology, and environment (see Fig. 1).

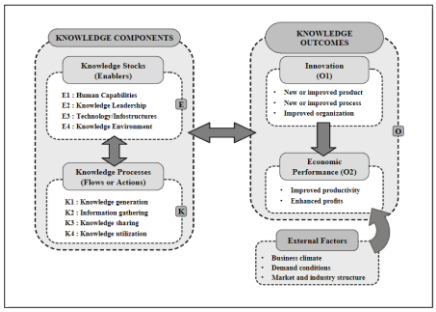

Fig. 1. Knowledge components affecting knowledge outcomes. Adaped from Shapira, Youtie, Yogeesvaran, and Jaafar (2006)

Aided by Knowledge Management Systems' centralized access, user friendly interface, and efficient search functions, knowledge sharing (e.g., via reviews), aid organizations to gain market insights, leading to product innovation. (Nie, Zhu, & Li, 2011). This in turn boosts organizational profitability (Cao & Zhai, 2007). In the next section, we present our design thinking focus, i.e., Customer Knowledge Management.

2.3. Customer knowledge management (CKM)

The dissemination of knowledge between the organization and customer is defined as Customer Knowledge Management (Kong & Cai, 2008). There are three types of Customer Knowledge Management, i.e., knowledge *about* the customer, knowledge *for* the customer and knowledge *from* the customer (Gibbert, Leibold, & Probst, 2002). Management of knowledge *about* the customer includes past business transactions and customers' input about their preferences (Gebert, Geib, Kolbe, & Brenner, 2003). It enables organizations to develop products or services that are desirable from the customer's point of view (Salomann, Dous, Kolbe, & Brenner, 2005). Knowledge *for* customers include assistance to customers during the purchasing process, and educating customers on the use and care of the products (Horovitz, 2000; Garcia-Murillo & Annabi, 2002; Chua & Banerjee, 2013). Knowledge *from* customers e.g., comments/reviews, can help businesses to improve product quality or develop new products (Salomann, Dous, Kolbe, & Brenner, 2005; Sigala, 2012).

Customer knowledge management is captured and managed by customer relationship management (CRM) systems. For instance, Payne and Frow's (2005) strategic, operational and analytical architecture provide multi-channel information flow along agile component-based designs. Gartner's (2012) yin-yang CRM model focuses on agility and trade-offs among 8 competencies.

2.4. Crowdsourcing

Howe (2006) notes the evolution from outsourcing of tasks to India and China in 2003 (to create content, solve problems/research/development), to crowdsourcing, and the discovery of different emerging roles e.g., a professional, packager, tinkerer. Second, Dell (Di Gangi, Wasko, & Hooker, 2010) exemplifies the agility and dynamic co-evolution in markets, customer trends and business models over time. Starbucks' *Ideastorm*, features high quality contributions from participants-cum-customers' suggestions and productize the most highly rated suggestions in their stores. These highlight that the challenge in crowdsourcing lies with how to structure incentives to achieve the best overall outcomes, for different local/international demographics.

Kohler's (2015) study confirms the importance of adaptive business models. This is echoed by Liu, Xu, and Qin (2018). In their review, they find that three factors are the most important: 1) Value proposition based on customer needs, products and services; 2) Revenue model based on pricing logic, customer interaction, channels, and value creation; and 3) Cost model as determined by core capabilities and activities, value network, value transfer. Subsequently, they propose utilizing value proposition, value creation, value network and value transfer as pillars. Among these, enterprise size, task complexity, technological ability, and external resources would influence how much the value proposed/created would be able to further develop/transfer/network.

Moreover, external resources are sometimes associated with external rewards. Ikeda and Bernstein's (2016) study into incentives structuring, is oriented in human-computer interaction (HCI). They draw on behavioural economics, to investigate whether payment in bulk after every ten tasks, or giving coupons, or giving material goods rather than money, would increase the number of completed tasks. They find that it is best to incentivize after every ten tasks. Moreover, payment with coupons results in slight negative effects on task completion rates, whereas material rewards reduce participation the most over time.

Geri, Gafni, and Bengov's (2017) online survey investigates the influence of type of rewards with attributes of knowledge shared among crowdsourced volunteers. Findings from three user-generated content (UGC) e-commerce websites, i.e., The Traveler (tangible rewards), Stack Overflow (virtual rewards) and Waze (virtual rewards) indicate that reciprocity, awareness of rewards (such as badges) and prestige, drive additions to content more than other factors. These explain Tiktok's popularity.

