HCI Knowledge for UX Practices in the Web Development Process

Idyawati Hussein, Murni Mahmud, and Abu Osman Md Tap

School of Informatics Science, Universiti Malaysia Sabah, International Campus Labuan, Jalan Sungai Pagar, 87000 Labuan F.T., Malaysia
Kulliyyah of Information and Communication Technology, International Islamic University Malaysia (IIUM), Gombak Campus, P.O. Box 10, 50728 Kuala Lumpur, Malaysia
idyawati@gmail.com, {murni,abuosman}@iium.edu.my

Abstract. Web development must consider good design in order to satisfy user interaction. However, for many users, the interfaces of Web applications are still difficult and frustrating to use. Frustration may not only result in personal dissatisfaction and inefficient use, but may also have a bad effect in the workplace. One experience with misleading data or unexpected results will undermine a person's willingness to use an application for a long time. Knowledge of Human-Computer Interaction (HCI) supports developers in designing useful, usable and pleasant computing technologies. However, regardless of this knowledge, practice of the waterfall approach is the main methodology, embedded and integrated in well-established procedures. This study reports the results of a survey of 82 individual practitioners who received a formal HCI and HCI-related education in their Web development projects. The study used a Likert-scale metric to measure the prevailing User Experience (UX) in explicit practice which is rooted in the HCI-related discipline. The findings indicate that enforcement of the use of HCI knowledge can strengthen the policy of integrating UX principles in the Web development process by the appropriate authority, e.g. university department for project assignment.

1 Introduction

Human-Computer Interaction (HCI) education was introduced in line with the merging of computer technologies in the 1980s, interaction design courses during the dotcom burst of the 1990s and now as user experience (UX) in ubiquitous computing (ubicomp.) The focus of HCI has evolved from usability-centred to UX-centred via a process called User Centred Design (UCD) or Human Centred Design (HCD). However, not much is known about the current state of UX practice and its relation to HCI education.

The number of education programmes and courses in HCI on offer at universities and other education organisations throughout the world continues to increase [1][2][3]. In Malaysia, for instance, 34 out of 40 public and private universities (85%) offer HCI courses with various names [4]. This fundamental knowledge should prepare IT practitioners and professionals to improve the quality of IT products, systems and services in terms of usability and total user experience, especially in Web applications.

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This is due to the Malaysian government's mission to enforce all systems to be online by the year 2015 [5]. However, the online Road Transport Department (RTD) system had very few users (10,017 out of more than 2 million motorists) of the system online. The conclusion was that the online systems should conform to usability standard, so that motorists would not waste their time queuing at the counter to renew their licence. The question is, what impact does HCI education have on the usability and UX of the online systems that are being forced on users.

The objectives of the study are, first, to measure HCI knowledge and explicit practice using an ordinal ranking Likert-style scale. This measurement is expected to be useful in a low HCI awareness country like Malaysia. The second objective is to identify what HCI practice these HCI-educated people apply in the Web development process. The paper is organized into several sections. The next section will analyze related studies in the context of HCI education and its relevance in practice. Section 3 presents the research methods for data gathering and analysis. Section 4 discusses the results from the study. Finally, section 5 summarizes the central themes and offers conclusions.

2 Related Literature

Although computer science (CS) curriculum studies have established HCI as one of the sub-areas of their field, CS departments have been slow to embrace HCI as a core topic to be taught in all CS departments [1]. However, a recent survey of iSchools has shown that the teaching philosophy includes usability/UCD as a core course, regardless of the students' career goals [6].

This may be due to the maturity of computing technologies and the emergence of ubiquitous computing, which requires transformation of the curriculum and restructuring of academic organizations to support HCI programmes featuring significant interdisciplinarity in content and goals. Universities should analyze the influences that shape the development of HCI in higher education [7]. HCI must be one of the key components in educational programmes which prepare professionals to become morally responsible practioners when designing future technology.

