

Smartphone Usage Capabilities among Younger and Elderly Users

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ABSTRACT

In recent years, the elderly population has increased, and most of them tend to live alone. This means that the elderly need to communicate with their younger colleagues, friends, and family via smartphones because these devices provide several channels of communication, such as calling, chatting, and video conferencing. However, the main problem for the elderly is their physical condition which inhibits them from using smartphones. Thus, the objective of this paper is to find out what are the UI components that degrade their ability for using smartphones. This can be achieved by comparing the capabilities of using smartphones between younger and elderly users and finding out the UI components what cause their capabilities to be different. From our assumption that physical conditions limit the capability of the elderly, we focused our research on their visual capabilities by conducting the experiments on younger users and elderly users, who were requested to

perform specific tasks on Line, which is one of the most popular communication applications among Thais. The experimental results reveal that most of the elderly people take longer time to complete their tasks and make more mistakes than younger users. It was found that most of them have problems with color, font style, size, and brightness of UI. As a consequence, it is suggested that a more appropriate UI for smartphone

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applications, especially communication applications, should be designed to solve such problems in order to increase the elderly's capabilities of using smartphones.

Keywords: Elderly, younger generation, mobile social network, limitations of using a smartphone by the elderly

INTRODUCTION

Thailand, like many other countries in the world, has a population that is inclined to have a longer lifespan, while the birth rates are on the decline. This situation has led Thailand into an increased ageing population; the number of people aged above 60 is increasing rapidly (Office of National Economic and Social Development Board, 2015). Moreover, the family structure of the younger generation tends to be of a nuclear family, where grandparents live by themselves while extended families have become less significant (Pitikultang, 2013). As such, more elderly people are living alone and feel more lonely (Durick & Robertson, 2013). According to Photisuvan and Bunurapeepinyo, (1990), they need to socialise with other people, communicate with friends and family in order to overcome their loneliness. Even in the extended families, most children and family members like to have social contact via communication applications on smartphones because they are convenient and fast (Mirum Thailand Team, 2015). To be up-to-date, more elderly people are trying to use smartphones to communicate with

friends and family (Economic Intelligence Center, 2015).

At present, the Ministry of Finance is trying to propose the tax policy that gives the elderly an opportunity to work by offering a special tax deduction to any companies that hire the elderly (Thansettakig News, 2016). This job opportunity is another reason that requires the elderly to use smartphones in order to communicate with their colleagues and have social contact with others. However, many of them begin to experience some form of physical limitations such as trembling hands, presbyopia, and slow-response actions. These limitations irritate the elderly and make them stay away from using smartphones because they cannot see the screen very well, are unable to find the functions or the buttons they want to use, and scroll or swipe the screen (Arfaa & Wang, 2014; Moffatt, 2013; van de Watering, 2005). These limitations cause the elderly to take longer time to send instant messages, make typing mistakes, and perform the wrong tasks (Nicolau & Jorge, 2012). Besides physical limitations, many of the elderly do not know how to use smartphones and touch screens (Sayago & Blat, 2009). If the elderly can overcome these limitations and use smartphones effectively, they can keep in touch with their family, friends, and colleagues, thus have positive mental health and wellness (Theng, Theng, Chua, & Pham, 2012). Obtaining more benefits from using smartphones means there is an opportunity to enhance relationships and communication between the elderly and their families, (Santana et al.,

2005), make life more enjoyable and active with their families, and have pleasant lives (Consolvo et al., 2004)

There is sufficient literature on smartphone usage capabilities of the elderly users but most of the literature focuses on the interaction between the elderly users and the touch screen of smartphones. It was found that elderly users can tap, drag, pinch, and swipe the screen very easily but make a lot of typing mistakes (Kobayashi et al., 2011). The literature also compares the ability of using smartphones between the elderly user group, the children user group, and the teenage user group by asking them to enlarge the content on the screen, drag the object, and rotate the screen. It was found that the elderly users have problems enlarging the content on the screen the most. They also take more time to drag and rotate the screen than others (Chang, H. T., Tsai, Chang, Y. T., & Chang, Y. M., 2014). Most of the elderly users spend more time on enlarging or zooming the content on the screen in order to find the icon (Lin, W., Lin, H. C., & Yueh, 2014). Therefore, the objective of this paper is to find out what are the main UI components that degrade the capabilities of using smartphones among the Thai elderly.

