EasyChair Preprint

№ 8328

The Impact of Electronic Shelf Label on Customer Well-Being in the Omnichannel Smart Retail

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June 19, 2022

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Abstract. While the number of online retail transactions shows a significant upward trend, most people still shop offline with the higher preferences on contactless encounters. The future technologies in omnichannel retail are enabled through in-store technology (IST) and one of the applications is Electronic Shelf Label (ESL). While a lot of studies have developed IST little is known about the impact of IST on customers wellbeing and their behavior. This study aims to assess the impact of ESL as an emerging and prospective IST on customer well-being. Data were collected through an online survey embedded with a video of ESL features stimuli. A total of 305 valid responses from people living in Indonesia were collected and analyzed using partial least square structural equation modeling (PLS-SEM). This study provides empirical evidence of how smart retails affect customers' subjective well-being (SWB) and psychological well-being (PWB). Practically, it also helps retail managers in considering ESL implementation in the next-normal era.

Keywords: customer well-being; electronic shelf label; omnichannel retail; smart retail

1. INTRODUCTION

The emergence of the COVID-19 pandemic has transformed the retail industry more rapidly. The implementation of social distancing and governments order to stay at home has accelerated the adoption of e-commerce usage at a significant level [1]. Retail and wholesale companies are disrupted and forced to implement significant amendments in running their business and further planning to adapt [2]. A global consumer survey in 2020 unveiled that 63% of respondents are buying more groceries online than before social distancing and 86% are going to continue this behavior [3]. However, despite the pandemic condition, traditional trade and modern trade channels have still become the major preferences for several product categories [4].

New technologies like the internet of things (IoT), the communication between machine to machine [5], are suggested to be the initial phase of the development of omnichannel commerce [6]. Smart retail is projected to develop significantly in the near future. 80% of customers use smartphones as in-store shopping assistants and 78% of customers' mark integrating e-commerce with in-store experience as critical [7]. A study among Generation Z consumers suggests that smart retail experience is important for meeting or even exceeding consumer expectations (price and customer service) [6], [8]. Furthermore, smart retail is affirmed to enhance customer experience and build consumer loyalty [9].

A product of smart retail that is growing and predicted to have an even more significant growth at a CAGR of 21.8% between 2021-2028 is Electronic Shelf Label (ESL) [10]. ESL is a substitute for traditional paper labels to display product information through a digital screen and is connected through a network to enable rapid and automatic updates [10], [11]. However, there is a lack of study of how ESL will affect customer behavior. Meanwhile at the customer level, there is an arguable impact of digitalization on human well-being [12].

Well-being is the combination of feeling good and functioning well [13]. It is a preferable measure in the service context due to its focus on promoting consumer and societal welfare [14]. A unique retail experience and well-being-focused retail are argued to be the ones that can bring back the brick and mortar retail industry after the massive loss caused by the COVID-19 pandemic [15]. This is due to the increased attention to health and wellness, as well as the transforming customer expectation of gaining leisure, social, and wellness value from shopping as a result of the sophistication of the retail environment [15]. The use of well-being measures in today's retail services is important. This study aims to study how ESL features and attributes will affect customer well-being.

2. LITERATURE REVIEW

2.1. ELECTRONIC SHELF LABEL (ESL)

ESL is equivalent to price tags in retail stores, product ID labels in warehouses, and instruction sheets in manufacturing assembly lines [16]. It is a device that enables product price to be displayed digitally [11], using an electronic paper, liquid crystal display, or thin-film transistor in various dimensions [17]. It offers a quick synchronization between background database, cash register, and price inquiry through various network technology, for instance, Near Field Communication (NFC), Zigbee, RFID, Bluetooth Low Energy (BLE), and so forth [10], [17].

The ESL provides several advantages both for retailers and customers. It elevates store operational efficiency [18], enabling the retailers to change the price quickly and accurately while cutting back on the number of labor needed [11]. While for customers, ESL as a product of IoT will enhance the customer experience and satisfaction [9], [19]. Technology companies are developing ESL, increasing ESL features and functionality. Several identifications of ESL features that may affect customer experience are listed in table 1.

