Influence of Mobile Device Categories on the Usability of Mobile Website Categories

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Abstract

This research investigates the influence of mobile device categories on the usability of mobile website categories. The mobile website categories investigated were, News, Search, Service, Portal, and Media Sharing Website categories. And the mobile device categories used were, Touch Screen Mobile Phones (TSMP), Non-Touch Screen Mobile Phones (NTSMP) and Tablet PCs respectively. The objective is to investigate some mobile usability issues that may be encountered when using mobile devices selected from the mobile device categories to access the five website categories mentioned above with the view to finding their influence on the usability of the websites and make some useful recommendations as to their usage. 75 usability tests were carried out remotely. Results indicate that all the three mobile device categories recorded high to very high usability with the five categories of mobile websites because very small usability issues were found in them, indicating that mobile device categories have little or no influence on the five mobile websites. Based on the investigations carried out, touch screen phones are recommended for News and Search Websites while Tablet PCs are recommended for Search, Portal and Media Sharing Websites. Smartphones with physical keyboard are not convenient for browsing websites.

Keywords: *Influence, Mobile Devices, Mobile Websites, Usability, Usability Issues*

1. Introduction

Mobile web usability is a measure of how easy (or otherwise) a user finds it to interact with a web site through a mobile device **(**Frederick and Lal [1]). A mobile website is considered usable when a user visits such a site through a mobile device and achieves his or her purpose in the least amount of time. In order to know if a given mobile website is usable, a mobile usability test is normally conducted for the site using a mobile device.

Just as we have different mobile website categories, so we have different mobile device categories for accessing the sites. Five different website categories have been identified by Frederick and Lal as News Websites, Search Websites, Service Websites, Portal Websites, and Media Sharing Websites. Fidgeon [2] also identified three main categories of mobile websites which include, Touch Screen Mobile Phones (TSMP), Non-Touch Screen Mobile Phones (NTSMP) and Tablet PCs. According to Fidgeon, our choice for a mobile usability testing session determines its success and so instead of focusing on 1 or 2 devices, it is recommended that we run mobile usability testing sessions across the three main categories of mobile devices mentioned above.

From the above review, it can be seen that there are five major categories of mobile websites and three popular categories of mobile devices that can be used to access these sites. It is in line with the above that it is necessary to carry out usability studies on these categories of websites with the three popular mobile device categories with the view to finding the influence of these devices on the usability of the above mentioned website categories.

The objective is to investigate some mobile usability issues such as slow load times (pages taking too long to load), too much scrolling, bloated pages (big pictures, long pages, etc), JavaScript crashes (Rich media features and videos failing to work on mobile), difficulty in navigation, difficulty in logging in and creating account, difficulty in accessing information, etc that may be encountered when using the three most popular mobile device categories with the view to finding their influence on the usability of the mobile websites and make some useful recommendations as to their usage to access the five websites.

It is foreseen that different usability problems may be encountered in each mobile website category when using each of the three mobile device categories and not all the three mobile device categories will be equally usable with all the mobile website categories. There is possibility that different usability problems will be encountered with each of these mobile devices category when accessing a particular website category and it is also possible that a particular mobile device category will encounter less

usability problems in one website category than the other categories. It is therefore justifiable to carry out usability studies on these categories of websites with the three popular mobile device categories with the view to finding their influence on the usability of the mobile websites and recommend appropriate mobile device category for a particular mobile website category.

2. Review of Related Works

According to Nielsen, cited in Lee and Grice [3], usability means the measure of the quality which the user experiences when interacting with something – whether it is a website, a traditional software application, or any other device the user can operate in some way. The subject of focus which is Mobile web usability is a measure of how easy (or otherwise) a user finds it to interact with a website through a mobile device (Frederick and Lal [1]). A mobile web site is considered usable when a user visits such a site through a mobile device and achieves his or her purpose in the least amount of time. In order to know if a given mobile website is usable, a mobile usability test is normally conducted for the site using a mobile device. Such a test is conducted to determine typical usability issues or problems that people encounter when using a mobile website on a variety of mobile phones or tablet PCs. In assessing usability of mobile websites, two main techniques could be used – quantitative techniques such as the System Usability Scale (SUS) and qualitative techniques such as Qualitative User Research (QUR).

SUS is one of the surveys that can be used to assess the usability of a variety of products and services (Broke, cited in Bangor et al [4]). According to Bangor et al, the SUS is made up of ten statements (five positive statements and five negative statements, which alternate), each having a five-point scale that ranges from Strongly Disagree to Strongly Agree. They found it to be a robust tool, having been used many times to evaluate a wide range of interfaces that included websites, cell phones, IVR, GUI, hardware, and TV user interfaces.

QUR technique is best for the study of specific user interface designs to see if users have difficult time or easy time accomplishing tasks with each design option (Nielsen and Budiu [5]). In their argument to support qualitative user research they said that empirical evidence from countless projects over the last 23 years showed that testing with a handful of users is sufficient to identify the majority of important usability problems in a design. In comparing quantitative technique with qualitative technique for assessing usability, Nielsen [6] said "you don't have to measure usability to improve it. Usually, it's enough to test a handful of users and revise the design in the direction indicated by a qualitative analysis of their behaviour." He said that qualitative study can usually be run with 5 users while quantitative studies required 20 users which are about 4 times as expensive and because they are expensive and easy to get them wrong and end up with misleading data warned against quantitative studies. According to Nielsen [7], elaborate usability tests are a waste of resources, since just as few as 5 users to run as many small tests as affordable can bring out the best results.

