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Li100A Study on the Usability of WAP Interface in the Philippines

Jazmin N. Chong †
Industrial Engineering Department, De La Salle University-Manila, Philippines 1004
E-mail: chongj@dlsu.edu.ph

Amelia S. Ponio V
Industrial Engineering, De La Salle University-Manila, Philippines 1004
Email: sept_ponio@yahoo.com

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Abstract. The existence of Internet revolutionized the computer and communications world. With the rising demand for accessing the Internet, the mobile technology has incorporated the use of Internet in mobile phones. Wireless Application Protocol (WAP) has combined two of the widest utilized technology today: mobile phones and Internet. This study aims to assess the existing WAP pages offered by the top service providers in the Philippines through usability testing experiments. The paper also aims to identify existing problems in WAP interface by focusing on the errors committed by the users. From the usability study, it was found out that common usability problems are wrong selection of links, unclear grouping of categories, wrong feedback, and redundant links. The type of service provider used is significant in determining the performance of users while experience in accessing WAP is insignificant.

Keywords: Wireless Application Protocol (WAP), Mobile Phone, Usability Testing, User Interface, House of Quality, Design of Experiment.

1. INTRODUCTION

In the Philippines, there are two major telecommunications companies that play a vital role in WAP services. In 2003, it marked the beginning of WAP services in the country and since then, the number of WAP users has been growing. With the increasing trend of 3G and WAP technology in the country, a usability study of the WAP interface will help improve the performance of WAP application.

Usability has become an important user requirement to improve the customer acceptance in the market (Butters and Dixon, 1998). Because of this, there is a need to perform usability studies such as this paper in order to attain the goal of satisfying customers' needs and wants.

1.1 WAP

Wireless Application Portal (WAP) emulates the Internet through handheld devices such as PDAs and mobile phones. WAP in itself is already a major development in accomplishing the fusion of both Internet and mobile phone services. WAP also undergoes innovations for better service as well as added features for utmost user satisfaction. Most mobile phone brands issue products that are already WAP capable because it provides portability, access to a wide variety of services, and availability in different media. The future of WAP seems to depend on the future trends in the cellular environment, applications, and service costs (Hung *et al*., 2002).

According to Kamba *et al*. (1996), the architecture of WAP can be subdivided into four elements, which are representation, structure, navigation, and content.

- **Representation** refers to the visual presentation of information. It consists of several aspects such as efficiency of the information is shown in the LCD panel of Mobile Devices, easiness to read the presented information, and how densely the information is presented to the users.
- **Structure** means how well mobile Internet service is organized. It includes sub components such as the relevance of menu-categorization, the appropriateness of menu labels, and the adequate order

† : Corresponding Author

of menu sequence.

- **Navigation** indicates how efficient the procedures of mobile internet service are designed. The sub-components of Navigation include how easy it is to learn the procedure, how easy it is to move between different sub-services, and how many different ways are provided to move other than current services.
- **Content** includes how effectively the information is given, how reliable and up-to-date the information is.

Although WAP is a current service for hand held devices, there are still problems associated with its usage. There is a low acceptance of WAP because of clumsy user interfaces, cumbersome applications, slow speeds, unreliable connections, and high costs (Schultz, 2001). Wireless data networks have limitations of power, memory and processing capability, less bandwidth, more latency, less connection stability, and less predictable availability than wired networks (Pearce, 2000).

Because of these observed problems, Vodafone (2002) developed WAP usability guidelines as follows:

1. Provide direct, simple access to focused valuable content. Give key, summarized information with very few keystrokes or text entry.
2. Trim down page-to-page navigation to a minimum by using simple and familiar hierarchies.
3. Reduce the amount of vertical scrolling by simplifying the text you wish to display.
4. Reduce the number of keystrokes you expect the user to do.
5. Combine theoretical and empirical evaluation to provide further insights.

The developments of technology paved the way for the setting of rules for designing WAP pages and these are (Topxml, 2005):

1. *No splash screens*-start-up pages with large pictures or images
2. *Make navigation easy*-people should be able to go backwards from every page or to the main menu. Numbered links are good for recognition and better navigation.
3. *Check for broken link*-leads to an error page saying "Page not found" or the like
4. *Test the WAP site on real phones and real networks* – this can save customer dissatisfaction.
5. *Make the WAP URL easy to type*-as much as possible, the WAP URL should be almost the same as the original one.
6. *Use images sensibly*-consider capabilities of all mobile phones when choosing images.
7. *Don't require unnecessary information from the users*-there should be minimal input like offering pick lists rather than text entry.
8. *Give indication of how long tasks take on WAP*-users want a scope of their tasks.
9. *Log users in*-apply auto-log in if possible.
10. *Ensure the content works on mobile phones*-do not concentrate on making the web site a smaller version in the WAP site. Select the important points only.