Most of the practice surveys [8] – [12] included the education of designers and developers, but did not focus on its impact on the survey results. This may be due to the existence of conferences dedicated to the HCI field and the variety of people who have HCI-related job titles, such as Usability Engineer, Human Factors, UI Designer and UX Designer, who are appropriate to be addressed by research on usability/HCI/UCD/UX practice. The gap in the existing literature is that researchers only ask respondents to select which UX methods they use in practice by either the dichotomies style (yes/no) or choosing from a long UX list using a Likert-scale (very bad to very good).

In the HCI literature, HCI practitioners are labelled as specialists in usability, human factors, UCD or usability engineering (UE), in considering users [13]. The individual practitioner is a person who elects to enter a professional realm, secure training and pursue their own personal and professional goals [14]. [15] presented findings of a survey of HCI practitioners' practices by incorporating questions asked by [16].

In terms of HCI knowledge, [2] measured how it is being disseminated by asking where and how the respondents received training in HCI. The amount of knowledge is estimated based on free-text answers to two questions: one concerning the sources of HCI knowledge, the other concerning the books they know in this area [17]. The knowledge was considered 'high' if the participant knew of many books in HCI, and 'low' if they claimed to have gained HCI knowledge through experience as learning on the job, full time education or courses and auto-didactic methods such as reading books and articles on the subject [17].

As the number and complexity of Web services grow, the need for research in Web applications' usability and UX increases. It is worrying that most companies do not involve users from the early stages of the Web design process [18]. The study of users is important as there are many uncontrollable variables that could affect users' preferences, as illustrated in a comparison of religious and health services Websites [19]. Among the influences on Web services are the brand and website design, as well as the users' cultures and values.

3 Methods

3.1 Respondents

The researcher recruited respondents through 'snowball' sampling from a personal contact list of students' email addresses when the researcher was a lecturer. Links to potential respondents were sent via social networks of groups that the researcher knew might have taken HCI courses. These included the Facebook closed group of the Kulliyyah of Information and Communication Technology (KICT) student society, and the School of Informatics Science Labuan (SSIL) students.

The link for an online questionnaire was sent personally by the researcher to 78 students who enrolled in HCI classes during the previous semester. The students were enrolled in the Bachelor of Computer Science and Information Systems of KICT. The postings may have overlapped with respondents in the closed group, which had some 123 members at the time the link was forwarded.

A similar closed group of the School of Informatics Science students was approached via Facebook. These students were enrolled for the Bachelor of Information Technology majoring in E-Commerce and Multimedia. The HCI course is a prerequisite subject for Multimedia students but not for E-Commerce students.

3.2 Questionnaire Design

The questionnaire was divided into three sections, A, B and C. Section A comprised Part 1, demographic information, and Part 2, company profiles. If the respondents were still students, they were asked to skip Part 2 and move on to Section B. Section B identified the knowledge and practice belief among the respondents. Section C listed the most-used UCD techniques and/or testing methods during their Web development practice.

Based on the expert recommendations after the pre-test of the survey, the operational definition of UX was given at the beginning of the questionnaire: "UX includes different terms, such as user interface (UI) design, usability engineering (UE), interaction design (IxD), information architecture (IA), human-computer interaction (HCI), human factors ergonomics (HFE) and usability".

According to the expert reviews, the practice of UX is still in its infancy in Malaysia. Several explicit terms related to the umbrella of UX demonstrated the existence of and needed to be further explored. They included the job role and responsibilities of the IT practitioners who develop any computing technologies.

4 Results and Discussion

A total of 84 out of the 182 people approached participated in the online survey, a response rate of 46.2%. However, two responses were found to be unusable as they were incomplete. The data of the 82 usable responses were analyzed using the Statistical Package for Social Science (SPSS) version 19.0. The open-ended questions were analyzed using a qualitative technique to interpret the meaning.