From the above-mentioned reasons, it is believed that it would be better for the elderly to adapt themselves to live with younger generations in the digital society. In order to help them, the tests on smartphone usage capability between elderly users and younger users were conducted over

Line application, which is one of the most popular communication applications on smartphones. The results are used to determine how effectively the elderly can use smartphones and the major factors that affect their capabilities.

LITERATURE REVIEW

The Elderly

It is an indication that a person is entering the stage of getting old but there is no standard of the exact age criterion. It depends on the social, economy and culture of each country. For Thailand, according to the Elderly Act B.E. 2546, the elderly stage is divided into three age groups based on physical and mental condition, and self-support (The Office of Industrial Economics, 2014).

Group 1: The elderly between 60 and 69 years; this group refers to the elderly in the first stage who are physically able to live alone and can take care of themselves. This group has the highest number of elderly people, accounted for 57.67% (from 2000-2030).

Group 2: The elderly between 70 and 79 years; this group refers to the elderly in the middle stage who can still help themselves but start to rely on family and society if they are not very healthy. This group has the number of elderly people accounted for 32.29% (from 2000-2030).

Group 3: The elderly from 80 years up; this group refers to the elderly who require assistance from a healthcare assistant or their family in daily life and should be

supervised by a physician. This group has the lowest number of elderly people accounted for 10.04% (from 2000-2030).

The volunteers in this research are the elderly from Group 1 because the elderly in this group are still self-supported and are able to use smartphones by themselves.

The Younger Generation

These are individuals, both males and females of Thai nationality, that fall into a group of young adults, aged between 18 to 35 years and middle-aged adults who are between 36 to 59 years, according to the age groups defined by Havighurst's (Baltes & Schaie, 1973). However, it is found that people, who like to use online communication via smartphones in the period of changing society with technological revolution and the Internet, are between 19 to 45 years (Mirum Thailand Team, 2015). By combining the above definitions together, this paper divides smartphone users into two groups: the younger user group and the elderly user group. The younger user group consists of the adults whose ages are between 18 to 45 years in order to include both younger adults and middle-aged adults who like to use smartphones, whereas the elderly user group consists of adults whose ages are between 60 to 69 years and are willing to use smartphones. The reason this paper does not include the middle-aged adults between 46 to 59 years into the sample set is because

they tend to use less smartphones and this might affect the statistical results.

Mobile Social Network

This is a kind of social network that uses social network communication applications on a smartphone to make connections through individuals. A user can perform any specific activity on a smartphone through a mobile application that is developed specifically for that activity (Krouse, 2012). A survey on the use of smartphones among Thai people of all ages reveals that the popular activity on smartphone is social networking via social networking communication applications which allow a user to join online community, exchange information, and talk with others. (Dewing, 2010; Mirum Thailand Team, 2015).

Limitations of Using Smartphones by the Elderly

Because the elderly experience physical and capability changes (Holzinger, Searle, Nischelwitzer, 2007), which cause major problems for the use of smartphones, this paper hence focuses on the physical changes that affect the use of smartphones. From an interview with an ophthalmologist from the hospital in Bangkok, it was learnt that most elderly people have either blepharoptosis, eye ptosis, dry eyes, cataract, glaucoma, or macular degeneration. Many of the elderly have symptoms, such as dimming of color, amblyopia, and photophobia. These kinds

of physical changes in the elderly obstruct the use of smartphones.