Table 1. ESL Features Available on Market

Feature	Description	Source/Company
Always updated information	Quick synchronization through several network technology allowing always updated information	Reference [10]
Digital display	Offering visualization of products on the label, able to display up to 3 different colors, and able to create a personalized label design template	High Bright Enterprise Limited, Opticon Sensors Europe
Detailed product information	Through QR code, NFC, and barcode, customer is able to get detailed product information on their smartphone	Tronitag, Solum ESL, [11].
Product wayfinding	Locate product through external applications and blinking LED light on ESL	LabelNest
Buttons on ESL	Buttons on ESL body to change ESL page, call service help, report low stock, and send system report	Solum ESL
Unmanned shopping experience	Digital shopping cart and payment through customer card, credit card, debit card, and NFC	Opticon Sensors Europe

An example of ESL implementation is the partnership between Kroger and Microsoft in creating Enhanced Display for Grocery Environment (EDGE) [20]. EDGE gain positive feedback from 90% of customers [21]. It is also preferred by 7 out of 8 mystery shoppers and influences customer decisions [22]. Personalization, in-the-moment marketing, and interactive wayfinding are EDGE features favored by customers [20]. On the retailer's side, EDGE has helped to increase offline retail value [20], [21].

2.2. CUSTOMER WELLBEING

Despite the preference of using well-being as a measure in the service context [14], the definition and concept of well-being vary in the literature [23]. Three well-being concepts are indicated to have a relationship with the retail context are presented in table 2.

The CWB measures well-being on all of the consumption processes, acquisition, possession, consumption, maintenance, and disposition [24]. Thus, since this study measures the impact of ESL on well-being only on the in-store experience, the CWB is inapposite. The different approaches of SWB and PWB complement each other and are the dimension of well-being [25]. Reference [26] also reviews the usage of both SWB and PWB on measuring UK national well-being. As for this research, SWB and PWB will both be used in the context of smart retail.

Table 2. Wellbeing Concepts and Definitions

No.	Concept	Description	Reference
1	Subjective Well-being (SWB)	Hedonic approach of well-being, focusing on attainment of pleasure and avoidance of pain	[25], [27]
2	Psychological Well-being (PWB)	Eudaimonic approach of well-being, focusing on meaning and self-realization	[25], [28]
3	Consumer well-being	Individual well-being as a consumer on the consumption-related aspects	[23], [24]

Reference [29] recognizes three dimensions of SWB: life satisfaction, positive feeling, and negative feeling. Life satisfaction and positive feeling have a positive effect on well-being while negative feeling has a negative effect on well-being. Ryff mentioned 6 dimensions of PWB: self-acceptance, good social relations, autonomy, environmental control, life purpose, and personal growth [30]. Used dimensions from the two concepts used for each hypothesis are listed in table 3.

Table 3. Wellbeing Dimensions

Hypothesis	Concept	Dimension Used
1	SWB	Positive feeling
2	SWB	Life satisfaction
3	PWB	Life purpose
4	SWB	Life satisfaction
5	PWB	Environmental mastery

Reference [31] discussed how the physical and informative aspect of a promotion display can increase customer attraction to promote customer positive attitudes. Sales promotion is the encouragement of customer action through the offering of additional benefits, commonly on a specific period, place, and target [32]. The rapid information update on ESL and its ability to provide a more sophisticated visualization as well as information compared to traditional paper labels should elevate customer positive feeling.
H1: Customer attraction has a significant positive effect on SWB.

ESL offers to provide more product information. Limitations on consumer capability in processing information may cause unsatisfactory decisions [33]. A study reveals that satisfaction in the acquisition, possession, and consumption process has a significant contribution to overall life satisfaction [24]. Thus, the abundance of information offered by ESL can be detrimental to a person's overall life satisfaction.
H2: Enhanced product information has a significant negative effect on SWB.