4.1 Demographics

The total number of male respondents was 44 (53.7%) and female 38 (46.3%). The largest age group was 20-31 representing 95.1% of the whole population. This is as expected because the age range of Bachelor degree students in Malaysia is 22 to 25 years old. The remaining 4.9% were 32-46 years old, considered normal based on the earliest year of graduation of students on the targeted list.

The composition of the highest level of education attained was: 75.6% possessed a Bachelor's degree, 11.0% were high school and 9.8% held a Master's degree. Respondents who indicated that high school was their highest educational level may be those who were currently at university and had not completed their Bachelor's degree. These students were required to relate their development practice during course assignments and/or Final Year Projects (FYP).

72.0% of the respondents were alumni of the International Islamic University Malaysia (IIUM) and 28.0% of the Universiti Malaysia Sabah (UMS). In terms of their level of experience in IT development and design, 12.2% claimed to be experienced, 23.3% were at intermediate level and 64.6% were novices.

The largest group of respondents were at top management level (56.1%), followed by technical and operations or professional (13.4%) and middle management (12.2%). 4.9% respondents declared themselves as individual contributors and 1.2% as assistant managers. The majority of the respondents (62 out of 82) had experience in developing and designing at least one of informational Websites, Web applications, community portals, offline systems, E-commerce Websites, mobile applications and multimedia applications.

4.2 HCI Level of Knowledge

Knowledge is acquired by formal education or reading. The measurement of this attribute is usually certification from an accreditted educational institution, be it a university, conference classes, or an in-house corporate educational arm [20]. The respondents were asked to rate their level of knowledge based on a five-point Likert scale. Zero means they had no knowledge regarding the selected courses. This was followed by self-reading, not sure, on-the-job training and the highest rank was attended formal education (i.e. not attended any course, self-reading, not sure, on-the-job-training and attended formal education).

Table 1. Shows the respondents' level of knowledge

Description	Mean	Median
HCI	4.78	0.78
User Interface	3.89	1.49
Interactive Systems	3.65	1.55
Usability	3.46	1.67
Other HCI related courses	3.22	1.58
Ergonomics	3.01	1.67
Agile Development	2.85	1.60
UX	2.78	1.53

Table 1 is arranged according to the highest mean to the lowest. It can be seen that HCI received the highest score with the lowest standard deviation (SD) and UX received the lowest score. This may be due to the fact that UX is a new term and has not yet been incorporated in the HCI discipline. 29 out of the 82 respondents claimed to have attended formal HF/ergonomics classes, 23 had not attended one and 12 were not sure if they have attended or not. This may be due to terminology unfamiliar to the respondents.

17 claimed to have gained their knowledge either through on-the-job training or self-reading, 49 had attended formal education in UI and 21 had received informal education by self-reading and on-the-job training. 12 respondents were not sure and had not received any formal education about UI. 41 respondents claimed to have attended Interactive Systems classes formally but 9 had not. Four respondents were not sure and 27 gained their knowledge from on-the-job training and self-reading.

40 respondents claimed to have attended a formal usability engineering course,. 18 had not, 10 were not sure and 14 gained their knowledge from on-the-job training and self-reading. Many respondents received formal education on other related courses; however, the details of these courses are not provided here.

29 of the 82 respondents had attended formal HF/ergonomics classes, 23 had not, and 12 were not sure if they had attended or not. This may be due to unfamiliar terminology. 17 claimed to have received their knowledge either by on-the-job training or by self-reading. Only 24 had attended a formal Agile class, and 14 had gained the knowledge from self-reading and on-the-job training. 44 respondents had either not attended Agile classess at all or were not sure about Agile.

4.3 HCI Knowledge in Practice

The respondents were asked to "briefly describe how they practise HCI knowledge". The detailed responses (N=66) were first coded using an in-vivo approach, and then repeated keywords and phrases were categorized. The summarized keywords were divided into four categories. Respondents were categorized as: (1) student; (2) front-end designer; (3) back-end developer; (4) management (5) non-IT job; (6) education and training.