Cappa, Rosso, and Hayes (2019) concur with the influence of financial and social rewards on crowdsourced inventive ideas/activities. Their survey into 2007-2014 global listed companies, find that these rewards and social cause positively influence the number of contributed ideas. Conversely, the absence of financial/social rewards, results in a decrease in the number of contributed ideas.

2.5. Visualization, problem-solving, and knowledge construction

Research in Learning Sciences/Educational Technology has often been grounded on scientific reasoning and creative thinking for problem solving and knowledge building. A notable example of such studies is Wu and Wang's (2012) dual-mapping learning environment, which visualizes problem solving and knowledge construction processes through concept mapping and argument mapping to support student learning in problem-solving contexts. Further, Wang et al. (2018) proposes a computer-based learning environment that allows learners to capture their problem-solving process in a visual format and identify the difference between their performance and that of the expert for

reflective thinking and learning with complex problems. More recently, Sun, Wang, Wegerif, and Peng (2022) utilized mind mapping technology to help secondary school students engage in scientific creativity tasks, which revealed how high- and low-performing groups generated ideas in different ways. The cognitive maps generated in these studies reflect students' cognition in problem solving and knowledge construction process, enabling more effective thinking and learning in complex situations.

3. Method

Our framework includes design thinking, Knowledge Management-Project Management-agile Systems Development Life Cycle (SDLC) and Gartner's CRM model (upscaling capabilities across architectures and processes). The agile SDLC is reviewed broadly by Schön, Thomaschewski, and Escalona (2017) and is the most popular for dynamic markets. We integrate Laudon and Traver's (2016) social marketing process, when branding the website.

3.1. Sample

For all three approaches, majority of the participants are young adults, aged 18-25 and adults, aged between 26 to 34. They are first briefed with regards to the objectives of the project, the website features and what they need to do at each phase.

3.2. Design

The term "additive" is used, as it indicates an incremental approach, rather than a combined approach, which may or may not be incremental. The incremental approach in our study, is in line with Bloom's taxonomy, as the users are not from Art/design background. The activities in each KM view, correspond with the objectives and system components in Table 1.

First, we familiarize them with RBV-KM, to attract the users to attractive designs and to stimulate their own reasoning, as to what would attract other users to like/share/perhaps one day, buy their designs. Hence, RBV-KM involves using the online form to upload images (develop resources), and viewing others' images at the gallery. RBV-KM maps to the remember, understand, apply, analyze and create levels in Bloom's revised taxonomy.

KBV-KM is then introduced, so that the UIC, would be encouraged to reformulate their own hypotheses, as to what other users would like/share/buy in the presence of feedback. Hence, KBV-KM involves mixing and matching images (resources) from the RBV-KM pool, discussing what they like or dislike in the blog. To address the steeper learning curve for those with totally no Art/design background, the top three users with the highest points are rewarded. KBV-KM maps to Bloom's revised taxonomy (remember, understand, apply, analyze, compare/evaluate and create levels).

MBV-KM involves all levels of Bloom's revised taxonomy, as the UIC need to synergize knowledge learnt, discuss/comment in the forum and suggest/produce new designs and further develop their own voice. New designs with the highest acceptance/preference/likes would be featured in the forum page. This is in line with prior literature on rewards in Section 2.4.

3.3. Development

We use mainly Wix for development and iterative refinements, and a third-party software for mix-and-match. Wix embodies Web design frameworks and enables rapid prototyping.

3.4. Evaluation

User testing evaluations are based on Davis (1989), Ventakesh and Bala's (2008) Technology Acceptance Models 1, 2, 3 and the standard Customer Satisfaction questionnaire (Qualtrics, 2018). Comments in the forum/blog are evaluated based on three categories, in line with Bloom's (Anderson, & Krathwohl, 2001) revised taxonomy as follows.

a) descriptive (able to describe or classify the design based on their individual perspective indicating basic understanding towards the design);
b) application (apply information they have and relate it to the design);
c) evaluative/advisory (analyse and evaluate the designs based on any elements and suggest improvements to the designs).

4. System description

The *HerAll* website portal is designed and developed based on user requirements and strategies pertinent to each approach. System components for each view are listed in Table 1 and developed based on incremental and iterative agile methodology.

Table 1
System components for each view

	RBV	KBV	MBV
Objective	gather resources for discussion, knowledge creation	create knowledge (new design) and facilitate knowledge transfer (various views towards specific design)	industrial design: how designs will look on objects (knowledge transfer)
Functions	• Form with upload button • Database • Gallery	• Login and Signup Form • Mix and match from the RBV-KM pool of resources to create a new design and upload to the blog as a new post • Blog (discuss feelings, likes, dislikes about the design) • Rewards are given to the top three users with the highest points. • Member history, Visitor Counter	• Forum • comment on suggested ideas • new designs with the highest like counts are selected & featured in the forum page.