Molich et al [8] in their paper titled, "Comparative Usability Evaluation", reported a study assessing the consistency of usability testing across organizations where nine independent organizations evaluated the usability of the same website, Microsoft Hotmail and found a wide difference in selection and application of methodology, resources applied, and problems reported. They said that out of the 310 different usability problems reported by the organization, only two problems were reported by six or more organizations, while 232 problems (75%) were uniquely reported, which means that no two teams reported the same problem. In concluding, they said, "our simple assumption that we are all doing the same and getting the same results in a usability test is plainly wrong".

Boss, QC [9] has identified the major problems faced by mobile users as, fewer visible options due to small screen size of the mobile device; trouble in handling GUIs like menus, buttons, hypertext links, and scroll bars; delays in navigation as a result of Network Bandwidth restrictions; and incompatible design across mobile phones. Charlton [10], in his post titled "Nielsen – Websites Need Mobile Versions" quoted Jakob Nielsen's verdict in his 'latest **Alertbox Column**' that "the mobile user experience on most websites, even when accessed on the best devices, leaves a lot to be desired, and companies need to optimize their sites for the small screen." Charlton listed the major mobile usability issues identified in that article by Jakob Nielsen as slow load times; too much scrolling; bloated pages; and JavaScript crashes. Friedman [11] posted an article in Smashing Magazine that listed the following usability problems: hidden log-in link; pop-ups for content presentation; dragging instead of vertical navigation; invisible links; visual noise; dead ends content blocks layering upon each other; dynamic navigation; drop-down menus and blinking images. Budiu and Nielsen [12] mentioned and discussed four main usability hurdles faced by mobile users as presented below:

- Mobile devices use small screens which mean that only few visible options at any given time can be

accommodated; making the users to depend on their short-term memory to build an understanding of an online information space and interactions with the device is thus made harder. Finding room for multiple windows or other interface solutions that support advanced behaviours like comparative product search is also hard.

- Awkward input for typing is a usability hurdle which users face because it is difficult to operate GUI widgets without a mouse, menus, buttons and hyperlinks, and because it takes longer time scrolling and is more prone to errors, whether they are touch activated or manipulated with a teensy trackball. Entering text is slow and littered with typos whether the device is touch activated or with dedicated mini-keyboards.

- Download delays is also a usability hurdle faced by users because getting to the next screen takes longer than it would on dial-up even when the device is using the supposedly faster 3G service.

- Mis-design sites is the last usability hurdle faced by users because websites are particularly optimized for desktop usability and as such they do not comply with the guidelines necessary for usable mobile access.

When conducting usability tests, consideration should be given to different categories of mobile websites as well as different categories of mobile devices for browsing the websites. Frederick and Lal [1] looked at five different website categories which are News Websites, Search Websites, Portal Websites, Services Websites and Media Sharing Websites and also showed how to apply best practices and design guidelines to create an effective website for a mobile device. They looked into twenty-five popular mobile websites and chose Bank of America, CNN, Flickr and Wikipedia websites as case studies representing Service websites, News websites, Media websites and Search websites. Their studies show the following about the four websites:

In the case of Bank of America, the mobile website contains fewer than 20 percent of the features in the desktop version of the website because a mobile user normally visits a bank for the purpose of either locating an ATM or to check or transfer his or her balance but the other services available in the desktop web site or bank branch are not useful in the circumstance.

In the case of CNN mobile website which is a representative of a news website, is made up of category headers and news title, which, when clicked, displays details of that category of news. The mobile website allows users to SMS or e-mails the news to another phone or e-mail address. Like in the case of the Bank of America mobile website, the CNN mobile website also has separate versions for older mobile phones with limited browser capability and for the latest smartphones so as to accommodate multiple devices. The smartphone version enables users to share via social network sites, like Facebook.

The Flickr mobile website represents the Media Sharing Website category which is about finding and sharing pictures and so the site allows for user login and search. Depending on the browser capability, Flickr can redirect users to different versions of the website without deviating from these core functionalities. Only the main functions are ported to the mobile version but the smartphone version also allows new account creation and has a link to the desktop website.

Wikipedia mobile website is in the category of Search Website which is all about instant information for visitors. The site used by users all over the world to get complete information about a particular topic. In the older phones with limited browser features and the language of the browser may not be known, the website allows for changing the language through settings. However, in smartphone Wikipedia can take the browser language and redirect the user to that language search and at the same time uses the space to display a feature article, which is dynamic information, with the search.