On the other hand, omnichannel consumers are identified to purchase consumption based on needs, financial rationality, and personal characteristic-and-individual value [34], demanding product information. Thus, enhanced product information should help and convince customers on determining their purchase decision better for their needs and value.
H3: Enhanced product information has a significant positive effect on PWB.

ESL can realize the unmanned shopping experience through digital payment and virtual shopping cart [35]. The unmanned shopping experience will provide time savings as a result of automation. The automated product wayfinding and quicker payment or even a check-out free feature are the examples. Time savings is suggested to elevate customer satisfaction [36]. Referring to the above-mentioned study, hypothesis 4 is made.
H4: Unmanned shopping experience has a significant positive effect on SWB

Furthermore, features such as automated product wayfinding and check-out free will enable customers to have more control over their surroundings. Thus, hypothesis 5 is made.
H5: Unmanned shopping experience has a significant positive effect on PWB.

3. METHOD

3.1. SAMPLES AND DATA COLLECTION PROCEDURE

Data were collected through an online survey distributed by agencies. Participants were restricted to those who are living in Indonesia and born between 1965-2012 (Gen X – Gen Z age cohort). Total valid responses collected was 305 respondents, far above the minimum sample of 125 respondents calculated using G Power 3.1 [37] (F test, linear multiple regression, fixed model, R2 deviation from zero, a priori type for 95% confidence interval using the least R square value from SWB of 0.167).

All variable indicators were measured using a fully labelled 5-point Likert scale. The measurement items are shown on table 4. All indicators were presented in Bahasa Indonesia as an everyday language in Indonesia to let the respondents have a better understanding. To ensure participant fully immersed to the ESL usage and environment, a 93-second video explaining ESL in general and ESL features was made and embedded into the online questionnaire. The video begins with ESL definition and system overview. ESL features of

(1) always updated information;

(2) advanced label visualization;

(3) product information access through smartphones;

(4) access to information of product availability-and-in-store location, and

(5) the full unmanned store experience

were visualized and narrated in Bahasa Indonesia. Several real case examples were also mentioned. The video was complemented with auto-generated subtitles for various languages provided by YouTube. Respondents should watch the video and tick the statement 'I have watched the video' prior to continuing to fill out the survey. A summary list of ESL features is also attached to ease respondents in reviewing the ESL features. A pilot study was conducted to ensure the survey was well-understood by the respondents and to select the final valid indicators. The snapshot of the video can be seen on figure 1.

Table 4. Measurement Items

Variables	Measurements	Source	Loadings	AVE	CR
Customer Attraction	ESL makes a pleasing color scheme	[38]	0.790	0.584	0.849
	ESL makes an attractive physical facility		0.759		
	ESL makes impressive in-store display		0.766		
	ESL is able to display adequate in-store information		0.742		
Enhanced Product Information	ESL provides easy access to various product information	Self-Developed	0.848	0.644	0.878
	ESL can provide easy access to detailed product information		0.811		
	ESL can provide easy access to product availability information		0.826		
	ESL can provide easy access to in-store product location information		0.719		
Unmanned Shopping Experience	ESL can realize the unmanned shopping experience	Self-Developed	0.800	0.612	0.863
	Self-payment features as well as virtual shopping lists can realize an unmanned shopping experience		0.778		
	The product availability information feature can realize an unmanned shopping experience		0.816		
	In-store product location information feature can realize unmanned shopping experience		0.732		
Subjective Wellbeing	In most ways my life is close to my ideal	[39]	0.824	0.650	0.903
	The conditions of my life are excellent		0.809		
	I am satisfied with my life		0.820		
	So far I have gotten the important things I want in life		0.810		
	If I could live my life over, I would change almost nothing		0.765		
Psychological Wellbeing	Generally, I feel confident and positive about myself	[30], [40]	0.705	0.542	0.876
	I am quite able to manage the many responsibilities about myself in my life		0.756		
	My daily life is full of busy activities, but I get a satisfaction feeling for I can do/ follow it all		0.725		