These guidelines will be used as references in identifying possible problems and errors encountered by users when accessing WAP pages in the Philippines. The principles will be employed when analyzing the results of the usability testing later on in the study.

1.2 Usability

Products and services are created to meet the consumers' wants and needs. In meeting consumers' wants and needs, planning is a must and here is where usability is employed. Usability can serve as a link between the consumers' capabilities and requirements and the designers' blueprint. The heart of usability is in the creation/development of a product/service that can be operated by all possible users, including beginners and experts.

As of the present time, there is no standard definition of usability agreed by usability experts (Van Welie *et al*., 2004). In this study, we used the definition of Neilsen (1996) which is "a measure of the quality of the user experience when interacting with a web-based or traditional software application which specifies five characteristics as follows Nielsen (1996):

a. *Ease of learning* - the novices' ability to reach reasonable level of performance quickly
b. *Efficiency* – expert's level of performance that is measured by the speed of performance
c. *Memorability or ease of use* – the ability of users to remember how to use a system after a period of time
d. *Error frequency* – refers to the number of errors incurred by users, to their ability to recover from errors, and the existence of errors that can prevent completion of the task
e. *Subjective satisfaction* – refers to user's subjective evaluation of the system concerning how pleasant it is to use

These usability guidelines will be used to assess the current WAP services in the Philippines and identification of possible usability problems. A usability problem occurs when there is difficulty incurred by the users upon utilization of a specific product. A user experiences difficulty in using a product when the product does not respond properly to what the customer wants it to do.

1.3 House of Quality (HOQ)

The technique aims to capture what the customer needs, and work to how it might be achieved. According to Akao (1990), HOQ is a well-known method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase. It is a structured procedure used to translate the expressed or perceived needs of customers' first into specific product or service design characteristics and features, and then into process and operational characteristics.

1.4 Design of Experiment (DOE)

The DOE is defined as conducting and analyzing of controlled tests to evaluate the factors that control the value of a parameter or group of parameters. It also refers to experimental methods used to quantify indeterminate measurements of factors and interactions between factors statistically through observance of forced changes made methodically as directed by mathematically systematic tables (iSixsigma, 2005). With the utilization of the DOE, the long process of prototyping several designs in order to determine the optimal design is eliminated.

This study aims to achieve the following:

1. Determine any user-experienced problems in using WAP services in the Philippines.
2. Identify any significant difference with respect to performance measures such as number of errors committed and task time between experienced and inexperienced WAP users.
3. Identify important design factors in WAP interface development through the help of HOQ and DOE to aid WAP designers.

The study covers the WAP services of the two top nationwide service providers named as SP-1 and SP-2. Nokia 6600 is used for the usability testing since Nokia is the market leader in the Philippines. It has a standard large screen size with XHTML (Internet through WAP) capability. Errors and task time are the data gathered from the usability testing. Errors were measured as deviation from the correct steps in accomplishing the tasks. Task time does not include loading of pages because the study does not cover the system of the service providers.

2. METHODOLOGY

2.1 Participants

The participants were from De La Salle University-Manila. A total of 60 students were selected with the criteria of at least 1 year Internet usage and at least one year mobile phone usage. Internet usage is necessary because WAP is modeled after the Internet. Mobile phone usage, on the other hand, assures a background on the handling of its technology. The 60 participants are equally divided into experienced and inexperienced WAP users. The ratio between the female and the male participants is proportioned equally at 50%. The mean age of the participants is 21 years old. Table 1 illustrates the division of participants in the usability testing.

Table 1. Division of participants

Factors	SP-1		SP-2	
	Male	Female	Male	Female
Experience	7	8	8	7
Inexperienced	8	7	7	8
Average Age	21	20	22	21

Table 2. List of equipment used

Equipment	Description
Rover Security Mini Camera	Serves as a feed of the WAP activity for recording
Hard Wire Mount	Mounts the mini camera on the Nokia 6600
RCA Wiring	Functions as connection of the mini camera to the VHS player/recorder and the TV
Sony VHS Player/Recorder	Records the activity captured by the mini camera
29-inch Color TV	Performs as the viewing medium of all WAP activity
VHS Tape	Serves as hardcopy of the recorded WAP activity
Nokia 6600	Channel for navigating the WAP Interface

2.2 Equipment

The equipment used in the usability testing experiment is presented in Table 2 with brief descriptions of their use. The Usability experiment set-up is shown in Figure 1, where it shows an image of phone and camera used.