For further evaluation, we map these functions to Kano, Seraku, Takahashi, and Tsuji's (1984) model, a theory for product development and customer satisfaction. Next, we modify Qualtrics's (2018) customer satisfaction questionnaire to suit our study's

objective. We choose this questionnaire because it focuses on quality, value and experience, encompassing the criteria in Kano et al's model. For user experience, we use selected criteria from Schrepp, Hinderks, and Thomaschewski's (2017) UX questionnaire, due to its close alignment with Kano et al's model. Screenshots of the website are presented in Fig. 2.

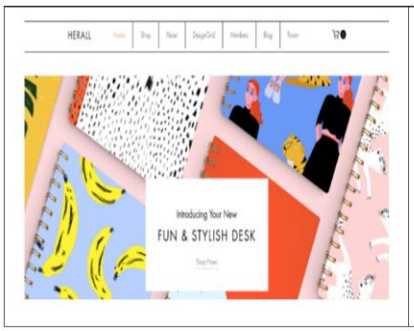

Fig. 2a. *HerAll* main page

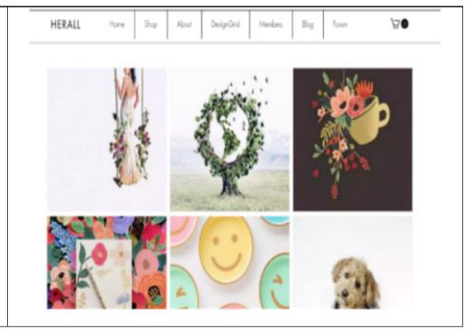

Fig. 2b. *Herall* – Design Hall (Gallery)

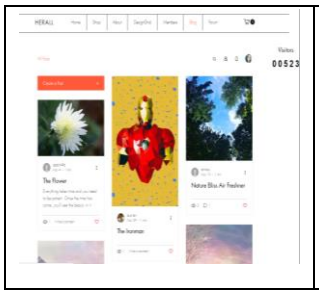

Fig. 2c. *Herall* – Blog

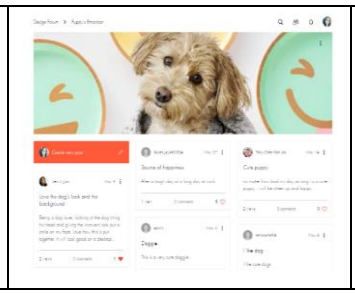

Fig. 2d. *HerAll* – User's Posts

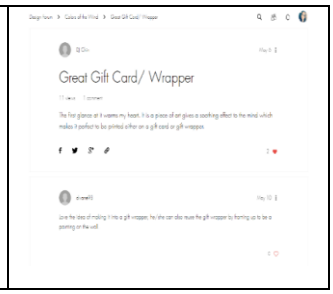

Fig. 2e. Users' Comments

5. Results and discussion

We will discuss the findings from each approach, and subsequently, summarize, by comparing the findings of each approach, to identify each approach's strengths and weaknesses.

5.1. Resource-based view (31 respondents)

A summary of the Customer Satisfaction & Retention Survey (CSRS) results for the RBV-KM approach is presented in Table 2. From Table 2, customer satisfaction for the RBV-KM approach is positive. 83.9% of participants would recommend *HerAll* to their social circles. The overall quality of content is exceptionally high (question 6) at 90.3%. Users perceive value as sharing good designs to have the selected image featured in the next product (question 9), scored at 90.4%. Hence, the user's willingness to upload, share and like the images is relatively high, scored at 80.7%. UX for the forum achieves ratings above 90%, easy (100%) supportive, clear (93.5%) and efficient (90.3%). Perceived value for exciting (90.4%) and interesting (87.1%) are encouraging. We conjecture that the main factor contributing to the positive ratings is the similarity between the gallery with Instagram layouts. Familiarity increases perceived ease of use.

Table 2
Customer satisfaction & Retention survey response statistics (Resource-based view)