I have goals in my life	0.752
I live my life from day to day and just think about the future	0.738
In my final analysis, I am sure that my life means a lot	0.739

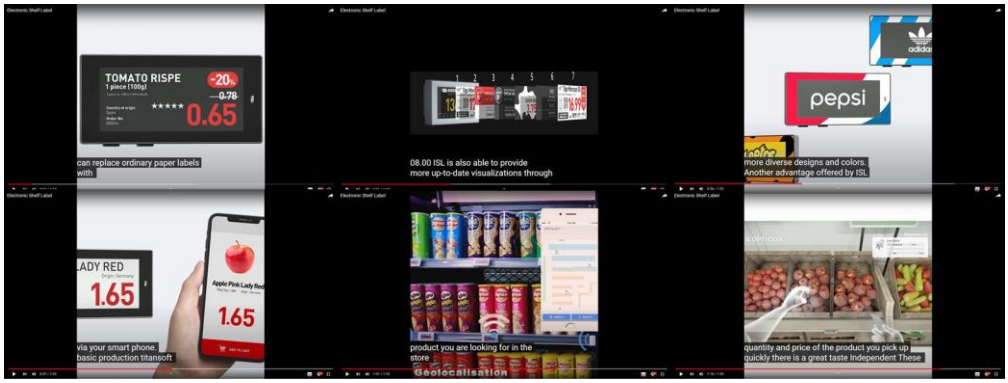

Fig. 1. ESLStimuli for Survey

3.2. DATA ANALYSIS

Employing the final indicator list, all factor loadings are proved to be statistically significant ($\lambda > 0.5$), showing that each indicator is a good measure for the latent variable [41]. The composite reliability score for all variables is above 0.7 [42] showing good internal consistency. Furthermore, all AVE score is above 0.5, showing a good discriminant validity [43], [44]. In addition, the heterotrait-monotrait (HTMT) ratio is also assessed to further ensure the discriminant validity. Although several variable HTMT values are close to 1, all of the values are still below 0.9 and acceptable [45].

4. RESULTS AND DISCUSSIONS

Hypothesis were analyzed using 5,000 resample complete bootstrapping with Smart PLS 3 [46]. Bias-Corrected and Accelerated Bootstrap for two-tailed test with significance level of 0.05 is employed. The results of hypothesis testing are shown on table 5, as well as figure 2. Post-hoc analysis was conducted by split the samples based on respondents' demographic profile of age cohort, Gen X & Millennials for those who were born between 1965-1996 and Gen Z for those who were born between 1997-2012.

Hypothesis 1, customer attraction has a significant positive effect on SWB is accepted. The visual enhancement is promoting customer convenience, excitement, and decreases complexity to ease information processing which results in customer positive emotion [31], [47], [48]. ESL's ability to provide various colors and personalized template designs on the electronic labels should ease customers in processing label information. Thus, ESL increases customer positive feelings.

However, hypothesis 1 is rejected by Gen X and Millennials on the split population test. The reason underlying this difference is technology exposure. Gen X are people who were born between baby boomers, which are considered a totally traditional generation, and Millennials, a more tech-savvy generation [49]. On the other hand, Gen Z has been exposed to technology from an early age [50]. Generation X is more comfortable to combine both traditional and technology-applied communication [51]. Gen X uses technology for utilitarian needs, unlike Gen Z which truly favored technology [52]. ESL changes the store environment to be very technologically applied. Thus, it is not very comforting and favored for Gen X and Millennials when compared to Gen Zers.

