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Usability Evaluation of Mobile Commerce Website on Internet – An empirical study

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Abstract: Mobile network creates an environment that is convenient with fast communication and no localization restriction in which it is a perfect network environment for mobile commerce websites in developing business information applications and services. Two Shopping Malls also launched many mobile commerce website services to capture the gradually growing market. Depending on how convenient and fast these services that the website provides consumers, the quality of these services will determine the consumers' decision to leave or stay on the website, and the usability of the website will be their deciding factor. This study reviewed how a website with better usability that offers consumers high efficiency and effectiveness with the ease of learning and memorizing have a strong influence over the buying behavior of consumers. This study used experimental questionnaire method to evaluate the usability in different Shopping Mall websites. Before the experiment, this study analyzed what would the expected processes and problems would be for these websites. After the experiment, this study compared the data retrieved from the questionnaires with the experiments of actual problems. The results showed that the psychology in the questionnaire and the physiology in the real-life situation of subjects corresponded with each other. In the usability guidelines, there are significant differences between Two Shopping Malls in the area of effectiveness and learning abilities. After the cross examination of the speculated expectation of the processes and problems on these websites with the actual problems in real-time, the results showed top three issues that were found on second Shopping Mall's "Registration Process" played huge influences on the consumer's behavior. This study proposed various ways of website improvements for better usability after analyzing the problems resulted from poor user interface design with the services provided on this website.

Keywords: mobile-commerce, usability, usability evaluation, experimental questionnaire method

1. INTRODUCTION

Current e-commerce providers, engaged through mobile devices, will find advantage in developing unique m-commerce value propositions founded upon the specific dimensions of ubiquity, convenience, localization, and personalization. A consumer orientation that provides value-for-time functions to create a new value curve may achieve a competitive advantage over traditional e-commerce models replicated for mobile business [4]. For enterprise, novel service or service model through mobile devices can explore a whole new business territory. Nowadays, mobile internet and information technology develop rapidly. Undoubtedly, consumers use mobile devices to communicate with the enterprise mobile commerce site becomes an indispensable information exchanging systems. Actually, mobile commerce sites rarely design for small screen, consumer browsers the same content as desktop version on a small screen view. The recommendations refer to delivered content and not to the processes by which it is created, nor to the devices or user agents to which it is delivered. It is primarily directed at creators, maintainers and operators of Web sites. Readers of this document are expected to

be familiar with the creation of Web sites, and to have a general familiarity with the technologies involved, such as Web servers and HTTP. Readers are not expected to have a background in mobile-specific technologies [13]. However, the Best Practices are not unchanged and not correct to all the mobile commerce websites [11]. Therefore, it is necessary to understand environment of the mobile commerce site and analyze the impact factors of usability guidelines for the design of mobile commerce web. Experiment of evaluating usability is able to collect qualitative and quantitative data to discuss appropriate usability of mobile commerce site then enhance the communication quality between enterprise and consumers. The main motivation of this study is to create new business opportunities, make more profit for business and benefit for consumers.

2. LITERATURE REVIEW

2.1 Definition, application and constrains of Mobile commerce

Mobile commerce (m-commerce) is defined as people or enterprises that can buy or sell products and services, search information or exchange goods through the use of wireless mobile devices [6]. M-commerce is considered the next generation of e-commerce and this particular technology will allow users to shop through the Internet without a plug-in terminal. Barely before Internet-facilitated e-commerce has begun to take hold, a new wave of technology-driven commerce has started — mobile (m-) commerce. Fuelled by the increasing saturation of mobile technology, such as phones and personal digital assistants (PDAs), m-commerce promises to inject considerable change into the way certain activities are conducted. Equipped with micro-browsers and other mobile applications, the new range of mobile technologies offer the Internet ‘in your pocket’ for which the consumer possibilities are endless, including banking, booking or buying tickets, shopping and real-time news [1]. Clarke follows four major value proposition attributes then lists the application of M-commerce as figure 1 which illustrates some possible m-commerce applications which manifest the specified value propositions. Each application provides the user with value that cannot be found through traditional e-commerce. For example, a person who is waiting to check-out at the local grocery, and therefore is unable to access conventional e-commerce, may exercise this time to use their wireless PDA to: move monies between personal bank accounts (convenience), receive an e-mail reminder to pick-up their dry-cleaning (ubiquity), and watch a tailored promotion (personalization) for a product available at a nearby point-of-purchase display (localization). In the past, the time of queuing has eluded e-commerce providers, but now, mobile devices offer this same person greater access to valuable services [4].