Fidgeon [2], identified three main categories of mobile devices based on devices' popularity which are Touch Screen Mobile Phones (TSMP), Non-Touch Screen Mobile Phones (NTSMP) (i.e mobile phones with physical keypads), and Tablet PCs. According to Fidgeon, our choice of devices for mobile usability testing session determines its success and so instead of focusing on 1 or 2 devices, it is recommended that we run mobile usability testing sessions across the three main categories of mobile devices mentioned above. Budiu and Nielsen [11], identified the following three distinct classes of mobile phones based on screen sizes: Feature phones which are the regular cell phones with tiny screen and a numeric keypad; Smartphones with mid-size screen and a full A-Z keypad; and Touch screen phones like iPhones with almost device-size screen and a true GUI driven by direct manipulation and touch gestures. Their studies show that the bigger the screen, the better the user experience when using websites and the average success rates for these classes of phones were given as 38% for Feature phones, 55% for Smartphones and 75% for Touch phones. Nielsen and Biudu [5] reported that across several user testing studies between 2009 and 2012, the average success rates for feature phones is 44%, smartphones is 55% and touch phones is 74% which, again, is an indication that usability

varies by mobile device category. The bigger the screen of the device category, the better the user experience when accessing the websites.

Adequate search on the subject of mobile usability issues were carried out as presented below: Schmeidl et al [13] carried out a study on usage and usability of the mobile website where usage scenario as well as the usability of mobile websites were compared to full websites. The results of their study show clearly that users prefer and effectively do benefit from mobile optimized versions. They also found out that content providers sometimes do not comprehend the mobile scenarios in which their sites are used but still go ahead to optimize the functionality at the wrong end. Shrestha [14] conducted research which presented the results of usability study in which the users' mobile web browsing experience was evaluated in comparison to desktop web browsing. The results of his tests show that the users' performance was poor on the mobile browser as users expected a similar experience to that on desktop; but for some users' familiarity of web on desktop helped instead to navigate easily on mobile web browser. He also discovered that participants had difficulty in locating the content in long narrow page, which in turn caused extensive scrolling.

Bruun et al [15] in their paper titled, "Let Your Users Do the Testing: A Comparison of Three Remote Asynchronous Usability Testing Methods" reported from empirical study where they systematically compared three methods for remote asynchronous usability testing: user-reported critical incidents, forum-based online reporting and discussion, and diary-based longitudinal user reporting. They also included conventional laboratory-based think-aloud testing as a benchmark for the remote methods. The results of their investigation indicated that each remote asynchronous usability method supported identification of a great number of usability problems, which is only about half of the problems identified with the conventional method but required significantly less time, thus making asynchronous methods an appealing possibility for usability testing in many software projects.

3. Experimental Procedures

3.1 Mobile Websites and Mobile Devices used in the Tests

The CNN mobile website (http://m.cnn.com) was selected to represent News Website, Google mobile website (http://www.google.com/mobile) to represent Search Websites, Facebook mobile website (http://m.facebook.com) to represent Service Websites, Yahoo mobile website (http://m.yahoo.com) to represent Portal Websites, and Flickr mobile website (http://m.flickr.com) to represent Media Sharing Websites. iPhone was selected to represent TSMP, Smartphone with physical keypad to represent NTSNP and iPad to represent Tablet PC.

3.2 Developing Usability Tasks

Although there are many usability issue of mobile websites mentioned in literature, but for the purpose of this paper, focus was placed on fifteen major usability issues which are specific to mobile websites and mobile devices since the study does not involve usability issues of normal PCs.
From the available literature on usability issues of mobile websites, fifteen important usability issues were identified and fifteen hypotheses that agreed with these usability issues were formulated as presented below.

Hypothesis 1: That when the mobile website is loaded it does not fit the screen of the mobile device.

Hypothesis 2: That because the mobile website automatically resizes in-browser and the mobile device zooms out to fit everything on screen; it makes the text unreadable forcing the user to zoom in.

Hypothesis 3: That the contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds.

Hypothesis 4: That the mobile website does not load as quickly as expected on the mobile device.

Hypothesis 5: That links in the mobile website are too close together to comfortably click using a thumb thereby frustrating the user when trying to navigate around the website.

Hypothesis 6: That links in the mobile website are not large enough to comfortably click using a thumb thereby frustrating the user when trying to navigate around the website.

Hypothesis 7: That some links in the mobile website contain misleading descriptions and do not lead to the destination they describe.

Hypothesis 8: That the use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user and can be frustrating.

Hypothesis 9: That the presence of dead links in the mobile website makes the site less usable.

Hypothesis 10: That the presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element.

Hypothesis 11: That videos and animations on the mobile website do not load on the mobile device.

Hypothesis 12: That forms and sign-ups are not easy to fill out using the mobile device.

Hypotheses 13: That the mobile website is not attractive and will not encourage the user stay on the site.

Hypotheses 14: That the necessity to engage in both

vertical and horizontal scrolls on the mobile device to view images that appear larger than the screen is annoying to the user.

Hypotheses 15: That entering text on the mobile device will be painfully slow and error-prone.

Some of these usability issues are related to the mobile website while others are related to the mobile devices. The hypotheses enabled series of usability test to be conducted on the mobile websites using the three mobile device categories that were mentioned earlier.

In order to test the hypotheses, usability testing was conducted on the five mobile websites listed above using the three mobile devices, iPhone, Smartphone with physical keypad and iPad.

Based on these hypotheses, five sets of 11 tasks were designed for each of the five websites. A typical task for the CNN mobile website (http://m.cnn.com) is shown in appendix I. Table 1 below summarises the tests carried out by the 15 users.