No	Category/Questions	Questions	Ratings' Results	Sum% score > 5
1	General User Statistic	What is your gender?	Female – 54.8%, Male –45.2%	
2	General User Statistic	How old are you?	Under 17 – 6.5%, 18-25 – 54.8% 26-34 – 29%, 35-54 – 6.5% > 55 – 3.2%	
3	Preference	Which approach do you prefer?	RBV – 25.8%, KBV – 12.9% Mixed – 61.3%	
4	General: Recommendation	How likely would you recommend this website to a friend/ colleague?	5 – 12.9%, 6 – 3.2% 7 – 22.6%, 8 – 22.6% 9 – 22.6%, 10 – 16.1%	83.9%
5	Product: Purchase Experience	How well does the available design meet your individual design preference?	5 – 9.7%, 6 – 3.2% 7 – 6.5%, 8 – 32.3% 9 – 22.6%, 10 – 25.8%	87.2%
6	Product: Overall Quality	How would you rate the quality of the content?	5 – 9.7%, 7 – 6.5%, 8 – 41.9%, 9 – 25.8%, 10 – 16.1%	90.3%
7	Product: User Experience	How willing are you to upload and share your preferred design?	5 – 9.7%, 6 – 3.2%, 7 – 19.4%, 8 – 29%, 9 – 19.4%, 10 – 12.9%	80.7%
8		How willing are you to like the available designs?	5 – 9.7%, 6 – 3.2%, 7 – 6.5%, 8 – 25.8%, 9 – 19.4%, 10 – 35.5%	87.2%
9	Product: Value	How willing are you to have your uploaded designs used in the next product design?	5 – 9.7%, 7 – 9.7%, 8 – 25.8%, 9 – 19.4%, 10 – 35.5%	90.4%
10	General: Customer Retention	How likely are you to purchase any of the products eventually?	5 – 9.7%, 6 – 12.9%, 7 – 12.9%, 8 – 12.9%, 9 – 22.6%, 10 – 19.4%	67.8%
11	General: Customer Satisfaction	Do you have any comments or feedback on the sharing and liking process?	Open-ended Question	
12	Usage Experience	Obstructive/Supportive	5 – 22.6%, 6 – 54.8%, 7 – 16.1%	*93.5%*
13		Complicated/Easy	5 – 22.6%, 6 – 25.8%, 7 – 51.6%	*100%*
14		Inefficient/Efficient	5 – 25.8%, 6 – 41.9%, 7 – 22.6%	*90.3%*
15		Confusing/Clear	5 – 16.1%, 6 – 25.8%, 7 – 51.6%	*93.5%*
16	Value	Boring/Exciting	5 – 25.8%, 6 – 19.4%, 7 – 45.2%	90.4%
17		Not Interesting/Interesting	5 – 16.1%, 6 – 25.8%, 7 – 45.2%	87.1%
18	Overall Quality	Conventional/Inventive	5 – 32.3%, 6 – 25.8%, 7 – 25.8%	83.9%
19		Usual/Leading Edge	5 – 29.0%,6 – 35.5 %, 7 – 16.1%	80.6%

5.2. Knowledge-based view (35 respondents)

The approach is closely related to design creation and discussion on elements of the design. Since most of the UIC are from non-Art/design background, the learning curve is undeniable. Nevertheless, from Table 3. the highest sum for scores above 5, is attributed to question 9 (willingness to like and comment on the design pieces) scored at 88.5%, followed by question 4 (more motivated to like, comment, post with the offer of rewards), scored at 80%.

For question 10 (willingness to mix and match any of the available designs to create another *new* design) scored at 77.2%. Question 11 provides two reasons: *Enjoy the process of creating a new design with mix and match (64.7%)* and *like participating in community-based sharing and discussion (14.7%).* Other reasons are easy to use (question 14) at 77.2% and inventive (question 19) at 77.2%. Hence, a high 77.1% of the UIC would recommend *HerAll* to their social circle.

Table 3
Survey response statistics (Knowledge-based view)

No	CSRS	FYP Questions	Ratings	Sum % score > 5
1	General User Statistic	What is your gender?	Female – 54.3 %, Male – 45.7%	
2		How old are you?	Under 17 – 2.9%, 18-25 – 57.1% 26-34 – 31.4%, 35-54 – 2.9% 55 or over – 5.7%	
3	General: Recommendation	How likely would you recommend this website to a friend/ colleague?	5 – 11.4%, 7 – 17.1%, 8 – 22.9%, 9 – 20%, 10 – 17.1%	77.1%
4	General: Motivation: with tangible rewards	Are you more motivated to like, comment, post with the offer of rewards?	5 – 11.4%, 6 – 8.6%, 7 – 14.3%, 8 – 22.9%, 9 – 17.1%, 10 – 25.7%	80%
5	General: Motivation: without tangible rewards	How likely would the create, like, & comment approach encourage you to re-visit the website?	5 – 17.1%, 6 – 8.6%, 7 – 14.3%, 8 – 17.1%, 9 – 22.9%, 10 – 14.3%	68.6%
6	Product: Overall Quality	How would you rate the quality of the content?	5 – 17.1%, 6 – 8.6%, 7 – 20%, 8 – 8.6%, 9 – 20%, 10 – 22.9%	71.5%
7		How well does the available design inspire you to create better combination of design?	5 – 14.3%, 6 – 8.6%, 7 – 20%, 8 – 14.3%, 9 – 25.7%, 10 – 14.3%	74.3%
8	General: Customer Retention	How likely are you to purchase any of the products eventually?	5 – 11.4%, 6 – 8.6%, 7 – 20%, 8 – 20%, 9 – 17.1%, 10 – 8.6%	65.7%
9	Product: Usage Experience	How would you rate the willingness to like and comment on the design pieces?	5 – 2.9%, 6 – 5.7%, 7 – 37.1%, 8 – 14.3%, 9 – 25.7%, 10 – 1.4%	88.5%