RESEARCH METHODOLOGY

The objectives of this research are to compare the smartphone usage capabilities among elderly users and younger users and to determine the UI component causes of problems among elderly users when using smartphones. This paper focuses on the capability of using smartphone to have social contact with others via Line application. The tests were conducted on two sample user groups: elderly user group and younger user group. The elderly user group consisted of 38 participants of Thai persons whose ages are between 60 to 69 years, whereas, the younger user group consisted of 46 participants of Thai persons who are between 18 to 45 years old. The test on smartphone usage has been reviewed on the moral discipline and has been approved that it is not harmful to physical and mental conditions of the participants. The procedure of conducting the research is as follows:

Study Line Functions

Line is a communication application that integrates messaging and voice over IP services together. It is the application that allows users to create discussion groups, send messages, post pictures, or make phone calls. All functions are free of charge, only user identification is needed to activate the application. Functions of Line can be summarised as follows: (Kuljitjuewong, 2013; Line Corporation Thailand; College of Management, 2013)

- a) Add friend: Friends can be added to a chat room in many different forms, such as with phone numbers, QR Codes, and Line ID.
- b) Chat: Chat can be carried out made with friends who use Line by typing on-screen keyboard or sending voice message. It also allows users to create a chat group of multiple members. In this chat room there are also other functions that can be used, for example:
 - Forward: Users can send text or pictures from one chat room to another friend or multiple friends.
 - Copy: Users can copy text from one chat room to another friend one at a time, or paste it back in the same chat room.
- c) Send Photo: Users can send photos or videos from the album in their phone as well as voice messages to friends in that chat room.
- d) Sticker and Emojis: Users can send sticker and emojis in various forms to a friend in that chat room and can also download additional stickers.
- e) Free Voice Call: Users can make a call to a friend in that chat room using Line application.
- f) Profile Setting: Users can access the setting pages to edit their personal information including names and pictures, or set authorities.
- g) Timeline: This is the online community that allows users to update their status, post messages or photos or video, offer feedback, press like, or send stickers.

- h) Games: Line has games that Line members can download using their Line account which users can play alone or compete against their friends in Line .

From the Line functions mentioned above, enquiry was made of 10 elderly users. It was found that most of them did not use all the functions, did not play games, or post information to their Timeline. Therefore, only eight functions were selected to conduct the test which is described in the following section.

Determine Activities for Testing

Since access to the functions of Line application depends on the setting of each smartphone, unbiased test was established by requesting the population to perform the same set of activities on the same smartphone model. The activities were selected from the most frequently used activities among smartphone users, and are shown in Table 1.

Table 1
Testing activities

Activity	Process of Activities
1. Chat	- Swipe the screen to select a friend and enter the Chat room - Type the messages as specified
2. Add friend	- Choose Add friends with ID/telephone number - Type the specified friend's ID
3. Forward	- Select messages to be forwarded as defined - Select Forward command - Select friends to be forwarded
4. Copy	- Select messages to be copied as specified - Select Copy command - Paste the copied messages and send
5. Edit name and profile Photo	- Select Setting and select Profile - Edit name - Search for photos - Enlarge the photo and select the photo to be displayed
6. Free call	- Select Free Call from Chat page - Press End Call
7. Sending photo	- Select Photo Menu - Search for photos and send photos
8. Sending sticker	- Slide Menu to Send Sticker - Scroll to a specified sticker - Send sticker

Prepare Test Recording Form

Before the test is conducted, the test recording form was prepared, which was used to keep personal information of each participant and the test results which consists of two parts:

Part 1: Personal information of each participant: sex, age, education, job

Part 2: Test results of usage capability based on eight specified activities. The results of each activity consist of the nature and the number of errors, duration, and other observations.

Conduct Usability Test

Two groups of smartphone users were selected as sample groups for the test: the elderly user group with 38 participants and the younger user group with 46 participants. The sample size of the elderly user group was calculated using the standard sample size calculation from an unknown population with 95% confidence interval. Elderly users who had already used smartphones in their daily lives were selected in order to make the test results unbiased. The sample size of the younger user group was larger because the interval of the younger user group was wider; therefore, the same number of participants were selected from three age groups as follows:

16 participants from ages between 18 to 21 years, which is, the group of students.