Table 1 Summary of the Tests Carried Out

S/NO	TEST NO.	WEBSITE URL	MOBILE DECICE USED
1	1.1	http://m.cnn.com	Smartphone with a physical
2	1.2	http://m.cnn.com	iPhone
3	1.3	http://m.cnn.com	iPad
4	2.1	http://www.google.com/mobile	Smartphone with a physical
5	2.2	http://www.google.com/mobile	iPhone
6	2.3	http://www.google.com/mobile	iPad
7	3.1	http://m.facebook.com/	Smartphone with a physical
8	3.2	http://m.facebook.com/	iPhone
9	3.3	http://m.facebook.com/	iPad
10	4.1	http://m.yahoo.com/	Smartphone with a physical
11	4.2	http://m.yahoo.com/	iPhone
12	4.3	http://m.yahoo.com/	iPad
13	5.1	http://m.flickr.com	Smartphone with a physical
14	5.2	http://m.flickr.com	iPhone
15	5.3	http://m.flickr.com	iPad

At the end of each test the tester would be asked to provide answers to the following questions:

1. What frustrated you most about this site when using the Smartphone, the touch screen phone and the tablet device?
2. What did you like about the site when using the Smartphone, the touch screen phone and the tablet device?
3. If you had a magic wand, how would you improve this site to be usable with all the mobile device categories you have used?
4. Roughly and for comparative purposes, how would you rate this site in terms of usability with each mobile device category you used on a scale of 0 – 10 with "0" for not at all usable, and "10" for highly usable)?

3.3 Usability Testing Procedures:

The remote usability testing method was used in this research. The method allows both tester and facilitator to work from their respective locations. The usability tests were conducted by UserTesting.com, an International organization that specializes in remote usability testing. The organization provides the fastest and cheapest usability testing on the market.

UserTesting.com website was accessed through the Internet and the mobile test form provided was filled. In the form, the URL of the mobile website to be tested, the mobile device category to be used, the number of users, the mindset they should have when conducting the tests, the tasks to be performed, and four questions users are to answer after performing the tests were specified in each test session. Altogether there were 75 test sessions, 15 sessions for CNN mobile web site; Google mobile web site; Facebook mobile website; Yahoo mobile website; and Flickr mobile website (3 sessions for the 5 mobile websites using the three mobile device categories, smartphone with physical keypad, iPhone and iPad). 15 users (5 for each of the 3 mobile devices, smartphone with physical keypad, iPhone and iPad) selected from a network of pre-screened users who are articulate and observant and who met specified demographics were engaged by UserTesting.com to perform the tests. Each of the users performed 15 tests (details of the 15 tests are shown in appendix I). By the think-aloud method, users performed the 11 tasks designed for each tests and their devices' screens and voices were recorded. The resulting videos were immediately made available online through the email address provided in the form for evaluation. All together there were 75 videos for the 75 tests for evaluation.

To ensure that there were no variability in the testing procedures, the type of network and type of mobile devices used in the tests, the author insisted that the user that conducts the first three tests with a particular smartphone, iPhone and iPad were the same user to perform the remaining similar tests. Although this arrangement was contrary to the remote usability testing procedures, the author had to incur extra expenses to have the tests

performed in this manner after explaining to the organization conducting the tests that the research was for academic purpose.

4. Results and Evaluations

4.1 Test Results for News Website

The CNN mobile website was used to represent News Websites. The test results for the non-touch screen phone (Android phone with physical keypad), touch screen phone (iPhone) and the tablet PC (iPad), for the CNN mobile website are as presented in Tables 2, 3 and 4 respectively. From the result for the non-touch screen phone in Table 2, it could be seen that out of the twelve applicable usability issues only **ONE** usability issue was found and that is "the contents in the home-page of the website is not digestible in 5 seconds." This result indicates that the CNN mobile website, representing News Websites, is highly usable. On rating the website in terms of usability with the non-touch screen phone on a scale of 0 to 10, an average of 7.4 was given by the five users that conducted the test. This rating was because most of the users do not find it easy to use the physical keyboard of the phone.

The result for the touch screen phone in Table 3 shows that, out of the fourteen applicable usability issues, **TWO** usability issues were found. The first usability issue is that "the contents in the home page of the mobile website are not digestible in 5 seconds." The second usability issue is that "the mobile website is not attractive and would not encourage the user stay on the site." An average rating of 9.6 on a scale of 1 to 10 for the website usability was given for the website. On the whole the usability result shows that the website is highly usable with touch screen phone.

The result for the tablet PC as shown in Table 4 is not for the mobile website because the users were automatically re-directed to the CNN full site and the test was conducted on that site. However the result for the full site indicates that, out of the fourteen usability issues, **FOUR** usability issues connected to the website when tablet PC is used to access the site were found. These usability issues include: "the contents in the home-page of the website is not digestible or memorisable in 5 seconds"; "links in the mobile website are too closed together to comfortably click using a thumb"; "links in the mobile website are not large enough to comfortably click using a thumb"; and "the mobile site is not attractive and will not encourage the user stay on the site." The fourth and last usability issue is controversial because only one user out of the five users that conducted the test found that as a usability issue. An average of 8.8 rating on a scale of 1 to 10 was given for the usability of the CNN full site.

4.2 Test Results for Search Websites

The Google mobile web site was used to represent Search Websites. The test results for the non-touch screen phone (Android phone with physical keyboard), touch screen phone (iPhone) and the tablet PC (iPad), for the Google mobile site are as presented in Tables 5, 6 and 7 respectively.

