Usability and User Experience, Vol. 39, 2022, 51–57
https://doi.org/10.54941/ahfe1001690

User Experience Study on Self-Checkout System of Hypermarkets in Taiwan

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ABSTRACT

This study investigated the impact of different information display methods on the usability of self-checkout services in two major hypermarkets in Taiwan among first-time users. The study found that illustrative and photographic interfaces did not help consumers to operate the software system and the surrounding hardware smoothly. The interaction between the current interface layout and hardware devices increases the mental stress and error rate of first-time users when they are faced with queues of people behind them. Futuristic machine design interface should aim to provide short and precise operation with better understanding of information.

Keywords: Self-Service technologies, Self-Checkouts, User experience, Usability

INTRODUCTION

Self-service technologies (SSTs) are defined as the interface between technology and services that can serve consumers without the direct involvement of employees (Oyedele & Simpson, 2007, Meuter et al., 2000). In recent years, retailers have increasingly introduced self-service technologies into the retail environment to improve the quality of consumer purchases and the traditional manual checkout process (Arnfield, 2014, Yang et al., 2012, Jamal, 2004, Burke, 2002, Merrilees & Miller, 2001). For consumers, self-service offers convenience and autonomy and saves queuing time (Collier & Kimes, 2013, Turner & Borch, 2012, Leeetal, 2010, Dabholkar et al. 2003, Meuter et al. 2000). Previous studies have found that consumers prefer self-service technology over traditional services because it is more convenient and avoids contact with service personnel (Dabholkar 1996, Meuter & Ostrom et al. 2003).

The AEON Group is the first retailer in Asia to introduce self-service technology applications. AEON began its experimental introduction in 2003, followed by the development and introduction of other companies. According to Digital Times, the AEON Group has installed about 3,000 self-checkout machines in its stores across Japan in 2015. The number of kiosks across Japan has increased by 139% from 2009 to 2013.

In Taiwan, Carrefour Taiwan accelerated the installation of self-checkout machines in 2019 and has already introduced them to 66 Carrefour stores

Figure 1: Self-checkout machine in store A (Left), Self-checkout machine in store B (Right).

and 58 convenience stores. RT-MART and A-mart have also introduced new self-checkout facilities.

The increasing number of self-checkout machines in the retail industry has changed the way many consumers used to check out. However, consumers have a wide range of individual differences and familiarity with the system, making it difficult for first-time users to quickly understand and complete the process on their own. According to a study by retail technology company Tensator (2013), 84% of consumers require assistance from store associates when using self-checkout, while 60% actually prefer traditional staff checkout, leading to the current trend for the hypermarkets to deploy service staff at self-checkout kiosks to help consumers get familiar with and adapt to the new technology.

This study evaluated the usability of self-checkout machines in the two hypermarkets in Taiwan, including hardware operation and display of software interface information.

METHODS

The kiosks in the two major hypermarkets, A and B (see Figure 1), were used as the study subjects in this study. Both hypermarkets adopt 24-inch vertical screens with additional barcode scanners, statement printers, EasyCard sensors, and credit card machines with different functions around the screens.

The difference lies in the fact that Store A uses more illustrations for its interface prompts, while Store B uses photos and text for its interface prompts.

We invited 30 subjects who had never used a self-checkout machine before to conduct the task experiment, including 15 subjects in store A and 15 in store B. Before the tasks, the subjects were asked to use the function cards based on their past checkout experience or imagination for sorting to see the difference between the operational flow expected by the test subjects and the actual one.

Table 1. Task performance for the two stores.

Store A	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total duration**
Average time	28.79 s	35.59 s	22.26 s	31.25 s	117.91 s
SD	14.47	10.15	9.72	10.32	28.89
Error rate	2%	13%	26%	66%	
Store B	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total duration**
Average time	27.29 s	69.69 s	39.66 s	28.09 s	164.75 s
SD	11.30	37.61	18.53	12.07	44.15
Error rate	33%	46%	66%	60%	
Significance	No P = 0.754	Yes P = 0.02	Yes P = 0.04	No P = 0.447	Yes P = 0.02

This experiment required the subjects to complete four tasks, the entire operation time and their movements were recorded with a camera. Tasks included:

(1) Member confirmation: Login with your cell phone number.
(2) Product scan: Scan 5 products in different packaging (bottled water, bagged snacks, stationery, fresh fruits, cleaning products) and confirm the product details on the interface.
(3) Receipt setup: From the 6 different receipt options (deposit to member account, direct print paper receipts, donation receipts, etc.), select the option for mobile e-receipts and complete the registration.
(4) Payment checkout: Select the Pay by Credit Card button and find the correct credit card machine among the various hardware devices around the machine to complete the payment.