10		How would you rate the willingness to mix and match any of the available designs to create another new design?	5 – 14.3%, 6 – 5.7%, 7 – 22.9%, 8 – 20%, 9 – 11.4%, 10 – 22.9%	77.2%
11		If you rate 5 and above for willingness in the mix- and-match approach, choose one of the possible reasons.	• Motivated by the rewards – 8.8% • Enjoy the process of creating a new design with mix and match – 64.7% • Website design content suits individual preference – 8.8% • Like participating in community-based sharing and discussion – 14.7% The ability to share ideas motivates me – 2.9%	
12		If you rate below 5 for willingness in the mix and match approach, choose one of the possible reasons	• Lack of interest in the mix and match approach – 0% • Lack of interest in the rewards – 37.5% • Lack of meaningfulness in the approach – 25% • Lack of interest in creating new design – 25% Others – 12.5 %	
13		Obstructive/Supportive	5 – 22.9%, 6 – 28.6%, 7 – 22.9%	74.4%
14		Complicated/Easy	5 – 22.9%, 6 – 31.4%, 7 – 22.9%	77.2%
15		Inefficient/Efficient	5 – 17.1%, 6 – 40%, 7 – 17.1%	74.2%
16		Confusing/Clear	5 – 25.7%, 6 – 20%, 7 – 34.3%	80%
17	Value	Boring/Exciting	5 – 22.9%, 6 – 17.1%, 7 – 31.4%	71.4%
18		Not Interesting/Interesting	5 – 22.9%, 6 – 17.1%, 7 – 37.1%	77.1%
19	Overall Quality	Conventional/Inventive	5 – 22.9%, 6 – 34.3%, 7 – 20%	77.2%
20		Usual/ Leading Edge	5 – 28.6%, 6 – 34.3 %, 7 – 5.7%	68.6%

Users' perception towards knowledge gained are positive, as presented in Fig. 3a and examples in Figs. 3b and 3c.

5.3. Mixed-based view (MBV-KM)

The summary of results for the MBV-KM approach is presented in Table 4. From Table 4, customer satisfaction for the MBV-KM approach is quite satisfactory, as 87.6% of

participants indicate they are likely to recommend the website portal to their friends and/or family. Good design quality encourages participants to suggest new product ideas and to relate their personal experiences as they look forward to the development of the product. Knowledge transfer between users is also successful. 87.5% of the participants agree they have gained knowledge via other participants' comments.

The UX for the forum page is scored above 80%, except for the leading-edge criterion. The forum layouts and design enable easy posting of product ideas and discussion of personal experiences. Users are able to glance through all selected designs and view related product idea posts from other users by clicking into the specific design. The forum's drill down function makes viewing product idea posts and comments easily relatable to the specific designs.

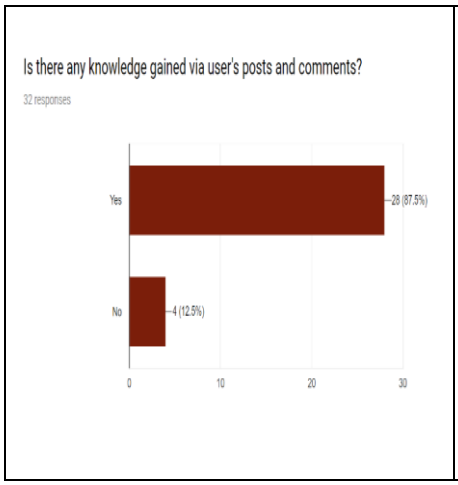

Fig. 3a. Positive perception towards knowledge gained

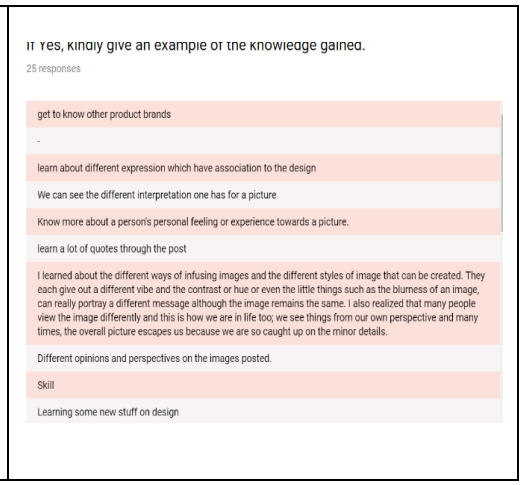

Fig. 3b. Examples of knowledge gained

Fig. 3c. Two participants' card designs: a) April 5, April 21; b) April 10 and April 13