Figure 1. M-Commerce Applications

Value proposition attributes	Application
Ubiquity	(1)news (2)sports scores (3)stock prices (4)travel information (5)weather
Convenience	(1)banking (2)communication (3)gaming (4)entertainment (5)mobile payment systems (6)retailing (7) videoconferencing
Localization	(1)coupons (2)customer service (3)dispatch/scheduling (4)discounting (5)emergency services (6)supply chain management
Personalization	(1)advertising (2)database development (3)knowledge management systems

Mobile commerce has many advantages obviously but still exist some constrains and problems such as Figure 2. [9].

Figure 2. Constrains and problems of Mobile commerce

Origin of constraints	Reasons
Mobile Device	(1)screen and the keyboard is too small (2)limit calculate capacity, memory and hard disk capacity (3)short battery life (4) complex text input mechanism (5) data storage and transmission errors at higher risk (6) low resolution (7) not user-friendly interface (8) Restricted graphical display capabilities
Mobile Service	(1) restricted bandwidth (2) unstable connection (3) low predictability (4) the lack of a standard protocol

2.2 Definition, evaluating principles and methodology of usability

Usability is defined as concepts of user-centered design. It's one of the key concepts in HCI (Human-Computer Interaction) research originally. Usability can contact the user's experience and extended to different products and services nowadays.

ISO (International Standards Organization) offer the definition of usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Usability is about [5]:

- (1) Effectiveness - can users complete tasks, achieve goals with the product, i.e. do what they want to do?
- (2) Efficiency - how much effort do users require to do this? (Often measured in time)
- (3) Satisfaction – what do users think about the products ease of use?

Nielsen offers the concept of Usability. Usability is not a single, one-dimensional property of a user interface. Usability has multiple components and is traditionally associated with these five usability attributes^[10]:

(1) Learnability : The system should be easy to learn so that the user can rapidly start getting some work done with the system.

(2) Efficiency: The system should be efficient to use, so that once the user has learned the system, a high level of productivity is possible.

(3) Memorability: The system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.

(4) Errors: The system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them, Further, catastrophic errors must not occur.

(5) Satisfaction: The system should be pleasant to use, so that users are subjectively satisfied when using it.

Nielsen offers nine research and evaluating methodology ^[10]:

(1) Heuristic evaluation: Heuristic evaluation is done by looking at an interface and trying to come up with an opinion about what is good and bad about the interface. Ideally people would conduct such evaluations according to certain rules, such as those listed in typical guidelines documents. Some collections of usability guidelines have on the order of one thousand rules to follow, however, and are therefore seen as intimidating by developers. Most people probably perform some kind of heuristic evaluation on the basis of their own intuition and common sense instead.

(2) Performance Measure: Performance Measure is the process of collecting, analyzing and/or reporting information regarding the performance of an individual, group, organization, system or component. It can involve studying processes/strategies within organizations, or studying engineering processes/parameters/phenomena, to see whether output are in line with what was intended or should have been achieved.

(3) Thinking aloud: Thinking aloud may be the single most valuable usability engineering method. Basically, a think aloud test involves having a test subject use the system while continuously. By verbalizing their thoughts, the test users enable us to understand how they view the computer system, and this again makes it easy to identify the major misconceptions. One gets a very direct understanding of what parts of the dialogue cause the most problem, because the thinking aloud method shows how users interpret each individual interface item.

(4) Observation: Observation is the active acquisition of information from a primary source. In living beings, observation employs the senses. In science, observation can also involve the recording of data via the use of instruments.

(5) Questionnaires: Questionnaire is a research instrument consisting of a series of questions and other

prompts for the purpose of gathering information from respondents. Although they are often designed for statistical analysis of the responses, this is not always the case.