Some of the respondents listed more than one keyword. For example, the four front-end designers mentioned creating a mental model as user and two of them also used HCI principles and theories. Therefore, the total accumulation in each category did not necessarily equal 100%. Table 2 shows all categories of coded keywords.

Table 2. Categorized coded keywords

Category	Example keywords or phrases/ideas
Create a user mental model and emotional characteristics	"Be like user", "behave like user", "think like user", "feel like user"
Hierarchical goal	"Must focus on function first, then user's satisfaction", "function first", "security and function first"
Use of HCI principles and theories	"usability principles", "HCI principles", "HCI theories"
Iterative development	"Agile development", "testing, redesign, testing redesign"

As can be seen from Table 2, the categorized coded keywords are identical to the principles of UCD [16]. The category 'create a user mental model and emotional characteristics' is in line with 'knowing your user' in the previous study. The emotional characteristics were added due to the repetition of words such as "like", "nice to look at", "satisfied". Hierarchical goal was reflected by the respondents'

answers including "must conform to security first", "function needed to be achieved before others", "the Web must work and be accessible first".

In the 'use of HCI principles and theories', respondents did not specify any principles but some mentioned, "heuristics" and "guidelines". 'Iterative development' is reflected by the answer of the choosen tools such as "Agile", "Scrum", and "redesign until the user is satisfied". Respondents from education and training put more emphasis on the use of HCI principles and theories when they practised HCI knowledge.

Half of the designers claimed to use these principles. Back-end developers scored the lowest in the use of HCI principles and knowledge, followed by students. It is expected that students use HCI principles during their assignments and other project development but the results showed contrary evidence. There was no significant difference among respondents' categories and UCD practice ($X^2 = 0.362$). However, the difference was significant between the respondents' level of HCI knowledge and their level of experience ($X^2 = 0.002$).

	Create a user mental model and emotional characteristics	Hierarchical goal	Use of HCI principles and theories	Iterative development
Student (N=53)	66%	85%	38%	13%
Front-end designer (N=4)	100%	0%	50%	75%
Back-end developer (N=9)	33%	100%	22%	33%
Management (N=1)	100%	0%	0%	0%
Education and training (N=7)	71%	0%	100%	29%
Non-IT job (N=8)	100%	0%	0%	0%

Fig. 1. Heat map of respondents' categories and HCI knowledge in practice

In Figure 1, all respondents from the front-end designer, management and non-IT job categories believed that they practised HCI knowledge by the key concept of 'walking in user's shoes' [15]. All back-end developers believed that functionality must be the first priority in any development process. Most of the students also believed in gaining programming skills first, then focusing on functionality and security; all other qualities would come later during the design and implementation phases. According to the data, there is a kind of hierarchy of goals among the developers and students.

4.4 Practice Metric

The respondents were required to reflect on their experience in any Web development process either during their formal education or in real work scenarios. They were then asked to indicate the methods and techniques they used. In this study, practice is measured by indicating 'none' as the lowest score on the Likert scale, followed by

Table 3. Metrics of UCD practice in the Web development process

	None (-2)	Only in Document (-1)	Not Sure (0)	Self-Initiative (+1)	Established /Standard (+2)	**Net Positive Value (NPV)**
UAT	4	2	16	24	34	**+142**
Information Design	4	7	15	28	27	**+67**
Navigation Design	3	8	14	33	23	**+65**
Click-through Prototyping	2	5	18	36	18	**+63**
Heuristics Evaluation	5	7	15	28	25	**+61**
Task Analysis	6	10	21	29	14	**+35**
Personas	8	6	28	28	9	**+24**
Typography	10	6	28	22	13	**+22**
Style Guides	10	8	30	20	13	**+20**
Card Sorting	12	2	39	14	10	**+8**
Wireframes	11	5	38	20	7	**+7**

'only in documentation', 'not sure' to show uncertainty, 'self-initiative' as quite high practice and 'established/standard' to indicate the highest level of practice. This means that the following method was established as the rule or became standard during the Web development process.