Figure 1. Usability experiment set-up

Accomplishing the House of Quality was completed with the use of QFD Capture computer application from International TechneGroup Incorporated. On the other hand, Design-Expert version 7 was utilized for the D-Optimal Screening, a method chosen because it can identify the significant design factors as well as the significant interactions between the design factors.

2.3 Procedure

The procedures for the usability testing are as follows:

1. Preparation of Task Scenario
   According to the two leading WAP service providers in the Philippines, the top WAP activity is downloading of items and these are ring tones, wallpapers, and games. The task scenario was patterned after this information and is presented in Table 3. Table 4 presents sample interface for the different tasks.
2. Setting up of equipment
   Equipment is arranged in the usability lab at the Science and Technology Research Center in De La Salle University-Manila Room 218. The control room set up is shown in Figure 2 together with the observation.

Table 3. Task scenarios

Task	Instructions
SP-1	
A	Download OPM ring tone "Liwanag Sa Dilim" by Rivermaya.
B	Download Java game "AncientRuins2".
C	Download wallpaper "Best Friends" under "Snoopy" category.
SP-2	
A	Download OPM ring tone "Huwag Na Lang Kaya" by "True Faith".
B	Download Java game "Black Jack 2" under "Casino" category.
C	Download wallpaper "Donald and Daisy Face2face" under "Mickey Xmas".

Table 4. Sample interface for SP-1 and SP-2

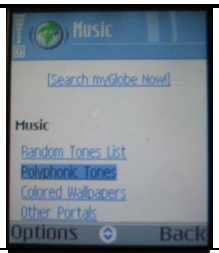
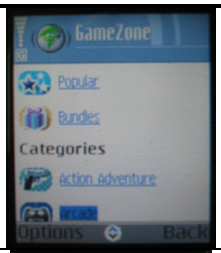
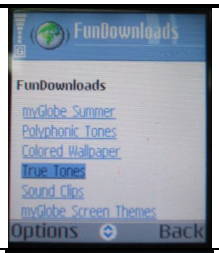
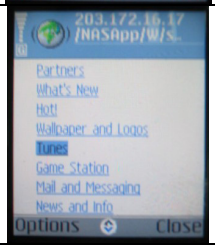
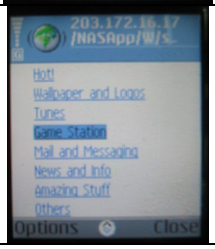
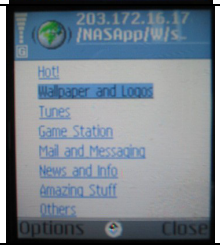
	Task A (ring tone)	Task B (Java game)	Task C (wallpaper)
SP-1			
SP-2			

Figure 2. Control room (Left) and observation room (Right)

3. Selection and Screening of Participants
   Participants were chosen according to the criteria of having at least 1 year Internet usage and one-year mobile phone usage.
4. Signing of Consent Form and Briefing
   The participants were informed on the method of the usability test through introduction of the task scenarios. Questions and clarifications were also addressed.
5. Familiarization of Mobile Phone
   The participants were briefed regarding the functions in the keypad of the mobile phone and were given 10 minutes to navigate the Nokia 6600 in order to be accustomed on how to use it.
6. Usability Testing
   During the usability test, participants were asked to think aloud while performing the different tasks. The researcher encouraged him/her to think aloud if he/she fails to do so.
7. Filling up of Questionnaires
   The Participants were asked to fill up a Pre-Test Questionnaire before the test, a Post-Task Questionnaire after each task. A Post-Test Questionnaire is accomplished by the participants after the usability test. These questionnaires were used to identify the participant's background, expectations, feedback regarding the tests, comments, and suggestions.
8. Interviewing/Debriefing of Participants
   After the usability test, participants were interviewed so the researcher can clarify the observed errors and problems from the completed usability testing.

Figure 3. Actual testing.