15 participants from ages between 22 to 35 years, which is, the group of young working people.

15 participants from ages between 36 to 45 years, which is the group of working people.

After the test activities and the test recording data were designed, it was the stage of conducting smartphone usability tests with the elderly user group and the younger user group by asking each of them to perform eight activities. Data were collected and recorded on the test recording form by observing their behaviour, observing the types of errors and the number of errors, and the time it took to accomplish each activity. The test was conducted by a team of three observers; the test procedure is as follows:

- a) Introduce the team and explain the test procedure to the sample groups.
- b) Clarify the purpose of the test and inform what data would be collected from the test results.
- c) Get acquainted with the sample groups and gather all personal information necessary for the test.
- d) Start the test by explaining the activities that a participant has to perform step-by-step together with the illustrations to make it easier for him / her to understand. The participants were then asked to start the test according to the steps in Figure 1.

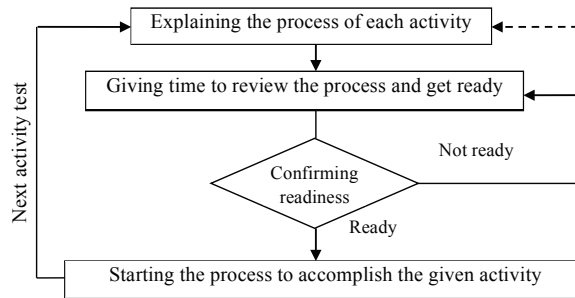


Figure 1. Test process of each activity

Analyse Smartphone Usage Capability of the Elderly

Upon completion of the smartphone usability tests via Line application from both groups, the test results containing the numbers of errors, the types of errors, and the duration of the two groups were compared in order to see if there were any significant differences between them. If significant differences in smartphone usage capabilities were recorded, the analysis was performed to find out the major causes.

RESULTS

The test results of smartphone usage capabilities through Line application of the two sample groups are presented below:

Smartphone Usage among the Younger User Group

The test results of smartphone usage based on eight activities from the younger user group of 46 persons, aged between 18 to 45 years, reveal that Chat activity that takes the longest time to accomplish due to typing that takes an average of 34.05 seconds. Next is Edit profile activity which needs many steps to accomplish for both renaming and changing the profile picture, that takes about 29.03 seconds. This is followed by the Free Call activity takes the shortest time with an average of 2.82 seconds because it needs the fewest steps to accomplish as shown in Table 2.

Table 2
Time spent on testing each activity among younger users

Activity	\bar{X} (sec)	SD	Max	Min
1. Chat	34.05	10.12	71.28	18.28
2. Add friend	9.45	3.27	21.50	4.71
3. Forward	13.96	4.56	27.63	7.59
4. Copy	5.34	1.63	9.28	2.29
5. Edit profile	29.03	7.17	48.95	15.40
6. Free call	2.82	0.63	4.31	1.76
7. Send photo	7.22	2.09	14.64	3.4
8. Send sticker	3.31	1.88	9.79	1.11

It can be seen that the maximum and the minimum time spent on each activity is considerably different, and the observation reveals that the users who spend longer time are the ones who often make mistakes. Remarks were recorded to see whether the age difference in the younger user group would take different time for the test or not, therefore, the overall data are divided into age groups as follows:

18-21 years: group of university/ college students

22-35 years: group of young working people
36-45 years: group of middle-aged working people

The average time of each activity is nearly the same; however, time also increases with age (see Table 3). Thus, the average duration in Table 2 can be used as the average time for each activity for the younger user group.