A net positive value [19] was then applied to the table by multiplying each score in the box starting from the middle 'not sure' score as zero value and accumulating the value in the row. The methods and techniques were then arranged according to the NPV value. The highest score indicates the most practised techniques in the Web development process. Light grey boxes highlight the highest responses for each technique.

Table 3 shows the level of explicit practice identified by measuring methods and techniques used in the Web development process. It can be seen that UAT received the highest score, followed by information design and navigation design. UAT is the only established method and standard in the Web development process. This may be due to the traditional System Development Life Cycle (SDLC) methodologies which had been institutionalized in the organization and universities' programme structure.

The highest practice scored by other techniques, such as information design, navigation design, click-through prototyping, heuristics evaluation and task analysis were performed as a self-initiative effort. This may be due to awareness of the dynamic nature of the Web itself. The remaining techniques, including personas, typography, style guides, card-sorting and wireframes, were considered as 'not sure' being practised by the respondents.

5 Conclusions

This paper reports the results of a survey among those who have successfully completed one HCI course during their bachelor degree programme or HCI-related course. Some of them acquired HCI knowledge through training, although they did not pursue careers as IT professionals. The finding shows that the indicator for the level of HCI knowledge could be attained by using the ordinal Likert-style scale based on the source of HCI knowledge. The type of answer such as "yes", "no", "did not attend formal education" and "self-reading/auto-didacts" indicated the level of the HCI knowledge [2]. Gaining HCI knowledge through "on-the-job training" and attending "formal education in HCI" may also provide some clues to the level of HCI knowledge among the practitioners and IT professional.

Previous studies show that HCI practice is at least used by individual practitioners as an appreciation of the end-users' participation in the process of design [15]. The results also lead to the grounding of values and goals for practitioners in the theory of hierarchical needs. However, overall results show a low awareness of UX practice among IT professionals. There is no significant relationship with HCI education, as many IT practioners and professionals are still strongly practising well-established methods such as SDLC. This result was also found in the context of IT practice in Korea, where it was shown that at that particular state of the Web development process, HCI did not have a strong impact on the IT industry [11].

There were some indications that the HCI-educated practitioners were trying to apply some related UX techniques in Web applications. However, UAT dominated the whole development process because it is the established procedure within organizations. It was also reflected in the findings that the SDLC methodology is a dominant approach in the Web development process.

This study has shown that implicit HCI practices can be measured using Likert-scale items. The review by expert practitioners made the questions in the survey more relevant and meaningful to the respondents. Consequently, the analysis using NPV as the measure of practice has yielded some useful results in this study; however, the answer of "not sure" should not be included in the measurement for practice. Overall, the use of HCI knowledge in Malaysia's IT industry is at an early stage, although the interest in practice, education and academic studies is growing rapidly.

Having knowledge of HCI and UX techniques should be strongly considered as a prerequisite for all project development assignments, especially Web development. This is very important as HCI education advocates that future IT professionals should become ethical practitioners and have a high appreciation of users in the development process. Acquiring HCI knowledge and principles is currently being integrated in many Computer Science and Information Technology curriculums.