9. Analysis on the Results of the Usability Test
   The Analysis of Variance (ANOVA), HOQ and DOE analysis are performed to determine important factors in designing WAP pages.
10. Analyze results and prepare recommendation
    The results of the whole study are compared with the review of related literature in order to come up with a recommendation for WAP page development. Significant factors identified in DOE are also incorporated.

3. RESULTS AND DISCUSSION

Through observations and interviews during the usability testing, comments were gathered to better assess the WAP interface in the Philippines. Table 5 presents a summary of the participants' comments while accessing WAP.

Based on the results the frequent comments, generally there was good color combination between the background and texts. Icons also match with the colors of the texts and the background. Negative feedbacks were that the categories are very confusing for both service providers. Participants cannot identify the differences between the choices that they are provided with. The participants also tend to become frustrated when they cannot accomplish a specific task. Because of this, some of them opted to discontinue with the said task. Out of the 180 total tasks for both service providers, 25 were not completed due to the choice of participants to quit.

The usability problems encountered by the participants are subdivided into four elements of WAP architecture as identified by Kamba *et al*. (1996) namely representation, structure, navigation, and content. These are all depicted in Table 6 and 7 and combined in Table 8.

The highest number of errors committed by both the experienced and inexperienced users for Philippine WAP sites is ***wrong selection of link***, which is under the navigation element, with a summed error of 592. This type of problem occurs when participants continue performing steps without realizing that they have already

Table 5. Summary of comments from participants while accessing WAP

TASKS	Participant Comments	
	Positive	**Negative**
SP-1		
Task A: Downloading a Ringtone	the color combination and the logo looks good	Options weren't in alphabetical order; it is difficult to find the correct category for the tone; songs should be sorted based on artists and genres; unite all portals; make it user friendly; should be like yahoo in terms of search engine; very frustrating
Task B Downloading a Java Game	it was colorful and clear it resembles internet, enables ease of use	Contents are in one long list; cannot find the search pad; make the choices simpler; listings must have order; hard to find the right link; similar terms/names different sites
Task C Downloading a Wallpaper	I like the blue text; the appearance is good; colors are cute	There are many different lists found everywhere; the search engine does not work; make an overall search for any item/topic that user want to find; categories are confusing; task is frustrating
SP-2		
Task A: Downloading a Ringtone	Icons and text match; simplicity of words used	messy interface; hard time in searching for the correct site; I'm going in circles; confusing icons; a different background color is better; layout was too monotonous; redundant words used in links; cheaper prices and free WAP browsing is better; add advertisements to compensate free browsing
Task B Downloading a Java Game	the WAP thing is easy to learn especially for new users	links are misleading; the categories of the game is confusing; hard to find the correct link; links are confusing; interface is not appealing; similarity of texts (category) meanings; misleading links; can be frustrating
Task C Downloading a Wallpaper	enables me to download things I want	the link is not familiar; easy to miss the link; include new stuffs as separate category; search engine gives no results; tab categories are unclear; to broad categories; groupings are unclear; frustrating

Table 6. Frequency of identified usability problems for SP-1 (Errors)

PROBLEMS	SP-1								
	Experienced				Inexperienced				
	Task A	**Task B**	**Task C**	**Total**	**Task A**	**Task B**	**Task C**	**Total**	**Overall Total**
Representation									
1. Too long listings	1	1	0	2	0	0	0	0	**2**
2. Difficult to read text	0	2	3	5	0	1	2	3	**8**
Structure									
1. Redundant links with different contents	***0***	***15***	***0***	***15***	***0***	***26***	***0***	***26***	**41**
2. Unclear grouping of categories	***11***	***13***	***9***	***33***	***7***	***21***	***14***	***42***	**75**
3. Icons does not match text	0	1	0	1	0	3	0	3	**4**
4. Cannot identify the meaning of icons	0	1	0	1	0	3	0	3	**4**
Navigation									
1. Wrong selection of link	***43***	***74***	***73***	***190***	***41***	***69***	***76***	***186***	**376**
2. Accidental selection of link	0	1	0	1	0	0	1	1	**2**
Content									
8. No feedback	0	4	0	4	0	0	0	0	**4**
9. Wrong feedback	0	0	0	0	0	2	0	2	**2**
TOTAL	55	112	85	252	48	125	93	266	**518**

committed an error in accomplishing the task. The value is quite high because the situation is alike the "domino effect" wherein a single error leads to another error and thus, it accumulates. This particular usability problem falls under the criteria identified by John and Marks (1997) when "users try several things and then explic-

Table 7. Frequency of identified usability problems for SP-2 (Errors)