Table 3
Average time spent on each activity by the younger user group

Activity	Age18-21 \bar{X} (sec)	Age22-35 \bar{X} (sec)	Age36-45 \bar{X} (sec)
1	35.61	31.69	37.87
2	8.45	8.88	12.97
3	13.11	13.43	17.09
4	5.04	5.42	5.66
5	29.14	26.29	36.71
6	2.77	2.74	3.14
7	6.41	7.17	8.88
8	3.02	3.41	3.56

Table 4
Type of errors for each activity by the younger user group

Activity	Type of Error	Frequency
1. Chat	Swipe the screen mistakenly	8
	Typing error	4
2. Add friend	Type the wrong ID	4
3. Forward	Swipe the screen mistakenly	5
4. Copy	-	-
5. Edit profile	Type wrong name	3
6. Free call	-	-
7. Send photo	Select the wrong photo	1
	Press the wrong button	1
8. Send sticker	Swipe the screen mistakenly	2
	Press the wrong button	1

From Table 4, it can be seen that the Chat activity has the highest number of errors because of swiping beyond the specified name and making mistake while typing; and therefore, taking longer time for the activity. It can be notice that the Edit profile takes long time to accomplish but contains less errors, this might be because there are many steps to do but each step is easy and straight forward.

Test results of smartphone usage from the elderly user group

The test results of smartphone usage based on eight activities from the elderly user group of 38 persons, ages between 60-69 years reveal that Chat is the activity that takes the longest time to accomplish with the average of 79.13 seconds, followed by the Edit Profile activity with the average of 70.21 seconds as shown in Table 5.

Table 5
Time spent on testing each activity among elderly users

Activity	\bar{X} (sec)	SD	Max	Min
1. Chat	79.13	26.61	164.56	37.44
2. Add friend	24.88	6.95	45.45	11.75
3. Forward	30.69	12.06	71.67	15.72
4. Copy	12.76	3.34	18.84	3.48
5. Edit profile	70.21	14.29	107.45	37.21
6. Free call	6.62	3.71	17.74	2.75
7. Send photo	16.58	5.10	31.02	8.09
8. Send sticker	5.47	3.40	16.30	1.27

Table 5 shows that the maximum and minimum time spent on testing are quite different due to different levels of expertise. The participants who spend longer time

are the ones who often make mistakes and spend more time staring at the screen before proceeding to the next step because most of them are afraid to make mistakes.

Table 6
Type of errors for each activity by the elderly user group

Activity	Type of Error	Frequency
1. Chat	Swipe the screen mistakenly	10
	Typing error	38
2. Add friend	Type the wrong ID	3
3. Forward	Select the wrong friend	2
	Select the wrong messages	2
	Select the wrong command	2
	Swipe the screen mistakenly	1
4. Copy	Select the wrong command	1
5. Edit profile	Swipe the screen mistakenly	3
	Select the wrong menu	2
	Enlarge the wrong photo	1
	Type the wrong name	2
6. Free call	Select the wrong button	4
7. Send photo	Swipe the screen mistakenly	3
	Select the wrong photo	1
	Press the wrong icon	1
8. Send sticker	Press the wrong button	3
	Swipe the screen mistakenly	2

According to the errors shown in Table 6, Chat activity has the highest occurrence of errors in both groups. The main errors are from typing mistakes and swiping the screen mistakenly. The second highest activity with the most number of errors is Edit profile activity where most of the errors are from swiping the screen mistakenly, choosing the wrong menu, typing the wrong profile name, and being unable to enlarge the photo.

From the comparison of errors between the elderly user group and the younger user group (Table 4 and Table 6), the elderly user group has more errors than the younger user

group in all activities. The most common errors that occur among both user groups are from swiping the screen mistakenly, misspelling, and sending wrong stickers in Chat activity. For other activities, the elderly users have various kinds of errors and usually have more errors than the younger users. In some activities, the younger users commit no error at all while the elderly users make so many errors, for example, the Free call activity where most of the elderly users press the wrong button. This may be caused by the degeneration of the eyes of the elderly.