Table 4
Summary of mixed-based view survey results

No	CSRS	FYP Questions	Ratings	Sum % score > 5
1	General User Statistic	What is your gender?	Female – 43.8 %, Male – 56.3%	

2		How old are you?	Under 17 – 3.1%, 18-25 – 56.3%, 26-34 – 25%, 35-54 – 15.6%	
3	General: Recommendation	How likely would you recommend this website to a friend or colleague?	5 – 9.4%, 6 – 3.1%, 7 – 18.8% 8 – 28.1%, 9 – 34.4%, 10 – 6.3%	87.6%
4	General: Motivation	How likely would the post-and-comment approach encourage you to re-visit the website?	5 – 9.4%, 6 – 9.4%, 7 – 21.9% 8 – 25%, 9 – 12.5%, 10 – 18.8%	78.2%
5	Product: Overall Quality	How would you rate the quality of the content?	5 – 6.3%, 6 – 3.1%, 7 – 18.8% 8 – 31.3%, 9 – 28.1%, 10 – 12.5%	90.7%
6	General: Customer Retention	How likely are you to purchase any of the products eventually?	5 – 9.4%, 6 – 12.5%, 7 – 18.8% 8 – 21.9%, 9 – 25%, 10 – 9.4%	75.1%
7	Product: Usage Experience	How willing are you to suggest new product idea via a post?	5 – 9.4%, 6 – 12.5%, 7 – 18.8% 8 – 34.4%, 9 – 15.6%, 10 – 6.3%	75.1%
8		How willing are you to share your personal experience via comments?	5 – 9.4%, 6 – 6.3%, 7 – 15.6% 8 – 25%, 9 – 21.9%, 10 – 18.8%	81.3%
9		Is there any knowledge gained via user's posts & comments?	Yes – 87.5%, No – 12.5%	87.5%
10		If yes, provide an example of knowledge gained.	Open ended answer	
11		Obstructive/Supportive	5 – 21.9%, 6 – 40.6%, 7 – 25%	87.5%
12		Complicated/Easy	5 – 9.4%, 6 – 40.6%, 7 – 37.5%	87.5%
13		Inefficient/Efficient	5 – 25%, 6 – 28.1%, 7 – 31.3%	84.4%
14		Confusing/Clear	5 – 18.8%, 6 – 34.4%, 7 – 34.4%	87.6%
15	Value	Boring/Exciting	5 – 18.8%, 6 – 31.3%, 7 – 34.4%	84.5%
16		Not Interesting/Interesting	5 – 21.9%, 6 – 40.6%, 7 – 25%	87.5%
17	Overall Quality	Conventional/Inventive	5 – 28.1%, 6 – 40.6%, 7 – 15.6%	84.3%
18		Usual/ Leading Edge	5 – 21.9%, 6 – 43.8%, 7 – 9.4%	75.1%

Sample designs via MBV-KM are presented in Fig. 4.

Fig. 4a. Featured design creations via MBV-KM

Fig. 4b. Sample design with the topic Flowers in *Dreamy Blue Ocean*

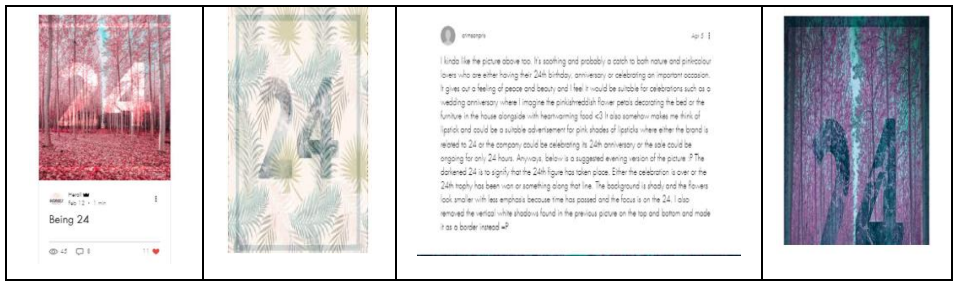

Fig. 4c. Example of designs based on the topic *Being 24*

6. Discussion

6.1. RQ1: Which approach (RBV-KM/KBV-KM/MBV-KM) is more likely to be useful and satisfying to the individual or user innovation community (UIC) in a simulated Malaysian B2C e-commerce niche card design industry?