Table 5. Hypothesis Results

	General				Gen X & Millennials		Gen Z	
Relationship	**Std Beta**	**Std Error**	**t-value**	**p-value**	**t-value**	**p-value**	**t-value**	**p-value**
H1. Customer Attraction -> SWB	0.408	0.094	4.232	0.000***	1.506	0.132	5.559	0.000***
H2. Enhanced Product Information -> SWB	-0.133	0.098	1.313	0.189	0.146	0.884	2.822	0.005**
H3. Enhanced Product Information -> PWB	0.236	0.067	3.518	0.000***	2.545	0.011*	2.46	0.014*
H4. Unmanned Store Experience -> SWB	0.127	0.075	1.694	0.09	1.176	0.24	1.46	0.144
H5. Unmanned Store Experience -> PWB	0.381	0.064	5.901	0.000***	3.288	0.001**	5.338	0.000***

Note: *p<0.05; **p<0.01; ***p<0.001

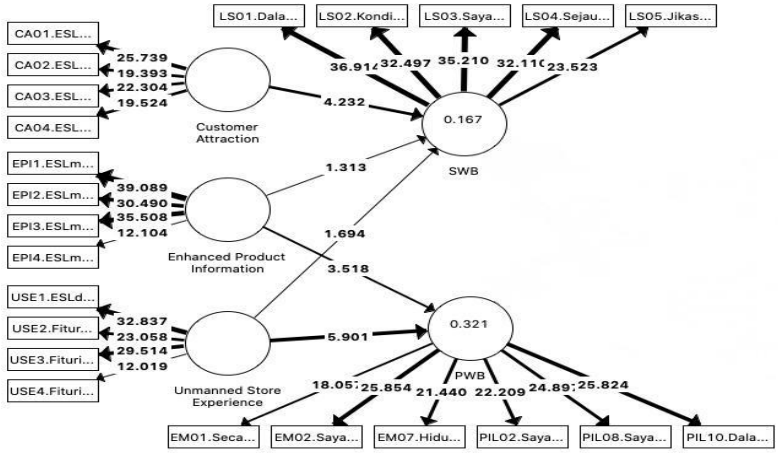

Fig. 2. Variable Loadings

Hypothesis 2, enhanced product information has a significant negative effect on SWB is rejected. While the hypothesis is rejected, the relation of enhanced product information to SWB is still negative. The previous study shows how information overload may cause dissatisfaction and create irrational decision making due to customer inability to process the information and unknown information sources and quality [33], [53], [54]. The enhanced product information provided by ESL may still cause information overload and causes dissatisfaction. However, the source of the information is clear and should be able to give customers a hint of information quality. Furthermore, information on product availability and in-store product location should not confuse customers.

However, on the split sample hypothesis testing, hypothesis 2 is accepted for Gen Z. The reason is because Gen Z has a higher demand for frictionless purchases than other cohorts [55], [56]. Gen Z likes to have the convenience and individualized experience [56], [57]. The process of gaining product information through QR code, NFC, and barcode that is provided by ESL may cause customer friction. Gen Z would prefer to be presented with information that suits them rather than being given a lot of information and letting them find what works for them. It is in contrast with Gen X who do product research prior to buying [58]. Thus, the significance of hypothesis 2 differs between the age cohorts.

Hypothesis 3, enhanced product information has a significant positive effect on PWB is accepted. Omnichannel consumers are said to respect their values on choosing products [34]. Self-identity is also moderating the positive effect of product information on purchase intention [59]. ESL's ability to provide various detailed information of a product through smartphones helps customers in choosing products that align with their values and identity. Information such as product material used, product supplier, and nearly anything is able to be presented.

Hypothesis 4, unmanned shopping experience has a significant positive effect on SWB is rejected. It was suggested that time savings should have a positive significant effect on customer satisfaction [36]. Satisfaction on the acquisition, possession, and consumption stage of consumption is also elucidated to influence satisfaction [24]. Conversely, a study also suggests the negative effect of in-store technology if shopping is seen as a sociable event [8]. Kargal and

Suresh also mention roadblocks of in-store IoT adoption, namely customer privacy issues, information misuse, and so forth [9]. The time savings provided by ESL might increase satisfaction, however, several factors such as the leisure factor of shopping and customer privacy concerns might also contribute significantly to the shopping satisfaction and other dimensions of SWB.