After completing the task, the participants were asked to fill out the SUS (System Usability Scale), the NASA-TLX questionnaire, and finally, a semi-structured interview was conducted. Then, the differences between the two types of self-checkout machines in terms of interface functions and evaluation were identified for future reference in design improvement.

RESULT & DISCUSSION

The results indicated that in terms of total operation time, Store B (M = 164.75s, SD = 44.15) was longer than Store A (M = 117.91s, SD = 28.89), with a significant difference (P = 0.02<0.05). In task 2, "product scans", the average time in Store B (M = 69.69s, SD = 37.61) was longer than that in Store A (M = 35.59s, SD = 10.15), with a significant difference (P = 0.02<0.05). During the experiment, item registration exceptions happened to 7 people in Store B, resulting in longer operation time. The frequent operation errors increased the operation time and psychological stress (see Table 1).

In Task 3, "Receipt Setup", the average time for Sale B (M = 39.66s, SD = 18.53) was longer than that for Sale A (M = 22.26s, SD = 9.72),

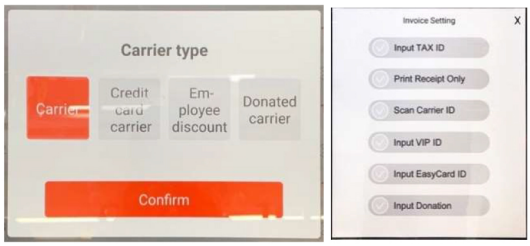

Figure 2: Interface for setting up receipts in Store A (Left), interface for setting up receipts in store B (Right).

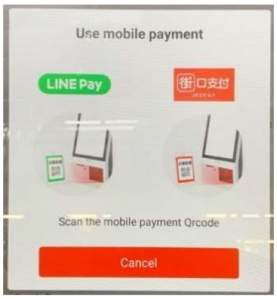

Figure 3: Illustrations and buttons of the checkout interface of payment in Store A.

with a significant difference ($p = 0.04<0.05$). The layout of the interface in Store B has 6 gray text buttons. Ten people reported that they could not find the correct option among these buttons due to the ambiguity of the Chinese interface, which made it more difficult to understand. There was no clear distinction in the color of the buttons when clicked (see Figure 2). The layout of the interface in Store A has 4 buttons with simple and easy-to-understand button text, and there is a clear difference in the color of the buttons when clicked.

Regarding the format of the interface, Store A adopted the illustration format and Store B adopted the photo format. The results showed that in both stores, there were cases of incorrect operation and failure to find the correct hardware device. The prompts in the system interface were not effective in helping the subjects operate successfully.

The interface of Store A is laid out with both illustrations and function buttons (see Figure 3). The interview revealed that 73% of the respondents were unable to distinguish the difference between the two types of information, resulting in incorrect operation and failure to find the hardware device. In task 4, "Payment checkout", 10 people accessed the wrong hardware device, and 7 of them said they could not find the correct hardware device through the illustration on the interface. All of the subjects clicked on the illustration because they expected the interface to guide them to the correct card machine only to find out that the system did not support the click function (see Figure 4). Three people reported that the interface did not show them the error message when they made a mistake, and the repetitive operation increased the time spent.

Figure 4: Checkout interface of payment in Store A.

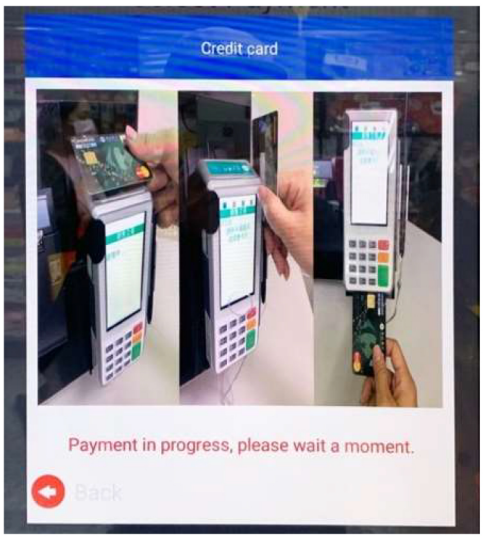

Figure 5: Credit card checkout instruction for Store B.