PROBLEMS	SP-2								
	Experienced				Inexperienced				
	Task A	Task B	Task C	Total	Task A	Task B	Task C	Total	Overall Total
Representation									
1. Too long listings	1	0	0	1	0	0	0	0	1
2. Difficult to read text	1	1	2	4	1	1	2	4	8
Structure									
1. Unclear grouping of categories	***21***	***3***	***3***	***27***	***11***	***6***	***7***	***24***	**51**
2. Icons does not match text	0	0	0	0	0	0	0	0	0
3. Cannot identify the meaning of icons	0	0	0	0	0	0	0	0	0
Navigation									
1. Wrong selection of link	***42***	***10***	***48***	***100***	***42***	***7***	***67***	***116***	**216**
2. Accidental selection of link	0	1	0	1	0	3	0	3	4
Content									
1. No feedback	3	5	2	10	9	2	2	13	23
2. Wrong feedback	***19***	***5***	***6***	***30***	***20***	***2***	***4***	***26***	**56**
TOTAL	87	25	61	173	83	21	82	186	**359**

Table 8. Total frequency of identified usability problems for SP-1 and SP-2 (Errors).

PROBLEMS	Philippines WAP Providers: SP-1 and SP-2								
	Experienced				Inexperienced				
	Task A	Task B	Task C	Total	Task A	Task B	Task C	Total	Overall Total
Representation									
1. Too long listings	2	1	0	3	0	0	0	0	3
2. Difficult to read text	1	3	5	9	1	2	4	7	16
Structure									
1. Redundant links with different contents	*0*	*15*	*0*	*15*	*0*	*26*	*0*	*26*	41
2. Unclear grouping of categories	*32*	*16*	*12*	*60*	*18*	*27*	*21*	*66*	126
3. Icons does not match text	0	1	0	1	0	3	0	3	4
4. Cannot identify the meaning of icons	0	1	0	1	0	3	0	3	4
Navigation									
1. Wrong selection of link	*85*	*84*	*121*	*290*	*83*	*76*	*143*	*302*	592
2. Accidental selection of link	0	2	0	2	0	3	1	4	6
Content									
1. No feedback	3	9	2	14	9	2	2	13	27
2. Wrong feedback	*19*	*5*	*6*	*30*	*20*	*4*	*4*	*28*	58
TOTAL	142	137	146	425	131	146	175	452	877

itly gives up."

Unclear grouping of categories is the next significant problem for Philippine WAP sites with a sum of 126 errors. This usability problem occurs when participants choose a certain category only to find out that the item they are looking for is not there. There are a lot of factors that affects the commission of this particular error; one aspect is that both service providers use ambiguous words in their menus and categories. The terminologies used were not what the users expected it to

Table 9. Comparison of guidelines with WAP providers.

Violation of Vodafone Guidelines (2002)		
Principle	**SP-1**	**SP-2**
Summarize information with very few keystrokes or text entry	Permits text entry but results are not the one expected (search engine)	
Reduce amount of vertical scrolling	Pages present long listings	
Violation of Topxml Guidelines (2005)		
Principle	**SP-1**	**SP-2**
Make navigation easy	1. Numbered links are not evident 2. Enables users to go back to previous page 3. Some back links are fixated 4. "Home" link is evident on all pages	1. Numbered links are not evident 2. Enables users to go back to previous page 3. Some back links are fixated 4. "Home" link is evident on all pages
Don't require unnecessary information from the users	Confusing/Numerous categories for users to select	

be. Such incident can cause frustration on the part of the users merely because the service providers were not able to meet their expectations, which will eventually result to loss of interest on the WAP services. This could lead to customer dissatisfaction, a major violation in the usability characteristic identified by Nielsen (1996), or non-completion of tasks. A satisfied customer is a happy customer that will continue patronizing the service. With this in mind, WAP developers should incorporate the expectations of the users in designing WAP pages.

Wrong feedback is third among the most number of errors incurred. This type of error occurs when a subject always experiences feedback such as "No Item Found" while using the search engine. Although the search engine operates effectively, it is not applicable to all terms or items captured by the WAP service.

Redundant links with different contents is the fourth most significant usability problem. This error occurred when the participants chose the same category name needed for the task but the contents were different. Such error can cause confusion since users perceived that the action taken is correct since they were able to identify the right category name but the action is wrong since the contents are not the one that is needed.