Hypothesis 5, unmanned shopping experience has a significant positive effect on PWB is accepted. ESL is able to provide customers with a high degree of customer independence, resulting in the realization of unmanned store experience at its best. Product availability information, automated product wayfinding, as well as virtual shopping cart-and-self check-out are ESL features that contribute to promoting customer independence. This high degree of independence gives a sense of positive functioning by enabling customers in creating the desired environment by themselves.

The proven effects of ESL features on customer well-being will help retail businesses to consider investing in ESL in the next normal era. Several studies have elucidated the connection of SWB and PWB that promotes customer behavioral outcomes to be beneficial for the retail businesses. For instance, promoting customer willingness to pay more and positive word of mouth that has a direct positive effect on product price and sales volume, the two variables that affect retail business revenue.

For willingness to pay, customer satisfaction and positive emotion (SWB) have been explained to have a positive significant effect on customers' willingness to pay more [36], [60]. Premium price is an important financial outcome, showing the price premium customers are willing to spend for the same goods at different providers [61]. This is an indication for retailers that they might be able to increase their product prices with ESL implementation through SWB promotion.

For positive word of mouth, a study discovers that positive emotion (SWB) is the best predictor of positive word of mouth among cognitive components and negative emotion [60]. Another study proves a significant effect of quality of life well-being (SWB) on positive word of mouth [62]. From PWB, service use self-efficacy is approved to have a significant positive effect on positive word of mouth (D, McKee, 2006). A study found that word of mouth and product sales is known to have a reciprocal effect that creates a snowball effect [63]. In addition, word of mouth is said to determine 20-50% of purchasing decisions [64]. The promotion of SWB and PWB through ESL implementation should increase positive word of mouth that is able to generate more sales volume.

Furthermore, retailers should put consideration in realizing the enhanced product information feature if the customer is in the Gen Z age cohort. Retailers should consider offering enhanced product information through personalization rather than providing information to avoid friction that causes negative feeling.

5. CONCLUSIONS AND IMPLICATIONS

This study responds to the current-future trend of omnichannel smart retail. While most papers discuss the development of IST and the managerial implications [65], little is known about its influence on customer well-being. This study evaluates the impact of ESL implementation as an emerging and prospective IST on customer well-being in Indonesia. The use of the customer well-being construct aligns with the transformative service research paradigm in responding to the transforming customer expectation of gaining leisure, social, and wellness value from shopping as a result of the sophistication of the retail environment [15].

Theoretically, this study provides empirical evidence of how smart retails affect SWB and PWB in a retail context. The concept is able to mediate the effect of ESL features on customer post purchase behavior. Practically, the study provides an initial picture of how ESL technology may impact retail businesses by discussing how customer well-being may be affected by the ESL features to choose which features should or should not be utilized in actual retail settings.

Several limitations are identified in this study. First, this study only restricts the respondents to those who are living in Indonesia and provides a general result. A future study might use a more specific segmentation by determining a more specific population beforehand. For instance, control variables based on rural and urban areas, as well as different technology adoption levels are able to be used.

Second, this study uses video-stimuli of ESL features. Respondents are required to individually imagine their ESL shopping experience based on the explanation video embedded in the survey. Future studies may replicate the framework using an actual ESL shopping environment. Several improvements are also able to be made on the conceptual framework adapting to the improvement of ESL features and relevant customer post-transaction behavior. For example, customer willingness to pay more and positive word of mouth. Relevant moderating variables with the well-being concept as the dependent variable are also able to be added. For instance, perceived risk of use, risk of privacy, information misuse, and so forth. These will increase the understanding of ESL's impact on the retail context.

Future studies should focus on developing shorter and more reliable indicators for well-being concepts. Study of the impact of ESL on customer post transaction behavior is important as well, mainly for practical purposes.

ACKNOWLEDGEMENTS

The authors report there are no competing interests to declare. This work was supported by the P2MI Research Grant 2022 from Institut Teknologi Bandung.

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