The result for the non-touch screen phone in Table 5 shows that out of the five users that conducted the test, only two were able to complete the test because users were redirected to the Google Apps for Android and the three other users could not navigate away from that site to the main Google site to conduct the test. For the two users who conducted the test only **TWO** usability issues out of the thirteen applicable usability issues were found, which are firstly, "the contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds" and secondly "the mobile web site is not attractive and will not encourage the user stay on the site." An average rating of **5** on a scale of 0 to 10 for the web site usability based on the two users that completed the test was given for this test. The rating value was as a result of the redirecting from the mobile website to the Apps site and not the functionality of the website.

For the result for the touch screen phone in Table 6, user 4 was not able to complete the test because users were redirected to Google Apps for iOS and user 4 was unable to navigate away from the Apps site to the Google main page to conduct the test. However three of the users were able to find **THREE** usability issues out of the fifteen usability issues been investigated. They include: "the contents in the home-page of the mobile website are not digestible or memorisable in 5 seconds"; "the links in the mobile website are not large enough to comfortably click using a thumb"; and "forms and sign-ups are not easy to fill out using the phone." The result however indicates high usability for the website. An average rating of **9** on a scale of 0 to 10 for the website usability based on four users was given for this test.

From the result for the tablet PC in Table 7, even though users were redirected to the Google Apps for iOS, they were able to navigate away from the Apps site to the Google main site to complete the test and out of the fifteen usability issues only **ONE** usability issue was found, indicating very high usability for the Google mobile site. The usability issue found is "the contents in the home-page of the mobile website are not digestible or memorisable in 5 seconds." An average rating of **9.4** on a scale of 0 to 10 for the web site usability based on five users was given for this test.

4.3 Test Results for Service Websites

The Facebook mobile website was used to represent Service Websites. The test results for the non-touch screen phone (Android phone with physical keypad), touch screen phone (iPhone) and the tablet PC (iPad), for the Facebook mobile site are as presented in Tables 8, 9 and 10 respectively.

As can be seen from the result for the non-touch screen phone in Table 8, user 3 and user 4 were not able to complete the test because they were not able to log on to Facebook to conduct the tasks marked with asterisk but **No** usability issue from among the thirteen applicable usability issues was found by the other three users that completed the test, indicating very high usability for the Facebook mobile website when non-touch screen phone is used. An average rating of **5.3** on a scale of 0 to 10 for the website usability based on three users was given for this test. This was because the users found it difficult to navigate with the keypad in completing the tasks and not at all related to the functionality of the Facebook mobile website.

The result for touch screen phone in Table 9 shows that **No** usability issue was found and this again indicates very high usability for the Facebook mobile website when touch screen phone is used. An average rating of **9.4** on a scale of 0 to 10 for the website usability based on the five users was given for this test which confirms the very high usability for the mobile website mentioned for this test.

For the result for the tablet PC in Table 10, only **ONE** usability issue out of the fifteen usability issues was found and this is still indicative of very high usability for the Facebook mobile website when tablet PC is used. The usability issue found is "the mobile website is not attractive and will not encourage the user stay on the site." An average rating of **9.1** on a scale of 0 to 10 for the website usability based on the five users was given, confirming that the Facebook mobile website is highly usable.

4.4 Test Results for Portal Websites

The Yahoo mobile website was used to represent Portal Websites. The test results for the non-touch screen phone (Android phone with physical keypad), touch screen phone (iPhone) and the tablet PC (iPad), for the Yahoo mobile site are as presented in Tables 11, 12 and 13 respectively.

From the result for the non-touch screen phone in Table 11, it could be seen that all the users were unable to perform task 11 because they did not find any video or animation on the site, but out of the thirteen applicable usability issues only **ONE** usability issue was found and it is that, "the contents in the home-page of the mobile website is not digestible in 5 seconds." An average rating of **6.4** on a scale of 1 to 10 for website usability based on five users was given for this site. The result indicates very high usability for the Yahoo mobile website even though the rating is not high because that was due to the difficulty experience by users in navigating with the physical keypad.

The result for the touch screen phone in Table 12 shows that out of the fifteen usability issues, **THREE** usability issues were found and they include: firstly, "the contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds"; secondly, "the presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element"; and thirdly, "the mobile website is not attractive and will not encourage the user stay on the site." An average rating of **8.25** on a scale of 0 to 10 for the website usability based on the five users was given for this site. The result indicates that the Yahoo mobile website is usable.

For the result for the tablet PC in Table 13, **TWO** usability issues out of the fifteen usability issues were found. They are: firstly, "the contents of the home-page of the mobile website is not digestible in 5 seconds", secondly, "the mobile website is not attractive and will not encourage the user stay on the site." An average rating of **7.4** on a scale of 0 to 10 for the website usability based on five users was given for this web site. The result here also indicates that the Yahoo mobile site is usable.

4.5 Test Results for Media Sharing Websites

The Flickr mobile website was used to represent Media Sharing Websites. The test results for the non-touch screen phone (Android phone with physical keypad), touch screen phone (iPhone) and the tablet PC (iPad), for the Flickr mobile site are as presented in Tables 14, 15 and 16 respectively.