Comparison on smartphone usage capabilities between the elderly user group and the younger user group

analysed in two different aspects: the duration and the errors of each activity as shown in Table 7.

Comparison on smartphone usage capabilities through Line application was

Table 7
Average duration and average errors of each activity between the elderly user group and the younger user group

Activity	A = The elderly user group B = The younger user group C = A-B			Average Error		
	Average Duration (\bar{X}) (Sec.)			A	B	C
1	79.13	34.05	45.08	1.21	0.26	0.95
2	24.88	9.45	15.43	0.08	0.09	-0.01
3	30.69	13.96	16.73	0.18	0.11	0.07
4	12.76	5.34	7.42	0.03	0.00	0.03
5	70.21	29.03	41.18	0.24	0.07	0.17
6	6.62	2.82	3.8	0.11	0.00	0.11
7	16.58	7.22	9.36	0.13	0.04	0.09
8	5.47	3.31	2.16	0.13	0.07	0.06

From Table 7, it can be seen that the average duration on smartphone usage of the elderly user group is higher than that of the younger user group in all activities. The graphs of

these data are displayed in Figure 2 to show the differences in the usage capabilities in two aspects: the average duration and the average errors of each activity.

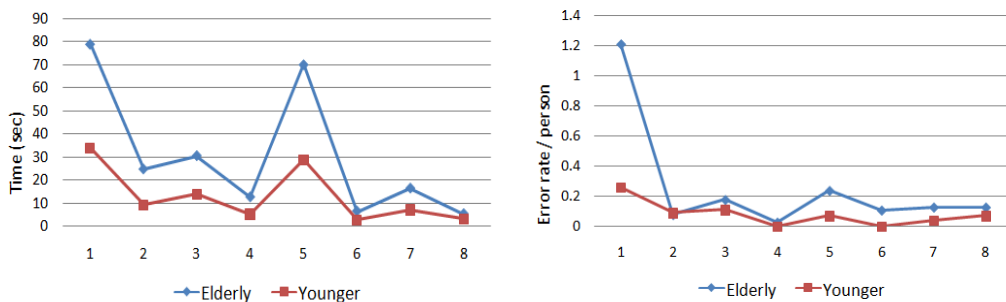


Figure 2. The average duration and average errors of each activity between the Elderly User Group and the Younger User Group

The differences on the usage capabilities between the elderly user group and the young user group can be categorised into three groups:

Group 1: This group consists of activities with the biggest differences; that is, Chat and Edit Profile. In the Chat activity, the elderly users spend more time than the younger users, of up to 45.08 seconds with the highest average error of 0.95 times per person. From the inquiry with the elderly group, it is found that they spend most of their time to scroll the screen to find friends and to type the message. In the Edit Profile activity, the elderly users spend more time than the younger users, up to 41.18 seconds, with the average error of 0.17 times per person.

Group 2: This group consists of activities with some differences; that is, Add Friend and Forward. In the Add Friend activity, the elderly users spend more time than the younger users, up to 15.43 seconds with the average error not much different from the younger users. Observation showed that the elderly users often take extra time to make sure that they do not make any mistake before proceeding to the next step. In the Forward activity, the elderly users spend more time than the younger users, up to 16.73 seconds, with the average error of 0.07 times per person, mostly from selecting the wrong friend and the wrong command.

Group 3: This group has only a few differences in the usage: Copy, Free Call,

Send Photo, and Send Sticker. In the Copy activity, the elderly users spend more time than the younger users, up to 7.42 seconds with the average error of only 0.03 times per person. In the Free Call activity, the elderly users spend more time than the younger users up to 3.8 seconds with the average error of 0.11 times per person from pressing the wrong call button. In the Send Photo activity, the elderly users spend more time than the younger users, up to 9.36 seconds with the average error of 0.09 times per person. In the Send Sticker activity, the elderly users spend more time than the younger users up to 2.16 seconds with the average error of 0.06 times per person. Most of the errors are when selecting the commands but the errors are not very different from the younger users because there are only a few steps to accomplish the activity.