(6) Interviewing: Interviewing, when considered as a method for conducting qualitative research, is a technique used to understand the experiences of others. Interviewing differs from other methods of data collection in that it is often more exploratory in nature, and allows for more flexibility. Interviewing stems from the desire to know more about the people around us and to better understand how the people around us view the world we live in: “At the heart of interviewing research is an interest in other individuals’ stories because they are of worth.

(7) Focus groups: A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members.

(8) Logging actual use: Logging involves having the computer automatically collect statistics about the detailed use of the system. It is useful because it shows how users perform their actual work and because it is easy to automatically collect data from a large number of users working under different circumstances. Typically, an interface log will contain statistics about the frequency with which each user has used each feature in the program and the frequency with which various events of interest (such as error messages) have occurred. Statistics showing the frequency of use of commands and other system features can be used to optimize frequently used features and to identify the features that are rarely used or not used. Statistics showing the frequency of various error situations and the use of online help can be used to improve the usability of future releases of the system by redesigning the features causing the most errors and most access for online help. This technique can be used at the test or deployment stages of software development.

(9) User feedback: User feedback is initiated by users so it shows their immediate and processing concerns.

ISO 9241-11 explains how to identify the information that it is necessary to take into account when specifying or evaluating usability in terms of measures of user performance and satisfaction. Guidance is given on how to describe the context of use of the product and the measures of usability in an explicit way. It includes an explanation of how the usability of a product can be specified and evaluated as part of a quality system, for example one that conforms to ISO 9001. It also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the quality of the whole work system in use [5].

Recent years, in the human machine interface field develops many questionnaires to evaluate the usability such as SUS(System Usability Scale), QUIS(Questionnaire for User Interface), CSUQ(Computer System Usability Questionnaire) and WAMMI(Website Analysis and Measurement Inventory)^[2,3,7,8], as shown in Figure3.

Figure 3. Questionnaires for evaluating the usability

Title of Questionnaire	Abbreviation	Organization	Reliability
System Usability Scale	SUS	DEC	0.85
Questionnaire for User Interface	QUIS	HCIL	0.94
Computer System Usability Questionnaire	CSUQ	IBM	0.95
Website Analysis and Measurement Inventory	WAMMI	HFRG	0.96

SUS、QUIS、CSUQ and WAMMI can be the questionnaires to evaluate website. This study will integrate items of aforementioned questionnaires to measure the cognitive level of consumers on mobile commerce website.

3. EXPERIMENT DESIGN

3.1 Select experimental platform

This study aims to construct a network environment under the mobile commerce shopping process. The real user experience will be collected after browsing the website to measure the usability of mobile commerce. The “7net” and “YAHOO shopping center” are selected as the experimental platforms.

3.2 Screening experimental subjects

To avoid testers rely the past experiences and impressions to complete the test task. This study screens the thirty subjects who don't have previous using experience as the testers to detect the usability of the mobile commerce.

4. EMPIRICAL ANALYSIS

4.1 Questionnaires distributed and Reliability Analysis

This study samples the 35 testers from campus randomly on Dec. 20, 2012 to Jan. 8, 2013. Two of them did qualify and three of them leave the experiment midway, therefore, effective subjects in this study are 30.

This study use Cronbach's α value to verify the reliability of questionnaire and follow Nunnally's principle to judge the internal consistency of the questions^[12]. If the Cronbach's α value is larger than 0.70, the reliability is high; the Cronbach's α value is between 0.35 to 0.70, the reliability is medium; the Cronbach's α value is lower than 0.35, the reliability is relatively low. In this study, the Cronbach's α value 0.932 is larger than 0.70, the reliability is high and the internal consistency is acceptable.

4.2 Results

4.2.1 Descriptive statistical analysis of the questionnaire

In Figure 4, subjects give higher score 3.30 in average on “7net” than 3.15 in average on “YAHOO shipping center”. Most answers lie in between general and do not agree (average is 2 to 3). Users give 3.93 highest score in the thirteenth positive question and 2.13 lowest score in the nineteenth negative question on “7net”. Users can find the information quickly and successfully when web site design user-friendly and use easy wording to express.