From Table 5, in terms of overall quality (question 2), all three approaches achieve percentages above 70%. MBV-KM scores the highest at 90.7%. KBV-KM's overall quality is lowest, at 71.5%. In terms of value (question 3), KBV-KM scores the lowest at 68.6%, while RBV-KM achieves the highest at 90.4%. Hence, RBV-KM's purchase experience (question 4) is the highest. However, in terms of usage experience, KBV-KM scores the highest, followed by RBV-KM and MBV-KM. At 88.5%, commenting and liking, are the most utilized functions. Due to these trade-offs, average customer satisfaction for RBV-KM is the highest, then, KBV-KM (-10.48%) and MBV-KM (-4.6%).

In terms of user experience, pre-post-survey findings indicate a drop for all three KM approaches, with a difference of -3.3% for RVB-KM, -6.8% for KBV-KM and -9.2% for MBV-KM. However, in terms of value, there are positive changes of +5.7% for KBV-KM and +2.8% for MBV-KM. KBV-KM's checkpoints also indicate increase of +5.6%. We conjecture that as the UIC learn more, internal quality standards and value of meaningful knowledge increase. These findings are promising.

From Table 5 (question 9, average customer satisfaction), the gap between RBV-KM and KBV-KM narrows. The gap between RBV-KM and KBV-KM is -4.45% and RBV-KM-MBV-KM+5.5%. These imply that as users progressively accept the system and their role as designers-cum-customers, they are acknowledge difficulties in formulating meaningful competitive knowledge and appreciate insightful synergies more.

6.2. Will an additive RBV-KM-KBV-KM-MBV-KM be more effective?

From the comparative findings in Table 5, the additive RBV-KM-KBV-KM-MBV-KM approach is more effective than individual approaches, as it provides a progressive learning path. Moreover, if intelligent guidance is factored in, then KBV-KM's overall quality, value, UX, satisfaction may be higher. We conjecture, the additive approach and findings may better be able to scaffold open design UIC learning, convergence/synthesis, and encourage optimization, if visualizations e.g., Wu and Wang's (2012) dual mapping

processes, enhanced with adaptive/ personalized learning recommendations, are designed/adapted contextually.

Table 5
Customer satisfaction for each approach

No	Questions	RBV-KM	KBV-KM	Mixed Approach
1	How often do you use the approach?	Moderate	Highest	Lowest
How did your approach perform?				
2	Overall Quality	90.3%	71.5%	90.7%
3	Value	90.4%	68.6%	87.5%
4	Purchase experience	87.2%	74.3% (design), 80% (reward)	78.2%
5	Usage experience	80.7% (upload), 87.2% (liking)	88.5% (comment, liking), 77.2% (create design)	75.1% (post new idea), 81.3% (share experience)
Average Customer Satisfaction		87.16%	76.68% (-10.48%)	82.56% (-4.6%).
How was performance (UX) on the approach?				
6	Overall Quality (pre-post)	83.9%, 80.6%	77.2%, 68.6%	84.3%, 75.1%
7	Value (pre-post)	90.4%, 87.1%	71.4%, 77.1%	84.5%, 87.5%
8	Usage experience (4 checkpoints across the three views)	93.5%, 100%, 90.3%, 93.5%	74.4%, 77.2%, 74.2%, 80% (maybe more Aha's)	87.5%, 87.5%, 84.4%, 87.6%
Average Customer Satisfaction		89.91%	75.01% (-14.9%)	84.8% (-5.11%)
General Questions (technology acceptance/recommendation)				
9	Based on your experience, how likely are you to buy/design again?	67.8%	65.7%	75.1%
10	Based on your experience, would you recommend this product to a friend?	83.9%	77.1%	87.6%
Average Customer Satisfaction		75.85%	71.4% (-4.45%)	81.35% (+5.5%)

6.3. RQ3: Which factors will boost customer satisfaction more?

Innovation is a continuum, depending on ownership, the contextual dynamics and which aspects we are focusing on. Debowski's (2006) strategic leadership, Laudon and Traver's (2016) business, technology and society, Hossain's (2015) review of crowdsourcing by firms, as an overlapping concept between Business, Management and Open Innovation, and Evans, Vladimirova, Holgado, van Fossen, Yang, Silva, and Barlow's (2017) unified perspective for innovation towards sustainable business models, highlight again the fluid flow among ecosystems and the importance of modeling stakeholders. We also concur with Hu, Huang, Cheng, and Lu's (2019) findings that sustaining value proposition, creation, capture, and delivery, necessitate dynamic evolution of sustainable business model innovation *in the midst* of developing a shared economy platform.