The interface of Store B uses the photo format to prompt information. Interviews revealed that 60% of the respondents did not notice the photo information. The information in photo format was not effective in helping the respondents to get the correct hardware.

In Task 1, "Member Confirmation", 5 people expressed that they are bewildered because the interface contains a lot of text, photos, and advertising images, and the color of the button is gray. The test subjects were disturbed by the photos and text resulting in failure to find the button and incorrect clicks.

In Task 4, "Payment Checkout", nine people operated the credit card machine incorrectly. All respondents reported that after selecting the credit card payment button, they focused on trying the closest hardware device and ignored the three photos in the interface regarding the location and how to operate the credit card machine (see Figure 5).

As for screen size, both Store A and Store B used 24-inch upright screens. When it comes to operating the kiosk at close range, 26% of respondents

Table 2. The NASA-TLX weighting scores for the two stores.

	Mental Demand	Physical Demand	Temporal Demand	Performance	Effort	Frustration	Total
Store A	108.66	25.33	128.33	64.33	44.00	66.33	29.80
SD	88.12	29.78	101.02	84.04	83.54	74.41	17.04
Store B	180.33	17.33	202.66	60.66	79.00	100.66	44.33
SD	99.97	24.84	147.71	53.51	78.40	141.58	23.64
Significance	Yes P = 0.047	No P = 0.431	No P = 0.119	No P = 0.88	No P = 0.247	No P = 0.413	No P = 0.065

said they did not notice the menu at the bottom of the screen or the surrounding hardware. Staff at both stores put a lot of educational prints around the machines. However, most of the respondents chose to ignore them because of the long queues and the fact that reading too much information would increase the operating time and psychological pressure.

The usability of the two stores was examined using the SUS scale. Store A ($M = 74.66$, $SD = 17.08$, Rating C), which was better than Store B ($M = 51.83$, $SD = 21.90$, Rating F). There was a significant difference ($p = 0.004<0.05$). The interface of the two stores' self-checkout machines cannot fully meet the operational requirements and there is still room for improvement.

The NASA-TLX weighting scores (see Table 2) showed no significant difference ($p = 0.065>0.05$) between the total scores of Store A ($M = 29.80$, $SD = 17.04$) and Store B ($M = 44.33$, $SD = 23.64$). The Mental Demand subscale showed a significant difference ($P = 0.047<0.05$) between Store A ($M = 108.66$, $SD = 88.12$) and Store B ($M = 180.33$, $SD = 99.97$). The results of the interviews indicated that with the multiple hardware devices installed in the self-checkout machines, the interface information was not effective in helping the test subjects understand how to operate the machines. As a result, a higher level of mental effort was required.

The Temporal Demand subscale showed that Store A ($M = 128.33$, $SD = 101.02$) and Store B ($M = 202.66$, $SD = 147.71$) were the highest among all NASA-TLX subscales. The results of the interviews indicated that the perceived length of time was longer than the actual operation time when the queue was gcrowing.

CONCLUSION

This study helps to understand whether the interface and process prompts of self-checkout services in the two hypermarkets in Taiwan are easy to follow and operate for first-time consumers. The study finds that the illustration-based interface does not effectively help consumers locate the corresponding physical device. It easily confuses users with the functional interface components and causes operational errors. The photo-based instructional interface contains a large amount of information, which is easily ignored by the test subjects and does not achieve the effect of hints. The lack of eye-catching

colors of the function buttons or feedback prompts increases the error rate and operation time, and increases the mental strain on consumers. The initial experience affects consumers' willingness to choose a kiosk next time. Only 46% of all respondents said they would be willing to try a kiosk again next time. The fact that customers still had to seek assistance from the two associates dispatched to the store in case of an error is the main reason for preferring manual checkout, in line with Tensator's findings. The findings of this study are useful for understanding the relationship between the content of the interface of the kiosk and the consumer's operation in the hypermarket. It is worthwhile to consider how to effectively guide consumers to operate the software system and hardware devices through the interface presentation, and to complete the checkout process easily. The future design of the interface should aim at short and precise operation and easy access to information to enhance the efficiency of self-checkout.

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