As seen in Table 9, both service providers enable text entry depicted in the search engine. The problem that was encountered during the use of the search engine is that the item being search yields no result. The search engine should integrate all the contents of the whole WAP site and not selected pages. The long list of categories presented in the two service providers assessed violates the guideline that information should reduce the amount of vertical scrolling (Vodafone, 2002). The navigation was made easy (Topxml, 2005) by the two service providers by having a home and back links in every page. The only problem for both is that some of the back links are fixated in a default link and not in the previous link that the user visited.

Users cannot succeed in attaining the goal in three minutes indicates a usability problem (John and Marks, 1997). Table 10 shows the average task times.

In SP-1, only Downloading a Java Game conformed to the said allowable time of 3 minutes and for SP-2, only Downloading a Ringtone conformed.

An ANOVA was utilized in order to identify the presence of significant difference between experienced and inexperienced users with respect to number of errors committed and the task time. Table 11 presents the summary of results. It can be seen that there is no significant difference between experienced and inexperienced users with respect to errors committed and task time. These results indicate that having a background on the usage of WAP does not necessarily mean that users will not incur errors or finish the tasks close to the ideal task time, because of this, the experience factor was disregarded. For all tasks, whether analyzing the error or task time, the service provider proves to have a significant difference. This means that the service provider being accessed when browsing WAP has an effect in accomplishing tasks. From this, a two-way ANOVA was completed (Tables 12 and 13).

Table 10. Average task time

Task	Average Task Time in minutes	
	SP1	**SP2**
Task A	5.52	2.38
Task B	1.4	3.53
Task C	4.53	4.51

It can be seen from Table 12 that the type of task is not significant in affecting the errors committed by the participants. This means that regardless of tasks, WAP users still commit errors. The service provider is a significant factor when analyzing errors incurred when performing tasks. Another significant factor is the interaction of service provider used and the nature of the task. The interaction implies that the errors incurred by the participants depend on which task is to be performed on which service provider. From these results, it can be deduced that successful usage of WAP in the Philippines depends on the service provider that is ac-

cessed by users. Table 13 shows that service provider, type of task, and interaction between the service provider and tasks have a major effect in the task time of users. This scenario is quite similar with the ANOVA for errors. The only difference is that task independently can have an effect on the time it takes for users to accomplish the tasks. Task completion time was highly dependent on the tasks because of the steps to be accomplished in order to finish them.

Based the interview results conducted after the usability test, House of Quality 1 (HOQ1) was developed (Figure 4). The first column represents the voice of the customer. The topmost row of the HOQ1 depicts the technical requirements in order to address the voice of the customer. The relationships of each of the voice of customers identified with the technical requirements are determined to compute for the absolute and relative importance of the technical requirements. From the *Relative Weight* column, it can be seen that the most significant requirement of the users was to accomplish their tasks immediately. The provision of a complete user engine ranked second since it also contributes to

Table 11. Summary of one-way ANOVA (p-value)

Tasks	Error		Task Time	
	Experienced vs. Inexperienced	SP-1 vs. SP-2	Experienced vs. Inexperienced	SP-1 vs. SP-2
Task A (ring tone)	0.6911	0.0182	0.2653	< 0.0001
Task B (Java game)	0.8445	0.0001	0.5297	< 0.0001
Task C (wallpaper)	0.7550	0.0323	0.6398	< 0.0685

Table 12. Summary of two-way ANOVA for errors

Source	p-value	F	Critical values (0.05)
Service Provider	0.007	7.26	1.29
Task	0.5779	0.55	1.9
Interaction	< 0.0001	14.55	3.28

Table 13. Summary of two-way ANOVA for task time

Source	p-value	F	Critical values (0.05)
Service Provider	0.0007	12.28	0.69
Task	< 0.0001	20.07	0.69
Interaction	0.0001	17.02	1.29