The result for the non-touch screen phone in Table 14 shows that out of the twelve applicable usability issue, only one usability issue based on the five users was found and that is "the mobile web site does not load as quickly as expected on the phone." An average rating of 5.8 on a scale of 0 to 10 for the website usability based on five users was given for this site. The result shows that the Flickr mobile site is usable as far as the criteria being used are concern because only one usability issue was found even though the rating was not high. The low rating was

because users had difficulty in navigating with the keypad and trying to login to Flickr site with their passwords.

The result for touch screen phone in Table 15 shows that out of the fourteen applicable usability issues, two usability issues were found and include: firstly, "the mobile website is not attractive and will not encourage the user stay on the site", secondly, "the mobile website does not load as quickly as expected on the phone." An average rating of 6.2 on a scale of 0 to 10 for the website usability based on five users was given for this site. The result indicates that the website is usable as far as the usability criteria used are concern. The low rating is due to other usability issues that were not among the fifteen considered in this project.

The result for the tablet PC in Table 16 shows that out of the fourteen applicable usability issues, only one usability issue was found and that is, "the mobile website is not attractive and will not encourage the user stay on the site." An average rating of 9.15 on a scale of 0 to 10 for the website usability based on five users was given for this site. The result indicates that the Flickr mobile website is highly usable with tablet PC.

5. Conclusions and Recommendations

5.1 Conclusions

On the basis of the criteria of fifteen usability issues used as hypotheses to test the mobile website categories with the three mobile device categories and in line with the aims and objectives of the research, all the websites, namely, News Websites, Search Websites, Portal Websites and Media Sharing Websites were found to be usable with all the mobile devices, which are non-touch screen phones, touch screen phones and tablet PCs, however, all the users who carried out the tests found difficulty in navigating with the physical keypad of the non-touch screen phones. It has been established in this work that all the five mobile websites are usable with all the three categories of the mobile devices indicating that the mobile device categories has little or no influence on the mobile websites, although there were some limitations to the usability with the non-touch screen phones in areas of navigation with the keypad and so in the opinion of the users who conducted the usability tests, mobile phones with both physical keypad and touch screen is preferable to those with physical keypad alone.

Due to the fact that the hypotheses used to test the websites' usability were limited to fifteen, it is likely that the websites may contain other usability issues that were not investigated. In the light of this, the research area is open to further research using new sets of hypotheses to fish out other usability issues in the websites using the three categories of mobile devices.

The following conclusions are also drawn for each of the five mobile websites:

- The usability of the News Mobile Website is better with touch screen phones followed by tablet PCs then non-touch screen phones.
- The usability of the Search mobile Websites is better with tablet PCs followed by touch screen phones then non-touch screen phones.
- The usability of Service mobile Websites is better with touch screen phones followed by tablet PCs then non-touch screen phone.
- The usability of the Portal mobile Websites with both the touch screen phone and the tablet PC are collectively better then the non-touch screen phones.
- The usability of the Media Sharing mobile Websites is better with tablet PCs followed by touch screen phones then non-touch screen phones.

5.2 Recommendations

Based on the results of usability tests conducted on the five mobile web sites with the three categories of mobile devices, the following recommendations have been given:

- From among the mobile device categories, touch screen phones followed by tablet PCs are recommended for News Websites.
- Tablet PCs followed by touch screen phones are recommended for Search Websites.
- Touch screen phones followed by tablet PCs are recommended for Service Websites
- Tablet PCs followed by touch screen phones are recommended for Portal Websites.
- Tablet PCs followed by touch screen phones are recommended for Media Sharing Websites.
- Phones with both physical keypad and touch screen are recommended in place of those with only physical keyboard for all the websites.
- Based on the difficulty experienced by users for the Google mobile website where users were redirected to Google Apps site, it is recommended that all mobile websites should give users options to access an Apps site rather than automatically redirecting them.
- Further research in mobile website usability is suggested as follows:
  - Similar project topic using different set of mobile websites as case studies for the five categories of

mobile websites and the mobile phone with only physical keypad replaced with phone having combine physical keyboard and touch screen.

- Similar project topic using different set of usability issues or hypotheses as criteria but the mobile phone with only physical keypad should be replaced with phone having combine physical keypad and touch screen.

Appendix 1: Task Table for Test 1.1

Test No.	Website URL	Task No.	Tasks
1.1	http://m.cnn.com	1	Use any smartphone with a physical keypad to load this mobile website. Does it fit the screen of the phone?
		2	Use the same phone to find the latest news and try to read it. Is the text unreadable unless you zoom in to make it readable?
		3	Use the same phone to glance at the contents in the home-page of the mobile website for 5 seconds. Are the contents of the home-page digestible in 5 seconds?
		4	Use the same phone to find current weather around the world. Type in "London, AR" and submit to view the current weather. Does the site load as quickly as you expected?
		5	Use the same phone to navigate around the site and click the available links. i) Are you frustrated because the links are too close together to comfortably click using a thumb? ii) Are you frustrated because the links are not large enough to comfortably click using a thumb? iii) Are there some links that contains misleading descriptions that do not lead to the desired destination? iv) Are there dead links on the site that make the site less usable?
		6	Use the same phone to browse on the website for 10 seconds. i) Are you frustrated due to interruption during the browsing session by the use of pop-ups on the site for content presentation? Ii) Are there blinking images around the site that make it extremely hard for you to focus on one single site element?
		7	Use the same phone to load videos and animations on the site. Are they available on the site and do they load on the phone?
		8	Use the same phone and try to fill out a form and sign-up to the site. Are there forms and sign-ups on the site and did you find it easy to fill them out using the phone?
		9	Using this phone to access the website, did you find the site attractive and were you encouraged to stay on the site?
		10	Try to view images if any on this site on the phone. Did you find the necessity to engage in both vertical and horizontal scrolls on the phone to view images annoying to you?
		11	Using the phone, try to locate on the site where you have to enter text and type something. Did you find entering text on the phone painfully slow and error-prone?