References

1. Strong, G.W., Gasen, J.B., Hewett, T., Hix, D., Morris, J., Muller, M.J., Novick, D.G.: A Report: New Directions in Human-Computer Interaction Education, Research, and Practice (1994)
2. Gulliksen, J., Boivie, I., Persson, J., Hektor, A., Herulf, L.: Making a Difference – A Survey of the Usability Profession in Sweden. In: NordiCHI 2004 (2004)
3. Buie, E., Dray, S., Instone, K., Jain, J., Lindgaard, G., Lund, A.: How to Bring HCI Research and Practice Closer Together. In: CHI 2010, Atlanta, Georgia, USA, April 10-15, pp. 3181–3184 (2010)
4. Mahmud, M., Hussein, I., Md Tap, A.O.: Human-Computer Interaction within the Malaysian University Curriculum Human-Computer Interaction and System Developments, pp. 51–63. IIUM Press, IIUM Repository (2011)
5. The Star Online: JPJ Targets 90% Online Transactions with Motorists by 2015. Published: Sunday July 31, 2011 MYT 4.35 pm (2011)
6. Bias, R.G., Marty, P., Douglas, I.: Usability/User-Centered Design in the iSchools: Justifying a Teaching Philosophy. Journal of Education for Library and Information Science 53(4), 274–289 (2012)
7. Gasen, J.B., Preece, J.: What Shapes the Face of Human-Computer Interaction in Higher Education? A Framework of the Influences. Journal of Computing in Higher Education Fall 8(1), 97–123 (1996)
8. Gould, J.D., Boies, S.J., Lewis, C.: Making Usable, Useful, Productivity: Enhancing Computer Applications. Communication of the ACM 34(1), 75–85 (1991)
9. Dillon, A., Sweeney, M., Maguire, M.: A Survey of Usability Evaluation Practices and Requirements in the European IT Industry. In: Alty, J., Guest, S., Diaper, D. (eds.) HCI 1993. People and Computers VII, Cambridge University Press, Cambridge (1993)
10. Mao, J.-Y., Vredenburg, S.P.W., Carey, T.: The State of User-Centered Design Practice. Communication ACM 48(3), 105–110 (2005)

11. Ji, Y.G., Yun, M.H.: Enhancing the Minority Discipline in the IT Industry: A Survey of Usability and User-Centered Design Practice. International Journal of Human-Computer Interaction 20(2), 117–134 (2006)
12. Chilana, P.K., Ko, A.J., Wobbrock, J.O., Grossman, T., Fitzmaurice, G.: Post-Deployment Usability: A Survey of Current Practices. In: CHI 2011, Vancouver, BC, Canada, May 7-12, pp. 2243–2246 (2011)
13. Iivari, N.: Understanding the Work of an HCI Practitioner. In: NordiCHI 2006, Oslo, Norway, October 14-18 (2006)
14. Schon, D.A.: The Reflective Practitioner: How Professionals Think in Action. Ashgate, Arena (1991)
15. Putnam, C., Kolko, B.: HCI Professions: Differences & Definitions. In: CHI 2012, Austin, Texas, USA, May 15-10, pp. 2021–2026 (2012)
16. Gould, J.D., Lewis, D.: Designing for Usability: Key Principles and What Designers Think. Communication of ACM 28(3), 300–311 (1985)
17. Vukelja, L., Müller, L., Opwis, K.: Are Engineers Condemned to Design? A Survey on Software Engineering and UI Design in Switzerland. In: Baranauskas, C., Abascal, J., Barbosa, S.D.J. (eds.) INTERACT 2007, Part II. LNCS, vol. 4663, pp. 555–568. Springer, Heidelberg (2007)
18. O'Connor, R.: Exploring the Role of Usability in the Software Process: A Study of Irish Software SMEs. In: O'Connor, R.V., Baddoo, N., Cuadrago Gallego, J., Rejas Muslera, R., Smolander, K., Messnarz, R. (eds.) EuroSPI 2009. CCIS, vol. 42, pp. 161–172. Springer, Heidelberg (2009)
19. Sutcliffe, A.G.: Assessing the Reliability of Heuristic Evaluation for Website Attractiveness and Usability. In: Proceedings of the 35th Annual Hawaii International Conference on System Sciences (2002)
20. Dayton, T.: Skills needed by User-Centered Design Practitioners in Real Software Development Environments. In: Report on the CHI 1992 Workshop. SIGCHI Bulletin, vol. 25(3), pp. 16–31 (1993)