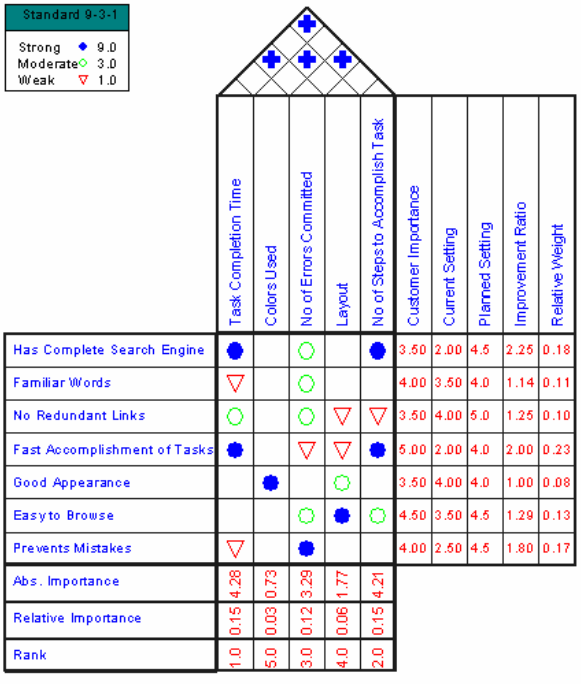


Figure 4. House of quality (HOQ) 1

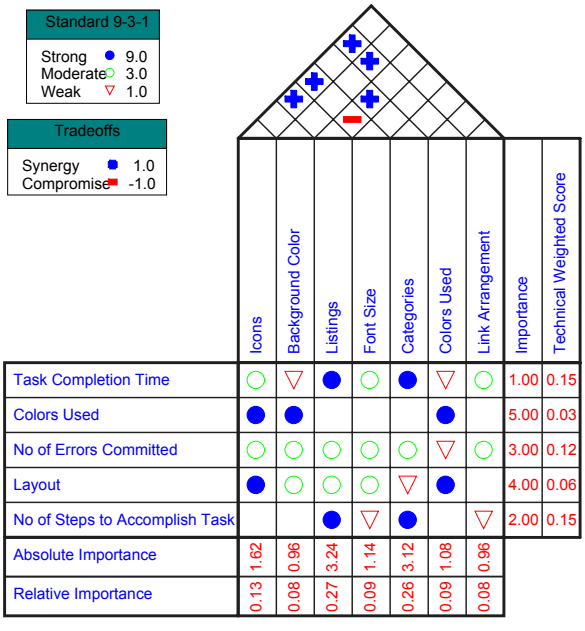


Figure 5. House of quality (HOQ) 2

the minimization of the task completion time.

The first row of the HOQ2 in Figure 5 depicts the design factors needed to address the technical requirements identified in the HOQ1. A Design of Experiments (DOE) is utilized in order to determine the important factors for WAP design. The design factors considered are those identified in the HOQ 2. The settings of the said design factors were established as depicted in Table 14. The said levels were determined to be able to evaluate possible combinations of the factors.

Table 14. Lists of factors considered for d-optimal screening

Factors	High	Low
Icons	With	Without
Background Color	With	Without
Listings	Long	Short
Font Size	14	10
Link Arrangement	Alphabetical	Logical
Categories	Slang	Dictionary Meaning
No. of Colors used	4	2

The design factors had interactions as seen in the roof of HOQ 2. Because of this, the D-Optimal Screening of factors from Design-Expert version 7 was utilized. It was the method chosen because it can identify the significant design factors and its interaction.

For the icons, the high setting is placing icons because aesthetics are also considered in human-computer interaction (Lavie and Tractinsky, 2003). The low setting does not incorporate icons since it adds to the mental workload of users (Customer Input, 2003).

The high setting for the background color uses a distinctive color, which is yellow, because it has a medium contrast. A medium contrast is preferred because from the study by Hill (1997), it is distinctive and adds to readability. The low setting incorporates a white background since, from theories of colors, white tend to be balanced against other colors and is usually regarded as having no background (NetKontoret, 2002).

The listing design factor has a high setting of long listing because users should quickly see the breadth of their options (Tognazzini, 2005). The low setting employs short lists since users dislike too much vertical scrolling.

The font size has a high setting of 14 pt. and a low setting of 10 pt. In interface design, 14 pt. is classified as large font size and 10 pt. is small font size (Meyer, 2005).