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Author's Biography

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Table 2: RESULT OF TEST 1.1

Usability Issues	Number of Usability Issues Found by each User in CNN Mobile Web Site with Non-Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1. The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	YES	YES	YES	NO	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NA	NA	NA	NA	NA
6.Links in the mobile website are not large enough to comfortably click using a thumb	NA	NA	NA	NA	NA
7.Some links in the mobile web site contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile web site for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile web site makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile web site do not load on the phone	NO	NO	NO	NO	*
12.Forms and sign-ups are not easy to fill out using the phone	NA	NA	NA	NA	NA
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	*
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	1				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 3: RESULT OF TEST 1.2

Usability Issues	Number of Usability Issues Found by each User in CNN Mobile Website with Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	YES	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile web site makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the phone	NO	NO	NO	NO	NO
12.Forms and sign-ups are not easy to fill out using the phone	NA	NA	NA	NA	NA
13.The mobile website is not attractive and will not encourage the user stay on the site	YES	NO	NO	YES	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	*	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	2				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 4: Result of Test 1.3

Usability Issues	Number of Usability Issues Found by each User in CNN Mobile Website with Tablet Device				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the iPad when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the iPad is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	YES	YES	YES	YES	YES
4.The mobile website does not load as quickly as expected on the iPad	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	YES	YES	YES	NO	YES
6.Links in the mobile website are not large enough to comfortably click using a thumb	YES	YES	YES	NO	YES
7.Some links in the mobile web site contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the iPad	NO	NO	NO	NO	NO
12.Forms and sign-ups are not easy to fill out using the iPad	NA	NA	NA	NA	NA
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	YES	NO	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	4				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 5: Result of Test 2.1

Usability Issues	Number of Usability Issues Found by each User in Google Mobile Website with Non-Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	*	NO	NO	*	*
2.The text on the screen of the phone is unreadable unless the user zooms in	*	NO	NO	*	*
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	*	YES	NO	*	*
4.The mobile website does not load as quickly as expected on the phone	*	*	NO	*	*
5.Links in the mobile website are too close together to comfortably click using a thumb	*	*	NO	*	*
6.Links in the mobile website are not large enough to comfortably click using a thumb	NA	NA	NA	NA	NA
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NA	NA	NA	NA	NA
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	*	NO	NO	*	*
9.The presence of dead links in the mobile website makes the site less usable	*	NO	NO	*	*
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	*	NO	NO	*	*
11.Videos and animations on the mobile website do not load on the phone	*	*	NO	*	*
12.Forms and sign-ups are not easy to fill out using the phone	*	*	NO	*	*
13.The mobile website is not attractive and will not encourage the user stay on the site	*	YES	YES	*	*
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	*	NO	NO	*	*
15.Entering text on the phone will be painfully slow and error-prone	*	NO	NO	*	*
Total number of usability issues found	**1**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform Task

Table 6: RESULT OF TEST 2.2

Usability Issues	Number of Usability Issues Found by each User in Google Mobile Website with Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	*	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	*	NO	*	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	*	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	YES	NO	NO	*	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	*	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	*	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	*	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	*	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	*	NO
11.Videos and animations on the mobile website do not load on the phone	NO	NO	NO	*	NO
12.Forms and sign-ups are not easy to fill out using the phone	YES	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	*	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	*	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	*	NO
Total number of usability issues found	**3**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or unable to perform task

Table 7: Result of Test 2.3

Usability Issues	Number of Usability Issues Found by each User in Google Mobile Website with Tablet Device				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the iPad when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the iPad is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	*	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the iPad	NO	NO	NO	NO	*
12.Forms and sign-ups are not easy to fill out using the iPad	NO	NO	NO	NO	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	**1**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or unable to perform task

Table 8: Result of Test 3.1

Usability Issues	Number of Usability Issues Found by each User in Facebook Mobile Website with Non-Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	*	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NA	NA	NA	NA	NA
6.Links in the mobile website are not large enough to comfortably click using a thumb	NA	NA	NA	NA	NA
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	*	*	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	*	NO	NO
9.The presence of dead links in the mobile web site makes the site less usable	NO	NO	*	*	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	*	NO	NO
11.Videos and animations on the mobile website do not load on the phone	NO	NO	*	*	NO
12.Forms and sign-ups are not easy to fill out using the phone	*	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	*	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	*	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	*	NO
Total number of usability issues found	**0**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 9: Result of Test 3.2