Figure 4. The statistical analysis of “7net” mobile commerce web site

Variables	Questions	Mean	Standard deviation
Efficiency	5	3.24	0.89
Effectiveness	5	3.70	0.71
Learnability	5	2.91	0.76
Memorability	5	3.38	0.74
	average	3.30	0.78

Figure 5. The statistical analysis of “YAHOO shipping center” mobile commerce web site

Variables	Questions	Mean	Standard deviation
Efficiency	5	3.10	0.92
Effectiveness	5	3.41	0.74
Learnability	5	2.97	0.92
Memorability	5	3.13	0.92
	average	3.15	0.88

4.2.2 Statistical Analysis of Mobile Commerce Website Usability

The statistical analysis of four research variables in different web site is shown as Figure 6. We can understand the

testers in “7net” web site have better performance on efficiency, effectiveness, learnability and memorability than testers in “Yahoo” web site. Results show subjects in the experiment are consistent with the questionnaire , the psychological and cognitive condition of subjects had no difference in the actual operation.

Figure 6. The statistical analysis of four research variables in different web

Research variables	Web site	Numbers	Mean	Standard deviation
Efficiency	Yahoo	15	404.6	157.56
	7net	15	345	153.27
Effectiveness (completion rate multiplied by the correct rate)	Yahoo	15	0.66	0.12
	7net	15	0.83	0.08
Learnability	Yahoo	15	11.33	5.92
	7net	15	3.67	2.26
Memorability (ratio)	Yahoo	15	2.27	1.91
	7net	15	2.45	0.85

4.2.3 Research hypothesis testing

This study runs independent samples T-test for four variables and the results are shown as Figure 7.

Figure 7. Independent samples T-test results for four variables

Variables	YAHOO	7net	t	Significance
	Mean			
Efficiency	404.60	345.00	1.05	0.15
completion rate multiplied by the correct rate	0.66	0.83	-4.45	0.00 *
Learnability	11.33	3.67	4.68	0.00 *
Memorability ratio	2.27	2.45	-0.34	0.37

*p<0.05

5. CONCLUSIONS

The purposes of this study is to realize the current situation of mobile commerce, Clarify the impact factors of usability guidelines for the design of mobile commerce web and discuss the evaluating model of the mobile commerce website and evaluate the usability to understand the differences and problems from different users by using mobile commerce website and make recommendations for improvement.

Figure 9. The results of empirical analysis

Events	Hypothesis	Results
H1	If different mobile commerce website exists different usability in efficiency	Not significant
H2	If different mobile commerce website exists different usability in effectiveness	significant
H3	If different mobile commerce website exists different usability in learnability	significant
H4	If different mobile commerce website exists different usability in memorability	Not significant

(1) If different mobile commerce website exists different usability in efficiency

The difference between “7net” and “Yahoo shopping center” is not significant in efficiency. The reason maybe the subjects in experiment had no experience in such experimental platform so the operational time is not different significantly. The mean of “7net” (Mean=345.00) is larger than mean in “Yahoo shopping center” (Mean=404.60), this represents the “7net” has better performance than “Yahoo shopping center” in efficiency. The reason maybe the subjects take a lot of time in task 2 to solve registration problem at “Yahoo shopping

center”.

(2) If different mobile commerce website exists different usability in effectiveness

The difference between “7net” and “Yahoo shopping center” is significant in effectiveness. The reason maybe the “7net” web site gives a more intuitive feedback such as better consistency and layout. Subjects only use less clicks to complete the task.

(3) If different mobile commerce website exists different usability in learnability

The difference between “7net” and “Yahoo shopping center” is significant in learnability. The reason maybe the subjects take a lot of time in task 2 to solve registration problem at “Yahoo shopping center” and add more incorrect click numbers.

(4) If different mobile commerce website exists different usability in memorability

The difference between “7net” and “Yahoo shopping center” is not significant in memorability. The reason maybe the subjects can reduce the operational time after searching product 1 but don’t reflect in memorability.

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