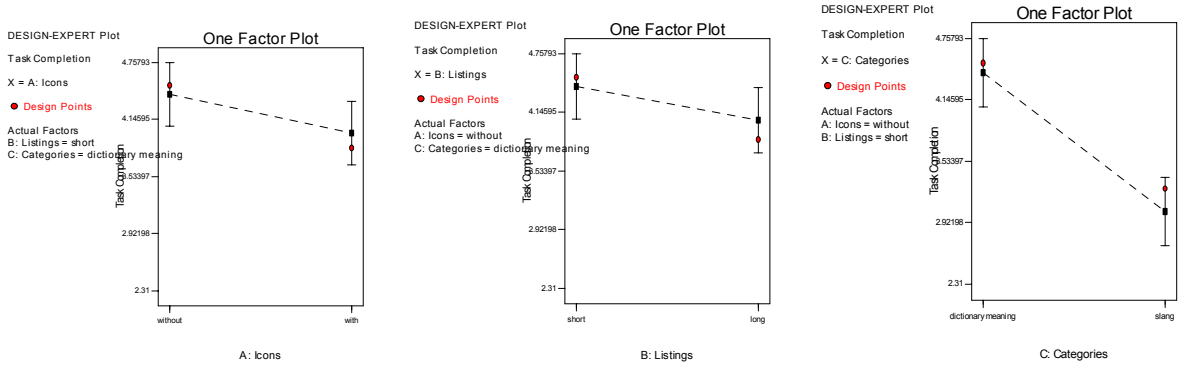
Link arrangement has a high setting in alphabetical mode where links are arranged sequentially. This is usually applied when a known list such as available polyphonic ring tone is to be presented to users (Usability.gov, 2005). The low setting is logical mode where links are arranged by priority or frequency of usage. This is employed because links or information should be presented by order of importance (Moss, 2005).

The categories factor, has a high setting as slang and the low setting is using dictionary meaning of words since using jargon can be very confusing (Usability.gov, 2005).

Last design factor pertains to the number of colors used. The maximum number of colors that can be used is 4 and the least is 2 (Shneiderman, 1998). The high setting is set with 4 hues namely blue, white, yellow, and orange. The low setting has 2 shades namely blue, and white.

D-Optimal Screening identified three design factors as significant: icons, listings and categories. In order to determine the settings that minimizes task completion time, number of errors committed, and the number of steps to accomplish task, a 2^K Factorial Design is performed.

It can be depicted in Figure 6A that the having no icons was favored by the graph in all of the responses measured. Because of the said behavior with respect to



(A) (B) (C)

Figure 6. (A) Model graph of icons vs. task completion (B) Model graph of listings vs. task completion (C) Model graph of categories vs. task completion

the responses, the without icon category level is chosen. Having no icons in the interface was better because space is limited in WAP and icons consume a lot of space.

As shown in Figure 6B, a short way of listing links yielded a higher response value as compared to the long way of listing. Because of this the short level was chosen in the development of the prototype interface design. Short lists were preferred as stated by the analysis. Figure 6C illustrates the preference for the usage of dictionary meaning of words, paving the way for its integration in the design of the proposed WAP interface. The cognitive capability of users was taken into consideration since the design of WAP interface should incorporate the usage of simple and direct choice of words.

4. CONCLUSION/RECOMMENDATION

Usability testing enables researchers to identify usability problems and its factors. To determine significant factors to be considered in the design with respect to errors, time and experience, an ANOVA is performed. HOQ helped identify important features valued by customers with its corresponding technical requirements in order to meet the voice of the customer. The DOE is used to identify important design factors identified in the HOQ that will have significant impact to time and error.

Usability problems are evident in using the WAP services in the Philippines. The common problems are under the elements of navigation (wrong selection of link), structure (unclear grouping of categories and redundant links with different contents), and content (wrong feedback). Such problems must be taken with great consideration by WAP developers upon the generation of the design.

Since there is a significant difference between SP-1 and SP-2, the WAP service provider greatly affects the performance of the users with regards to error commitment and task time. In the design of WAP interface, consideration of experienced and inexperienced users in terms of information presentation on WAP pages can be disregarded since it yielded an insignificant interaction. This means that experience need not be taken into account in WAP design and that all users are assumed to be novices. Thus, the interface should be easy to use so that users will incur fewer errors or no errors at all.

Upon completion of the usability testing conducted usability can be defined as an ergonomic tool that is employed in order to enhance the service provided by an end product where there is evaluation of effectiveness, flexibility, ease of usage, and error recovery.

The most significant factors in designing a WAP page are the icons, listings and categories. In designing a WAP interface, developers must keep in mind that the absence of icons is better since icons are space consuming. Short lists are favorable since it minimizes the long vertical scrolling of pages. And lastly for the categories, the dictionary meaning of the words is better than using unfamiliar words because it reduces the cognitive requirement of processing the given information. Also, the dictionary meaning of the words can cater to different ages thus eliminates the generation gap of users.

For further research, an affect evaluation of cultural factors with regards to specifying categories can help consider the voice of the customers. The category naming can also be researched according to the expectations and interpretations of the users since it is a decision factor in the selection of links.

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