Usability Issues	Number of Usability Issues Found by each User in Facebook Mobile Website with Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile web site makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the phone	*	*	*	NO	NO
12.Forms and sign-ups are not easy to fill out using the phone	NO	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	*	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	**0**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or unable to perform task

Table 10: Result of Test 3.3

Usability Issues	Number of Usability Issues Found by each User in Facebook Mobile Website with Tablet Device				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the iPad when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the iPad is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the iPad	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the phone	*	NO	*	NO	NO
12.Forms and sign-ups are not easy to fill out using the iPad	NO	NO	NO	NO	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	NO	YES
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	1				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or unable to perform task

Table 11: Result of Test 4.1

Usability Issues	Number of Usability Issues Found by each User in Yahoo Mobile Website with Non-Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	YES	NO	NO	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NA	NA	NA	NA	NA
6.Links in the mobile website are not large enough to comfortably click using a thumb	NA	NA	NA	NA	NA
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile web site makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the phone	*	*	*	*	*
12.Forms and sign-ups are not easy to fill out using the phone	NO	NO	*	NO	*
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	NO	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	**1**				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 12: Result of Test 4.2

Usability Issues	Number of Usability Issues Found by each User in Yahoo Mobile Website with Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	YES	NO	NO	YES	YES
4.The mobile website does not load as quickly as expected on the phone	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	YES	NO	NO	YES	YES
11.Videos and animations on the mobile website do not load on the phone	*	*	NO	*	*
12.Forms and sign-ups are not easy to fill out using the phone	*	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	YES	NO	NO	NO	YES
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	**3**				

key: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or UNABLE to perform task

Table 13: Result of Test 4.3

Usability Issues	Number of Usability Issues Found by each User in Yahoo Mobile Website with Tablet Device				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the iPad when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the iPad is unreadable unless the user zooms in	NO	NO	NO	NO	NO
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	YES	NO	NO	NO
4.The mobile website does not load as quickly as expected on the iPad	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile web site makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the iPad	NO	NO	NO	NO	NO
12.Forms and sign-ups are not easy to fill out using the iPad	NO	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	YES	YES	YES	YES	YES
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	2				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"*"** means user skipped task or unable to perform task

Table14: Result of Test 5.1

Usability Issues	Number of Usability Issues Found by each User in Flickr Mobile Website with Non-Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NA	NA	NA	NA	NA
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the phone	NO	YES	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NA	NA	NA	NA	NA
6.Links in the mobile website are not large enough to comfortably click using a thumb	NA	NA	NA	NA	NA
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	*	*
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	*
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	*	*
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	*
11.Videos and animations on the mobile website do not load on the phone	*	NO	NO	*	*
12.Forms and sign-ups are not easy to fill out using the phone	*	*	NO	NO	*
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	NO	*	NO	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	*	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	*	NO
Total number of usability issues found	1				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 15: Result of Test 5.2

Usability Issues	Number of Usability Issues Found by each User in Flickr Mobile Website with Touch Screen phone				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the phone when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the phone is unreadable unless the user zooms in	NA	NA	NA	NA	NA
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the phone	YES	NO	NO	NO	YES
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the phone	NO	NO	NO	*	*
12.Forms and sign-ups are not easy to fill out using the phone	*	NO	NO	*	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	YES	YES	NO	YES	NO
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the phone will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	2				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task

Table 16: Result of Test 5.3

Usability Issues	Number of Usability Issues Found by each User in Flickr Mobile Website with Tablet Device				
	User 1	User 2	User 3	User 4	User 5
1.The mobile website does not fit the screen of the iPad when loaded	NO	NO	NO	NO	NO
2.The text on the screen of the iPad is unreadable unless the user zooms in	NA	NA	NA	NA	NA
3.The contents in the home-page of the mobile website is not digestible or memorisable in 5 seconds	NO	NO	NO	NO	NO
4.The mobile website does not load as quickly as expected on the iPad	NO	NO	NO	NO	NO
5.Links in the mobile website are too close together to comfortably click using a thumb	NO	NO	NO	NO	NO
6.Links in the mobile website are not large enough to comfortably click using a thumb	NO	NO	NO	NO	NO
7.Some links in the mobile website contains misleading descriptions and do not lead to the destination they describe	NO	NO	NO	NO	NO
8.The use of pop-ups in the mobile website for content presentation interrupts the browsing session of the user	NO	NO	NO	NO	NO
9.The presence of dead links in the mobile website makes the site less usable	NO	NO	NO	NO	NO
10.The presence of blinking images around the mobile website makes it extremely hard for the user to focus on one single site element	NO	NO	NO	NO	NO
11.Videos and animations on the mobile website do not load on the iPad	*	NO	NO	NO	NO
12.Forms and sign-ups are not easy to fill out using the iPad	NO	NO	-	NO	NO
13.The mobile website is not attractive and will not encourage the user stay on the site	NO	YES	YES	YES	YES
14.The necessity to engage in both vertical and horizontal scrolls on the phone to view images that appear larger than the screen is annoying to the user	NO	NO	NO	NO	NO
15.Entering text on the iPad will be painfully slow and error-prone	NO	NO	NO	NO	NO
Total number of usability issues found	1				

KEY: **"NO"** means this usability issue was not found; **"YES"** means usability issue found; **"NA"**, means not applicable; **"*"** means user skipped task or unable to perform task