We have hypothesized that higher customer participation in the design, will lead to higher customer satisfaction. Fig. 5 affirms the importance of the blog, community and

members, similar to Dell's and Starbuck's *Ideastorm*. These findings echo research such as Lin's (2003) emphasis on customer value besides customer need, and cost, McLean and Blackie's (2005) emphasis on community who will promote and share, and Rita, Oliveira, and Farisa's (2019) e-service quality (*website design*, security/privacy and *fulfilment*). We also concur those factors more likely to boost customer satisfaction, partially depends on motivation (the degree of importance of the targeted outcomes and/or rewards), ability and environmental factors and partially, the presence/lack of intelligent guidance (prompts).

Fig. 5. Top starting and top visited pages

6.3.1. Customer satisfaction based on Kano et al's model

In Table 6, we categorize *HerAll's* functions to Kano et al's model. We have expected member history and visitor counter to fall under must-be quality, but they fall under indifferent quality. Furthermore, blogs can be categorized either as one-dimensional quality or as attractive quality, depending on the user's expectations, background, level of design, and time constraints.

Based on Fig. 5, blogs fall under Kano et al's attractive quality category, complementing Schrepp, Hinderks, and Thomaschewski's (2017) pragmatic and attractive UX criteria. It is also interesting to note the increase in visits to the member's page. Such visits may be the beginnings of community building.

Table 6
Functions mapped to Kano et al's model

Function	Kano et al's categories
• Login and Signup Form • Form with upload function, database ○ Galery, Blog (discuss feelings, likes, dislikes about the design) • Mix and match from RBV's resources to create new designs and upload to the blog as a new post). • Forum comment on suggested ideas, new designs with the highest like counts are featured in the forum. • Rewards are given to the top three users with the highest points.	• Must-be Quality (basic requirements that the customers expect) ○ One-dimensional Quality (promised expectations/selling point) • Attractive Quality (unexpected/novel aspects of a product which would bring delight)
○ Member history, Visitor Counter	○ Must-be/Indifferent/Reverse Quality

The importance of comments in the blog is supported by Han's (2020) investigation into how YouTubers make money and lessons learned from the most subscribed YouTube channels. He finds that the number of views, the comment rate, and the perceptions of customers after-viewing, contribute significantly to a YouTuber's yearly revenues. The number of subscriptions is, however, not significant.

6.4. What are the implications since technology and strategies often co-evolve rapidly? Are there factors we should take further note of and to a greater extent?

All hypotheses are confirmed. The additive RBV-KM-KBV-KM-MBV-KM evidence better outcomes compared to individual KM approaches. However, macro-micro dynamics in intertwining e-commerce ecosystems, e.g., contextual factors (for instance environment, culture, regulation), internal factors, (for instance ability and motivation), and mediating factors (for instance leadership, (intelligent) guidance and rewards), are more likely to improve customer satisfaction.

Our findings are supported by Cheng, Wang, Yang, Kinshuk, and Peng's (2011) study. They find that peer support and cooperation do promote acceptance and adoption of new competency-based e-learning systems, and that support to increase social ties, does not augur well on employees' intention to adopt the competency-based system. These findings may be linked to productivity, and competition, within the same organization, a scenario common in every organization, every country. We have extended to open innovation systems, where community and identity, social/financial rewards, and support for social networks are important.

The dynamics between individual and organization/environmental contexts, reflect how CRM models such as Payne and Frow's (2006) CRM model, and Porter's Diamond model, frame and mediate technology adoption and competency-based open innovations. Findings may also eventually inform Lee, Koper, Kommers, and Hedberg's (2008) proposed reference model, for internal organizational improvements. Section 2.4 serves as further reference, for deeper deliberation and localization.

7. Conclusion

Sustainable business models and ecosystems are multivariate, and intertwining. Our case study aims to identify the effects of RBV-KM, KBV-KM, MBV-KM, in a partially simulated e-commerce environment. Our focus is on training/developing customers as designers, as part of participatory design. This includes knowledge, skills and perspectives. Findings highlight the importance of perceived value, social and financial rewards, in relation to prior research. There are also limitations to our study. Our environment is simulated, scoped to the initial capstone and grant's objectives. We have not reached individual and community identity development yet. Furthermore, in actual gig economies, leadership is open and dynamic. This requires much agility and interconnectivity amidst variations. Sample size is also small. Hence, our findings cannot be generalized.

Author Statement

The authors declare that there is no conflict of interest.

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