DISCUSSION

The test results from using smartphones to communicate through Line application of the elderly users and the younger users reveal that elderly users take more time than the younger users in all the activities. These results tell us that the elderly users have problems using communication applications on smartphones. In some activities, the capabilities of the elderly users are almost as good as those of the younger users, but in some activities the capabilities of the elderly users are very low, especially for Chat activity. It is because the elderly users need to spend more time to find the alphabets and also tend to press the wrong

alphabets. In addition, there are other causes and effects that make the capabilities of the elderly users and the younger users different as shown in Table 8.

Table 8
The impact of smartphone usage on the elderly users

Activity	Errors / Timing Difference	Impact on Communication
1	Swipe the screen mistakenly Typing error Take longer time	Slow response and miscommunication
2	Type the wrong ID Take longer time than usual	Add the wrong friend or communicate with the wrong person
3	Select the wrong command Swipe the screen mistakenly Take longer time than usual	Slow forwarding/sending wrong messages/ sending to the wrong person
4	Select the wrong command Take slightly longer time	-
5	Type the wrong name Select the wrong photo Select the wrong menu Take slightly longer time	Might cause the partner to think of you as another person but no impact on duration
6	Press the wrong call button Take slightly longer time	-
7	Swipe the screen mistakenly Select the wrong photo Take slightly longer time	The wrong photo might lead to miscommunication
8	Select the wrong command Select the wrong sticker Take slightly longer time	The wrong sticker might lead to miscommunication

From Table 8, it can be seen that errors and duration when using communication applications increase with age. Only some activities are not affected by age, such as Free call and Copy, because if a user selects the wrong command, the activity cannot proceed any further.

Most of the problems that cause errors are due to typing mistakes, pressing the wrong command and swiping to the

wrong object. From the test results and the interviews with the elderly users, it was found that the current screen or the user interface may not be appropriate for the elderly users' vision, and result in errors and are time consuming. After analysing errors and duration of smartphone usage of the elderly users, the main causes of errors can be summarised, as shown in Table 9.

Table 9
Screen components that affect smartphone usage of the elderly users

Error Group	Components that Affect Usage
Selecting the wrong button or command	Color, brightness, size of the letters and buttons, space between objects
Swiping the screen mistakenly	Color, brightness, size of the letters, space between objects

From Table 9, the errors can be divided into 2 main groups: selecting the wrong button or command and swiping the screen mistakenly. These errors are the results from vision problems of the elderly, such as blurred vision and halos. From the analysis, it was learnt that the main elements on a screen that affect vision of the elderly are brightness, colour, fonts, size of the buttons or objects as well as the space between objects on the screen.

CONCLUSIONS AND RECOMMENDATION

At present, communication via smartphone is an important part of everyday life. It is a means for borderless and worldwide communication without limits, in terms of location, time, and people of different age, especially the elderly, who need to adapt to the new technology in order to communicate with their children, other family members as well as their colleagues. The elderly who need to communicate with others via smartphones have to encounter vision problems that decline their smartphone usage capability. It takes a long time for

them to accomplish most of the tasks and they tend to make more errors in communication than the younger ones.

From the test results, it is concluded that capabilities of smartphone usages among the elderly users are lower than those of younger users; the main reason is that the elderly's physical and mental conditions decline with age. Therefore, their capabilities of searching, typing, thinking, memorising, and seeing are not as good which slow down their performance and cause more errors. Furthermore, observations during the tests revealed that most elderly users have vision problems that cause them inconvenience when using smartphones because they cannot see the UI components very well. Most elderly users have problems with colour, font style, size, and brightness. Therefore, it is recommended that the smartphone usage capabilities of the elderly be improved if a more appropriate UI for smartphone applications is designed especially for the elderly. Thus, a viable follow-up study would be to find the most suitable combination of the UI components for smartphone applications in order to improve smartphone usage capability of the Thai elderly.

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